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Abstract

We investigate whether non-GAAP earnings disclosures increase stock price crash risk. Consistent with non-GAAP disclosures allowing managers to inflate investors' perceptions about firm performance, our results indicate that income increasing non-GAAP reporting increases crash risk. We also find that managers can use non-GAAP reporting as a substitute for earnings management to withhold bad news from investors (the traditional explanation for crashes). Finally, we find a positive association between non-GAAP reporting and the likelihood of subsequent events that can trigger a crash. Overall, our evidence is consistent with some non-GAAP disclosures exposing investors to risks of large and sudden price declines.

Key words: Non-GAAP earnings, Stock price crash risk, Disclosure, Regulation

JEL: D82, G12, G17, G18, M41

1. Introduction

Stock price crashes represent an extreme decline in stock price and these crashes are of substantial concern for investors. A burgeoning literature has identified several firm characteristics that predict a higher likelihood of stock price crashes, such as reporting opacity and less conservative accounting (Hutton et al., 2009; Kim and Zhang, 2016). This literature often attributes the increased likelihood of crashes to managers exploiting their information advantage over investors by withholding bad news required to be disclosed in GAAP-based financial reporting. We examine whether the likelihood of crashes also increases when managers disclose *alternative* earnings metrics beyond what is required by GAAP. Specifically, we study the relation between non-GAAP disclosures and stock price crash risk.

Non-GAAP earnings are adjusted earnings numbers that exclude GAAP-mandated earnings components. Managers can voluntarily disclose these metrics to signal the relative importance of the earnings components that they include in, versus exclude from, their non-GAAP earnings calculations (Bhattacharya et al., 2003; Hsu and Kross, 2011). These alternative earnings metrics have been a prominent disclosure in firms' earnings announcements since the early 2000s and prior research finds that investors respond more to non-GAAP earnings than to GAAP earnings (e.g., Bradshaw and Sloan, 2002; Bradshaw et al., 2018). As a result, non-GAAP performance metrics represent an important voluntary disclosure and investors' focus on these metrics suggests that they could influence crash risk.

Ex ante, it is unclear whether non-GAAP reporting would increase or decrease crash risk. On the one hand, critics of non-GAAP reporting assert that managers can use non-GAAP earnings to inflate investors' perceptions of firm performance. For example, (1) non-GAAP earnings often depict stronger firm performance than their GAAP counterpart (e.g., Bradshaw and Sloan, 2002); (2) non-GAAP exclusions can increase the likelihood of meeting market expectations (e.g., Heflin and Hsu, 2008; Doyle et al., 2013; Black et al., 2017; Kyung et al., 2019); and (3) some of the items excluded in calculating non-GAAP earnings associate with future operating performance (e.g., Doyle et al., 2003; Kolev et al., 2008). Moreover, recent studies suggest that managers themselves may fixate on non-GAAP earnings and discount the importance of some expenses that

they exclude in calculating non-GAAP earnings (Rozenbaum, 2019; Laurion, 2020). Therefore, non-GAAP earnings can redirect investors' attention away from weaker GAAP earnings to stronger non-GAAP earnings, potentially leading investors to miss cues that might have revealed that the stock was overvalued or bad news was likely forthcoming. As a result, optimistic non-GAAP earnings could lead to overvaluation and increase the likelihood of a stock price crash when the firm's future events are not consistent with investors' optimistic expectations.

On the other hand, more recent research indicates that managers often disclose non-GAAP earnings for informative reasons (e.g., Black et al., 2018). For example, managers commonly exclude non-recurring items in calculating their non-GAAP metrics (Black et al., 2021), and these adjustments provide investors with a better understanding of firms' underlying economics (e.g., Bhattacharya et al., 2003). Moreover, managers' non-GAAP adjustments increase earnings comparability across firms (Black et al., 2021), and more comparable earnings are associated with lower crash risk (Kim et al., 2016a). As a result, managers' non-GAAP disclosures may provide investors with a clearer picture of sustainable operating performance and decrease the likelihood that they will significantly overvalue the firm, reducing the chances of a crash.

To investigate our research question, we explore the relation between non-GAAP reporting in a fiscal year and crash risk in the subsequent year. Using a large sample of US firms with fiscal years ending between 2003 and 2016, we follow prior research (e.g., Hutton et al., 2009; Kim et al., 2016b) and identify crash risk using four different measures: (1) an indicator for when a firm experiences an extreme negative weekly stock return, (2) the negative skewness of weekly stock returns, (3) the asymmetric volatility of negative versus positive stock returns, and (4) a composite measure of the three individual crash risk measures. Since crashes relate to a substantial decline in firm value, it takes time for investors to over-value the firm to a point where a subsequent price correction is large enough to meet the definition of a crash. We expect that investors' focus, and any related firm overvaluation, increase in the extent to which managers redirect investors' attention to non-GAAP earnings and away from GAAP earnings throughout the year. As a result, we hypothesize that any relation between non-GAAP reporting and crash risk increases in firms' non-GAAP reporting frequency during the year. We operationalize our non-GAAP reporting

frequency variable using the percentage of quarters in a fiscal year that managers disclose non-GAAP earnings (i.e., a firm's non-GAAP reporting frequency over the year). We then use a lead-lag design and examine the relation between non-GAAP reporting frequency in year *t* and the crash risk measures in year *t*+1.

Based on univariate evidence, we find that the likelihood of a crash significantly increases when a firm discloses non-GAAP earnings at some point during the prior year (i.e., the firm's non-GAAP reporting frequency is greater than zero). Our descriptive evidence also indicates that the likelihood of a crash significantly increases with the firm's non-GAAP reporting frequency during the prior year. Moving to a regression analysis, we find that a firm's crash risk increases in the frequency in which managers reiterate these alternative earnings metrics to investors during the year. This result is consistent with the notion that frequent non-GAAP disclosures focus investors' attention more on non-GAAP earnings, and that this additional attention leads to greater firm overvaluation and higher crash risk in the subsequent year.

Next, we assert that the influence of non-GAAP reporting on crash risk depends on whether the adjustments managers make in calculating their non-GAAP earnings increase or decrease the non-GAAP metric. In particular, if investors over-estimate a firm's value because of their focus on non-GAAP earnings, our results should concentrate more in settings where managers exclude expense or loss components to paint a rosier picture of performance (i.e., they make income increasing exclusions). In contrast, managers might also exclude revenue- or gain-related items in calculating their earnings metrics (i.e., they make income decreasing exclusions), which could decrease crash risk by revealing to investors that they should discount certain items that increase GAAP earnings. Consistent with these assertions, the positive association between non-GAAP reporting frequency and future crash risk only exists when firms exclude items that result in non-GAAP earnings that exceed GAAP earnings. In contrast, the relation between non-GAAP reporting frequency and crash risk is negative when exclusions result in GAAP earnings that exceed non-GAAP earnings. Thus, non-GAAP earnings can either increase or decrease a firm's crash risk, depending on the sign of the exclusions. Since regulators and investors are

particularly concerned about firms' more aggressive non-GAAP reporting practices, we focus the remainder of our analyses on instances where non-GAAP earnings exceed GAAP earnings.[1]

We also examine whether non-GAAP reporting can serve as a complement to or a substitute for the traditional form of bad news withholding in the crash risk literature—earnings management.[2] We identify two possible roles for non-GAAP earnings. First, in the complementary role, managers could use non-GAAP earnings in conjunction with earnings management to withhold bad news from investors and inflate perceptions about the firm. Alternatively, the non-GAAP literature finds that some managers use non-GAAP disclosures to substitute for other forms of perception management, such as earnings management (Doyle et al., 2013; Black et al., 2017). As a result, in the substitutionary role, managers may use non-GAAP earnings as opposed to earnings management to divert attention from bad news included in GAAP earnings. We explore these competing roles by examining whether the relation between non-GAAP reporting frequency and crash risk concentrates in instances where earnings management is above or below the sample median. Using both reporting opacity and abnormal accruals as measures of earnings management, we find that the relation between non-GAAP reporting frequency and crash risk concentrates among firms with lower earnings management. These results are consistent with managers using non-GAAP earnings as a substitute for earnings management to divert investor attention from bad news.

Moreover, we use cross-sectional analyses to buttress our evidence that non-GAAP reporting can increase crash risk. First, we expect the non-GAAP reporting and crash risk relation to be stronger in periods where managers are likely to be aggressive in their reporting. Specifically, we focus on periods of high investor sentiment and instances where non-GAAP exclusions allow a firm to meet analysts' forecasts (e.g., Brown et al., 2012; Black et al., 2017). Second, we also

[1] Since the number of firm-quarters in our sample with income increasing adjustments is almost four times the number of firm-quarters with income decreasing adjustments, our focus on income increasing adjustments implies that we focus on the most common type of exclusions. This focus, however, does not imply that all income increasing adjustments are aggressive, but simply that aggressive non-GAAP reporting is more likely with these exclusions.

[2] When we say that managers use non-GAAP earnings to withhold bad news, we mean that non-GAAP earnings can divert investors' attention from negative cues about the firm by redirecting their attention toward more optimistic performance measures. In this setting, non-GAAP earnings allow managers to divert investors' attention from the whole truth and delay the pricing of bad news.

expect the relation between non-GAAP reporting and crash risk to be stronger in scenarios where managers have stronger incentives to inflate stock price. In particular, we focus on firms with high executive compensation sensitivity to share price changes and on firms with large estimates of opportunistic insider sales. Consistent with our predictions, our results indicate that the non-GAAP reporting and crash risk relation is higher when non-GAAP earnings are likely more aggressive and when managers have larger incentives to inflate stock price.

To further reinforce our main results, we investigate the effect of non-GAAP reporting on crash risk using a plausibly exogenous shock to non-GAAP reporting quality (i.e., Regulation G).[3] We employ a difference-in-differences design with two groups of firms, one where Regulation G is likely to have increased the quality of firms' non-GAAP reporting and one where the regulation is less likely to have affected reporting quality (e.g., Heflin and Hsu, 2008; Kolev et al., 2008). Consistent with our expectation, the decline in crash risk is greater for firms that likely had a larger increase in their non-GAAP reporting quality as a result of the regulation.

We also conduct several other analyses and find the following results. First, we find that the negative stock price implications of crashes for non-GAAP reporting firms extend at least two years after the crash week, suggesting that crashes have longer-term negative consequences. Second, we examine the events during a crash week and link these potential crash triggers to non-GAAP reporting. We find that crashes are more likely to occur during weeks in which firms disclose an 8-K filing with the SEC, particularly when the filing relates to: financial information, accounting and financial statement matters, corporate governance, Regulation FD events, and other events. We also find a positive association between negative tone in these filings and the likelihood of a crash. Further, we find a positive relation between non-GAAP reporting frequency in year *t* and negative tone in 8-K filings during crash weeks in year *t*+1. These results indicate that crashes often coincide with various negative corporate disclosure events and these negative events increase with prior non-GAAP reporting frequency. Third, we find that investors' response to non-GAAP earnings increases in non-GAAP reporting frequency even though persistence

[3] The SEC implemented Regulation G in early 2003, which, among other things, mandates firms to provide a reconciliation of their non-GAAP earnings number to the most directly comparable GAAP number.

analyses indicate that the quality of non-GAAP earnings and exclusions declines in reporting frequency. Thus, finding that investors have a larger response to less persistent non-GAAP earnings helps explain why crash risk is higher for more frequent non-GAAP reporters. Finally, we also control for concurrent events and firm characteristics that may motivate non-GAAP reporting and lead to a crash, and find that our results are robust in these analyses.

It is important to note that our evidence does not (1) conflict with the common inference in the literature that managers primarily use non-GAAP earnings to inform in the post-Reg G period (e.g., Black et al., 2018) or (2) imply that the increased crash risk fully negates the average benefit of non-GAAP reporting by firms more generally. In additional analyses, we estimate that approximately 3.6%–6.1% of the firms with income increasing exclusions appear to aggressively report these metrics in a manner that leads to a crash. This conclusion aligns with the economic magnitude from our regression analyses, where a one standard deviation increase in non-GAAP reporting frequency leads to a 4.7% increase in the likelihood of a crash in the subsequent year. Thus, these results are consistent with the common view in the literature since the vast majority of non-GAAP firms are not overly aggressive in their reporting, and do not experience a crash. The magnitude of this effect, however, does not imply economic insignificance since crashes are extreme events and create a large economic loss for investors.

Our analyses contribute to the extant literature in several ways. First, we extend the crash risk literature by identifying a new mechanism that influences crashes–the disclosure of alternative earnings metrics to investors. This literature traditionally attributes crashes to managers' withholding of bad news from investors through earnings management. Our results suggest that some managers view non-GAAP reporting as a substitute to using earnings management for withholding bad news. Specifically, some managers appear to use non-GAAP earnings, as opposed to earnings management, to redirect investors' attention toward more optimistic earnings metrics that inflate investors' assessments of firm value. Moreover, we examine the triggers of stock price crashes and link non-GAAP reporting to these triggers. This type of analysis extends the literature because prior research generally does not examine the specific triggers that can lead to stock price crashes.

Second, we contribute to the non-GAAP reporting literature, which provides little evidence that non-GAAP information can negatively affect investors' welfare after Regulation G (Zhang and Zheng, 2011). Thus, we extend this stream of research by providing evidence that managers' non-GAAP earnings disclosures can expose investors to extreme negative economic outcomes for a subset of firms, particularly in settings where managers make income increasing exclusions and are more incentivized to be aggressive in their reporting choices. We also find that stock price crashes adversely affect investors over a longer-run window.

Third, our results have implications for regulators, who have long expressed concerns about the potential that managers' non-GAAP reporting could mislead investors. The SEC's interest piqued again in the recent decade as non-GAAP metrics have become increasingly more common in capital markets (e.g., Bentley et al., 2018). The extant literature, however, provides little evidence consistent with the SEC's recent apprehension about these metrics. We provide evidence (1) consistent with the SEC's concern that some non-GAAP reporting could mislead investors in certain settings and (2) on the type of exclusions and settings that are, and are not, particularly concerning. These results answer Black et al.'s (2018) call for evidence that helps reconcile the SEC's recent concern about non-GAAP earnings and the dearth of evidence that corroborates this concern.

2. Background and hypothesis development

2.1 Crash risk

The crash risk literature builds upon agency theory, where corporate insiders maintain an information advantage over corporate stakeholders and use their advantage to hide bad news about the firm using opaque financial reporting (Jin and Myers, 2006; Hutton et al., 2009).[4] Because shareholders are not aware of the accumulating bad news for an extended period of time, the firm's stock return distribution does not reflect enough bad news and becomes asymmetric. At a certain point, corporate insiders are no longer willing or able to continue withholding bad news and the stockpiled news enters the market all at once, leading to a stock price crash.

[4] Corporate insiders might choose to withhold bad news for a number of reasons, including career concerns, compensation, and litigation risk (Kothari et al., 2009).

Stock crashes have significantly negative consequences for investors, whose exposure to these crashes is only mitigated through screening, as opposed to diversification (Sunder, 2010).[5] Thus, a growing body of research examines the relation between certain accounting properties and stock price crashes. Hutton et al.'s (2009) seminal research indicates that more opaque financial reports, measured by the absolute value of abnormal operating accruals over a three-year window, are more likely to induce stock price crashes. Other studies explore how different accounting properties affect stock price crashes, including tax avoidance, accounting conservatism, and IFRS adoption (e.g., Kim et al., 2011a; DeFond et al., 2015; Kim and Zhang, 2016). Further, Kim et al. (2016a) find that expected crash risk declines with financial statement comparability, consistent with comparable reporting practices reducing managers' bad news hoarding. Prior studies have also examined how managerial characteristics associate with crash risk, such as the sensitivity of equity incentives, the degree of overconfidence, and the amount of insider debt (Kim et al., 2011a; He, 2015; Kim et al., 2016b).

The crash risk literature, however, does not consider crash risk and non-GAAP reporting. In this setting, managers do not necessarily have to withhold bad news through managing GAAP earnings, but can instead influence investors' perceptions through non-GAAP disclosures, which can divert investor attention based on overly optimistic non-GAAP disclosures.

2.2 Non-GAAP earnings

Managers generally disclose non-GAAP earnings in their earnings announcements. These alternative performance metrics are not in accordance with GAAP because they exclude items that GAAP earnings require. Managers' non-GAAP exclusions primarily relate to non-recurring item adjustments, such as restructuring charges and impairments of goodwill, or recurring item adjustments, such as amortization of acquired intangible assets and stock-based compensation (Whipple, 2015; Black et al., 2021). Bradshaw and Sloan (2002) were the first to cast light on the increasing popularity of non-GAAP earnings during the 1990s. This increasing popularity has

[5] Crash risk only relates to investment losses, while risk of return refers to a dispersion of outcomes (i.e., uncertainty) that include both investment gains and losses. Although investors can reduce risk of return through diversification, they cannot diversify away crash risk because risk-preferring behavior in the crash risk setting would simply relate to incurring more of a loss, as opposed to expecting a higher future return.

generally continued since that time, with 71% of S&P 500 firms reporting an annual non-GAAP earnings metric in 2014 (Black et al., 2021).

Managers assert that non-GAAP earnings are informative because they provide investors with a performance metric that better depicts core operations. Several studies provide evidence consistent with this assertion. For example, managers commonly exclude non-recurring items when calculating non-GAAP earnings (Black et al., 2021), and managers can exclude these items even when the exclusion lowers the non-GAAP metric (Curtis et al., 2014). Managers also appear to vary their non-GAAP calculations over time, and across firms, for informative and comparability reasons (Black et al., 2021), and their non-GAAP metrics can be particularly informative when firms report a GAAP loss (Leung and Veenman, 2018). Finally, investors find non-GAAP metrics to be more informative than their GAAP counterparts (Bradshaw and Sloan, 2002; Bhattacharya et al., 2003; Bradshaw et al., 2018).

Non-GAAP earnings, however, have long faced the criticism that they positively bias investors' perceptions about firm performance. For example, Lynn Turner, the former SEC Chief Accountant, famously characterized early non-GAAP reporting as "everything but bad stuff" (Dow Jones, 2001). The tenor of this criticism carries into the current reporting environment. Black et al. (2021) find that, among their sample of S&P 500 firms, nearly 70% of non-GAAP reporters disclose an earnings metric that exceeds GAAP earnings. Prior research also finds that (1) non-GAAP exclusions are often associated with future firm performance (e.g., Doyle et al., 2003; Kolev et al., 2008), which is inconsistent with these items being transitory or non-cash in nature, (2) non-GAAP exclusions can allow firms to meet market expectations (e.g., Heflin and Hsu, 2008; Doyle et al., 2013; Black et al., 2017; Bradshaw et al., 2018), and (3) investors underprice exclusions prior to Regulation G (e.g., Doyle et al., 2003). These results suggest that non-GAAP reporting can inflate investors' perceptions about firm performance. Moreover, recent studies indicate that managers themselves can fixate on alternative earnings metrics and discount the relevance of certain expenses (Rozenbaum, 2019; Laurion, 2020). Despite these results, however, there is little evidence that non-GAAP metrics have negative economic consequences for investors after Regulation G (Zhang and Zheng, 2011).

The SEC has long expressed concern that managers' non-GAAP metrics could mislead investors, and it implemented Regulation G in 2003 to increase the transparency and quality of non-GAAP reporting. Although non-GAAP earnings have become more transparent and less biased after the regulation (e.g., Heflin and Hsu, 2008; Kolev et al., 2008), aggressive reporting sometimes persists (e.g., Curtis et al., 2014; Bradshaw et al., 2018).[6] More recently, the SEC has issued comment letters and Compliance and Disclosure Interpretations (C&DIs) in an effort to improve the quality of non-GAAP information (Gomez et al., 2020). In addition to regulators, the FASB questions whether non-GAAP information sends a signal about ways to improve the quality of GAAP information (e.g., Linsmeier, 2016; Golden, 2017), while the PCAOB questions the role of auditors in auditing non-GAAP metrics (PCAOB, 2016). Needless to say, regulators and standard setters have expressed a substantial interest in non-GAAP reporting in recent years.

2.3 Hypothesis development

The crash risk literature concludes that stock price crashes result from managers (1) withholding bad news from investors over an extended period of time, often related to their GAAP-based performance, which leads to overvaluation, and (2) subsequently disclosing the bad news to investors, all at once, leading to large negative price corrections. We examine whether the disclosure of non-GAAP earnings also facilitates the diversion of investors' attention from bad news in GAAP earnings that subsequently leads to a crash. Specifically, non-GAAP earnings can redirect investors' attention away from GAAP earnings to an alternative performance metric that is more optimistic. Because investors focus on the more optimistic non-GAAP metric, they miss the cues in GAAP earnings that might have revealed that the stock is overvalued or that bad news is likely forthcoming. In this sense, non-GAAP earnings mask (or withhold) the bad news from investors as they focus and value the firm based on the more promising non-GAAP metrics.

We focus our research on non-GAAP earnings because they are the most commonly used alternative performance metric in capital markets (Audit Analytics, 2018), and prior research finds that investors pay particular attention to non-GAAP metrics when pricing performance (e.g.,

[6] Besides regulation, prior research finds that corporate governance and analysts can serve as monitors of aggressive non-GAAP reporting (Frankel et al., 2011; Bentley et al., 2018; Christensen et al., 2021).

Bradshaw and Sloan, 2002; Bradshaw et al., 2018). In addition, critics of non-GAAP earnings argue that these metrics positively bias investors' perceptions of the firm, and Christensen et al. (2014) find that short sellers view non-GAAP earnings as a red flag of overvaluation. This investor optimism could lead to overvaluation and subsequent crashes when future firm performance does not corroborate investors' overly optimistic views.

Ex ante, however, it is unclear whether non-GAAP earnings increase or decrease crash risk. On the one hand, non-GAAP earnings better capture firms' core operations and are more value relevant for investors than GAAP earnings (Brown and Sivakumar, 2003; Gu and Chen, 2004). Recent research also indicates that managers often use non-GAAP earnings for informative reasons after Regulation G (Black et al., 2018). Further, although managers commonly exclude expenses in calculating their non-GAAP metrics, Black et al. (2021) find that approximately 30 percent of firms report a metric that is *lower* than the GAAP counterpart, which should reduce investors' perceived value of the firm. Black et al. (2021) also find that non-GAAP earnings are more comparable across peer firms than are GAAP earnings, and Kim et al. (2016a) find that higher earnings comparability decreases expected crash risk. Thus, non-GAAP earnings might provide investors with a clearer understanding of firms' operating performance, allowing them to more accurately value the firm, lowering crash risk.

On the other hand, critics of non-GAAP reporting argue that these metrics present an overly optimistic picture of the firm. Consistent with this view, prior research indicates that managers can use non-GAAP reporting for non-informative reasons. For example, managers can remove recurring expenses from their non-GAAP metrics, either by excluding the recurring item directly, or by shifting a recurring expense into a transitory earnings classification (e.g., Doyle et al., 2003; McVay, 2006; Kolev et al., 2008). Managers can also exclude items in calculating non-GAAP earnings to meet earnings benchmarks that they miss on a GAAP basis (e.g., Barth et al., 2012; Black et al., 2017; Bradshaw et al., 2018). Finally, managers' aggressive non-GAAP reporting is not only limited to settings with negative firm news, but managers can also use non-GAAP metrics to make positive performance appear even better. For example, Brown et al. (2012) find that managers aggressively report non-GAAP earnings when investor optimism is high. To

the extent that investors do not expect excluded expenses to persist into the future, or they believe a firm's earnings surprise represents an unexpected increase in future cash flows, investors will increase their estimate of firm value. If this overvaluation grows large enough, a crash will occur once investors realize they have over-valued the firm.

Because the relation between non-GAAP reporting and crash risk is unclear, we state our first hypothesis in the null form as follows:

H1: *There is no relation between non-GAAP reporting and stock price crash risk.*

Next, conditional on non-GAAP reporting increasing crash risk, we examine whether non-GAAP reporting can serve as a complement or a substitute for the more traditional method of withholding bad news in the crash literature—earnings management (e.g., Hutton et al., 2009). There are several reasons why non-GAAP reporting might play a complementary role to earnings management. First, managers could use non-GAAP earnings to further inflate investors' perceptions of firm performance if earnings management is unable to raise perceptions to the level that managers prefer. Second, investors might be more likely to overlook earnings management in GAAP earnings if non-GAAP earnings also depict a positive assessment of firm performance. Finally, to the extent that managers are able to aggressively manage GAAP earnings, existing monitoring mechanisms might allow them to also be aggressive in their non-GAAP reporting.

In contrast, non-GAAP reporting could play a substitutionary role if managers prefer disclosing these alternative performance metrics relative to managing earnings to influence investors' perceptions. For example, firms might perceive managing GAAP earnings to be costly in the presence of various firm monitors (e.g., auditor, regulators, investors, analysts) and due to litigation risk, particularly in a post-SOX environment, which could be less of a concern for non-GAAP disclosures, which are not audited (Cazier et al. 2019). Further, managing earnings through accruals provides only short-term benefits because accruals reverse in subsequent periods. Non-GAAP earnings, however, do not reverse and, thus, are relatively costless. Finally, consistent with the substitutionary role, prior non-GAAP disclosure research finds that managers sometimes use non-GAAP reporting to substitute for other forms of perception management in certain scenarios (Doyle et al., 2013; Black et al., 2017; Kyung et al., 2019).

To investigate whether non-GAAP reporting serves as a complement or a substitute to withholding bad news through earnings management, we examine the relation between non-GAAP reporting and crash risk conditional on a firm's level of earnings management (using either reporting opacity or abnormal accruals to measure earnings management). If non-GAAP reporting is a complement (substitute) for earnings management, we expect the non-GAAP reporting and crash risk relation to concentrate among firms with a high (low) level of earnings management. We state our second hypothesis in null form as follows:

> **H2**: *The relation between non-GAAP reporting and crash risk does not vary with the extent to which a firm engages in earnings management.*

3. Variable measurement and research design

3.1 Variable measurement: Crash risk

Following prior research, we examine four measures of crash risk (e.g., Hutton et al., 2009; Kim et al., 2011a, b). Because all four measures are based on a firm's weekly returns, we first estimate the following model to ensure that our weekly return estimates capture firm-specific factors, as opposed to market-wide factors:

$$r_{j,\omega} = \alpha_j + \beta_{1,j} r_{m,\omega-2} + \beta_{2,j} r_{m,\omega-1} + \beta_{3,j} r_{m,\omega} + \beta_{4,j} r_{m,\omega+1} + \beta_{5,j} r_{m,\omega+2} + \varepsilon_{j,\omega}, \quad (1)$$

where $r_{j,\omega}$ is the return for firm j in week ω, and $r_{m,\omega}$ is the value-weighted CRSP return in week ω. For each firm, we estimate expected weekly returns using the α and β coefficients in Eq. 1. We define the firm's specific weekly return ($W_{j,\omega}$) as the natural log of $1 + \varepsilon_{j,\omega}$.

Our first measure of crash risk (*Crash*) is an indicator variable equal to one if a firm has at least one weekly return falling 3.2 standard deviations or more below the mean firm-specific weekly return (i.e., the firm has at least one "crash week") in fiscal year t+1. Similar to prior studies (e.g., Kim et al., 2011a, b), we focus on returns that are at least 3.2 standard deviations below the mean because they identify extreme negative returns, consistent with the notion of a stock crash. Our second crash risk measure (*NSkewness*) is negative return skewness, which captures the amount of negative skewness in a firm's weekly stock returns during the year. Our third measure of crash risk (*LnDuVol*) is the natural log of the asymmetric volatility in weekly stock returns over the year. We measure *DuVol* using the ratio of the firm's standard deviation of

weekly returns ($W_{j,\omega}$) below the mean weekly return for the year to the standard deviation of weekly returns above the mean weekly return for the year. Finally, we use a composite measure of crash risk (*Crash Composite*) based on a principal component analysis of the three individual crash risk measures (*Crash*, *NSkewness*, and *LnDuVol*). This composite measure extracts the commonality across the three individual measures and reduces measurement error in the proxy.[7] Across all four crash risk measures, higher values represent greater crash risk.

3.2 Research design

We examine the potential relation between non-GAAP reporting and stock price crash risk using the following regression:

$$\begin{aligned} Crash\ Risk_{i,t+1} = \; & a_0 + a_1 NonGaapFreq_{i,t} + a_2 NSkewness_{i,t} + a_3 Size_{i,t} + a_4 MTB_{i,t} \\ & + a_5 Leverage_{i,t} + a_6 ROA_{i,t+1} + a_7 Return_{i,t} + a_8 Sigma_{i,t} \\ & + a_9 ChgTurnover_{i,t} + a_{10} Opaque_{i,t} + a_{11} SqOpaque_{i,t} \\ & + a_{12} MissingNGData_{i,t} + \sum \gamma_t Year_t + \sum w_j Ind_j + e_{i,t}, \end{aligned} \quad (2)$$

where *Crash Risk* represents one of our four measures of crash risk in year t+1 (*Crash*, *NSkewness*, *LnDuVol*, and *Crash Composite*). When *Crash* is the dependent variable, we estimate the model using a logistic regression. Otherwise, we estimate the model using an ordinary least squares regression. Our primary variable of interest is *NonGaapFreq*, which represents the percentage of quarters in year t where managers disclose non-GAAP earnings in their earnings announcements. A significantly positive (negative) coefficient on *NonGaapFreq* (a_1) indicates that more frequent non-GAAP earnings disclosure is associated with higher (lower) crash risk in the subsequent year.

We focus our non-GAAP variable on reporting frequency, as opposed to the existence of non-GAAP earnings more generally, for two key reasons. First, we assert that reporting frequency allows us to capture the extent to which managers reiterate non-GAAP numbers to investors as a substitute for GAAP-based earnings. We expect that investors are more inclined to embrace managers' non-GAAP reporting when managers routinely disclose these metrics.[8] Second,

[7] Although our crash risk measures represent actual events that occur for the firm, we use a lead-lag research design where we compare non-GAAP reporting in year t with the crash risk measures in year t+1. Thus, following prior studies (e.g., Kim et al., 2011a, b), our design captures the crash *likelihood* in the subsequent year given a firm's current non-GAAP reporting choices.

[8] Consistent with this expectation, we find (in section 6.1) that investors' pricing of non-GAAP earnings increases in non-GAAP reporting frequency even though the persistence of non-GAAP earnings declines in reporting frequency.

crashes relate to a substantial decline in a firm's market value and it takes time for overvaluation to accumulate to a point where a price correction can meet the definition of a crash. If non-GAAP reporting increases crash risk, we assert that reporting frequency allows us to better identify firms that are highly overvalued.

Our analyses also control for variables identified in prior research that might affect a firm's future crash risk (e.g., Chen et al., 2001; Hutton et al., 2009; Kim and Zhang, 2016). In particular, we control for the negative skewness of firm-specific weekly returns in fiscal year *t* (*NSkewness*), firm size (*Size*), market-to-book ratio (*MTB*), leverage (*Leverage*), and future accounting performance (*ROA*). We also include the average firm-specific weekly return (*Return*) in fiscal year *t* to control for concurrent events that might be related to both non-GAAP reporting and subsequent crashes. Moreover, we control for volatility in firm-specific weekly returns (*Sigma*), changes in investor belief heterogeneity (*ChgTurnover*), measures of information opaqueness (*Opaque* and *SqOpaque*), and an indicator variable if an observation has missing non-GAAP information for at least one of the quarters during the fiscal year (*MissingNGData*).[9] Finally, we include year ($Year_t$) and industry (Ind_j) fixed effects to control for time- and industry-invariant unobservable effects. We estimate the model using robust standard errors, cluster standard errors by firm, and winsorize all continuous control variables at the extreme one percent of the sample.[10]

4. Sample construction and primary analyses

4.1 Sample construction and descriptive evidence

To construct our sample, we first identify firms from the Compustat, CRSP, and I/B/E/S universe with fiscal years from 2003 to 2016. We begin our sample in 2003 because it is the first year in which large scale data about managers' non-GAAP reporting became available. We obtain accounting data from the Compustat Quarterly files, stock price and return data from the CRSP

[9] The managerial non-GAAP data from the Bentley et al. (2018) dataset (available at: https://sites.google.com/view/kurthgee/data) has missing information for some firm-quarters. For observations with missing Bentley et al. data up to four quarters, we set the missing quarter(s) as a GAAP-only quarter so that we can still calculate *NonGaapFreq* for the firm during the year. We include *MissingNGData* to help control for any effect this design choice might have on our inferences (e.g., Hanlon and Slemrod, 2009; Choi et al., 2011). In additional analyses, we replicate our primary results on a subsample of observations with non-missing manager non-GAAP data.

[10] Following prior research, we do not winsorize the crash risk variables because they capture the extreme tails of the return distribution (e.g., Kim et al., 2011a, b). Winsorizing these variables would modify the values that are specifically relevant to our study.

daily files, and data about managers' non-GAAP reporting from the publicly available Bentley et al. (2018) dataset. Following prior crash risk studies (e.g., Hutton et al., 2009), we remove observations that (1) do not have positive total assets and book values of equity, (2) have fewer than 26 weekly returns in year *t* and year *t*+1, and (3) reside in the financial or utility industries. Our final sample consists of 30,419 firm-year observations.

Table 1 presents the descriptive statistics. The mean values of our crash risk measures (*Crash*, *NSkewness*, *LnDuVol*) are consistent with the values found in the extant literature (Kim and Zhang, 2016; Kim et al., 2019). For example, *Crash* is 0.234, suggesting that just over 23% of firm-years in our sample experience at least one crash week during fiscal year *t*+1.[11] Across the sample, firms report a non-GAAP performance metric in 27.5% of fiscal quarters.[12] If we partition non-GAAP reporting frequency based on the frequency in which managers exclude income increasing or decreasing items, we find that 22.5% of quarters have a non-GAAP metric that exceeds GAAP earnings ($NonGaapFreq^{NG>G} > 0$), while 5.0% of quarters have a non-GAAP metric less than GAAP earnings ($NonGaapFreq^{NG<G} > 0$).[13] The descriptive statistics of the control variables are also generally consistent with those reported in the extant literature.

Next, we provide descriptive evidence on how *Crash* varies with non-GAAP reporting. In Panel A of Figure 1, we first examine non-GAAP reporting more generally, regardless of reporting frequency. We find that the likelihood of a crash in year *t*+1 is significantly higher among firms that report non-GAAP earnings at some point in year *t* (25.2% for non-GAAP firms versus 22.0% for GAAP-only firms, which are significantly different at *p*-value < 0.01). Further, the likelihood of a crash is also significantly higher when non-GAAP firms report a metric that exceeds GAAP earnings at some point in year *t*, relative to when they report a metric that is less than GAAP earnings (*p*-value < 0.01). In Panel B, we examine whether the non-GAAP reporting and crash

[11] Our *Crash* value of 23.4% is slightly higher than the values reported in prior studies (typically ranging between 15% and 22%), largely because we examine a more recent sample period. If we recalculate *Crash* using sample periods in prior studies (e.g., Kim et al., 2016b; Li and Zhan, 2019), we find nearly identical values for *Crash*.

[12] More specifically, 16,726 observations do not report non-GAAP earnings in any of the four fiscal quarters, while 4,312 (2,690) [3,005] {3,686} observations report non-GAAP earnings in 1 (2) [3] {4} of the fiscal quarters.

[13] If we limit our descriptive evidence to firm-years with non-GAAP reporting (i.e., *NonGaapFreq* > 0), we find that 60% of fiscal quarters for these firms have a non-GAAP metric. Moreover, 48% of quarters have non-GAAP earnings greater than GAAP earnings ($NonGaapFreq^{NG>G} > 0$), while 12% of quarters have non-GAAP earnings smaller than GAAP earnings ($NonGaapFreq^{NG<G} > 0$).

risk relation varies with non-GAAP reporting frequency (*NonGaapFreq*). We find that *Crash* monotonically increases with reporting frequency, which provides descriptive evidence that crash risk increases in the extent that managers disclose non-GAAP earnings. In Panel C, we partition non-GAAP reporting based on the frequency in which non-GAAP earnings exceed GAAP earnings ($NonGaapFreq^{NG>G}$) during year *t*, or are less than GAAP earnings ($NonGaapFreq^{NG<G}$). We find that *Crash* monotonically increases in the $NonGaapFreq^{NG>G}$ setting, while there is not a discernible pattern in the $NonGaapFreq^{NG<G}$ setting.[14]

4.2 Testing the hypotheses

4.2.1 H1: Non-GAAP reporting and crash risk

Table 2 presents the results from estimating Eq. 2, where the dependent variables are *Crash*, *NSkewness*, *LnDuVol*, and *Crash Composite* across the four columns. In each specification, the coefficient on *NonGaapFreq* is significantly positive, indicating that more frequent non-GAAP reporting is associated with higher future crash risk. These results lead us to formally reject hypothesis H1, which does not predict a relation between non-GAAP reporting and crash risk. The magnitude of the relation is also significant. For example, the evidence from column 1 suggests that a one-standard-deviation increase in *NonGaapFreq* leads to a 4.7% increase in the likelihood of a crash in the subsequent year. The signs of the coefficients on the control variables and other known determinants of crash risk are largely consistent with prior research. Overall, we find that managers' non-GAAP reporting is a significantly positive predictor of crash risk, even after controlling for other known determinants of crash risk.

Next, we explore whether the relation between non-GAAP reporting frequency and crash risk varies based on whether managers make income increasing or decreasing adjustments in calculating their non-GAAP earnings. In particular, we re-estimate Eq. 2, but partition firms' non-GAAP reporting frequency (*NonGaapFreq*) into $NonGaapFreq^{NG>G}$ and $NonGaapFreq^{NG<G}$ based on the sign of their adjustments throughout the year. As we previously discussed, we expect

[14] We find that crash risk is significantly higher for $NonGaapFreq^{NG>G}$ than for $NonGaapFreq^{NG<G}$ at the 50%, 75%, and 100% frequencies, but is not significantly different in the 25% frequency group (one-tailed). This latter result is not surprising since the non-GAAP reporting in this group might not be frequent enough to generate a large effect for a subsequent crash.

the relation between reporting frequency and crash risk to be larger when managers paint a rosier picture of firm performance by making income increasing adjustments (without implying that all income increasing exclusions are attempts to mislead investors). Thus, we expect the coefficient on $NonGaapFreq^{NG>G}$ to be significantly larger than the coefficient on $NonGaapFreq^{NG<G}$.

Table 3 presents the results. In each column, the coefficient on $NonGaapFreq^{NG>G}$ is significantly positive, consistent with crash risk being higher when non-GAAP earnings are more frequently higher than GAAP earnings throughout the year. In contrast, the coefficient on $NonGaapFreq^{NG<G}$ is significantly negative in three of the four columns. Thus, non-GAAP reporting can either increase or decrease a firm's crash risk, depending on the sign of the non-GAAP adjustments. These results indicate that non-GAAP reporting is particularly concerning for crash risk when the adjusted earnings metrics routinely paint a more favorable picture of performance than GAAP earnings.[15]

Since regulators and investors are particularly concerned about firms' aggressive non-GAAP reporting practices, we focus the remainder of our analyses on better understanding instances where non-GAAP reporting is likely to be more aggressive, and thus increases crash risk. As a result, we specifically focus on the relation between crash risk and $NonGaapFreq^{NG>G}$. This design choice also allows us to focus on the most common type of exclusions (income increasing exclusions), and the exclusions that are responsible for the positive relation between non-GAAP reporting frequency and crash risk in Table 2.

4.2.2 H2: Non-GAAP reporting, crash risk, and earnings management

We next examine whether managers can use non-GAAP reporting as a complement or a substitute for the more traditional method for withholding bad news in the literature—earnings management. In particular, we re-examine the association between non-GAAP reporting frequency and crash risk using the model specification in Table 3, however we partition the sample based on the degree of firms' earnings management. To measure earnings management, we follow

[15] In untabulated analyses, we re-estimate Eq. 2 based on whether the firm discloses non-GAAP earnings at some point during year *t*, as opposed to the frequency of the reporting. We find that the non-GAAP reporting coefficient is significantly positive when the dependent variable is *Crash*, and marginally significant for *Crash Composite*. When we further partition the non-GAAP metric based on whether the firm has net income increasing or income decreasing non-GAAP adjustments during at least one quarter in year *t*, our inferences are identical to those in Table 3.

the crash literature and use reporting opacity (e.g., Hutton et al., 2009), which is measured as the three-year sum of the absolute value of abnormal accruals. We partition our sample based on the median level of reporting opacity (*Opaque*), and define firms in the high (low) partition as having a high (low) level of reporting opacity. If non-GAAP reporting is a compliment (substitute) for earnings management in the crash risk setting, the positive relation between non-GAAP reporting and crash risk should concentrate in the subsample with high (low) reporting opacity.[16]

We present our results in Panel A of Table 4. Across all four crash risk measures, the positive association between income increasing non-GAAP reporting ($NonGaapFreq^{NG>G}$) and crash risk is concentrated among firms with a low level of opacity. In contrast, the coefficient on $NonGaapFreq^{NG>G}$ is insignificant for firms with a high level of opacity. Moreover, the coefficient on $NonGaapFreq^{NG>G}$ is significantly larger for firms in the low partition than in the high partition across the four crash risk measures. These results are consistent with some managers using non-GAAP reporting to divert investor attention, which is a substitute to using earnings management to withhold bad news from investors. Overall, our results lead us to formally reject hypothesis H2 that the relation between non-GAAP reporting and crash risk does not vary with the level of firms' earnings management.[17]

The non-GAAP reporting literature also highlights how managers can use non-GAAP reporting as a substitute for accruals management (e.g., Black et al., 2017). To further connect our evidence with the non-GAAP reporting literature, we re-estimate the analyses in Panel A, but partition the sample using the median of signed abnormal accruals in year *t* (*AbnAccruals*), as opposed to the opacity partition.[18] We present the results in Panel B of Table 4. Across the crash risk measures, we find a significantly positive coefficient on $NonGaapFreq^{NG>G}$ in the low

[16] Throughout our analyses, we compare coefficients across the high and low partitions using Fisher's Permutation test with bootstrapping (Efron and Tibshirani, 1993).

[17] In untabulated analyses, we repeat the analysis in Panel A of Table 4 except we partition our high and low groups based on $NonGaapFreq^{NG>G}$ and examine the relation between *Crash Risk* and *Opaque*. We find that the relation between these two variables is only significant in the low $NonGaapFreq^{NG>G}$ group, providing further evidence consistent with the notion that managers use non-GAAP reporting and opacity as substitutes when withholding bad news from investors.

[18] We view the opacity variable in Hutton et al. (2009) (*Opaque*) and the accruals management variable in Black et al. (2017) (*AbnAccruals*) as both capturing managers' attempts at perception management. In particular, managers manage earnings in both measures to inflate investors' perceptions of GAAP performance.

accruals partition. Further, for three of the four crash variables, the relation between crash risk and $NonGaapFreq^{NG>G}$ is significantly higher in the low accruals partition where managers are less likely managing earnings. Not only do these results strengthen the conclusion that managers use non-GAAP reporting as a substitute for accruals management, but they also extend the non-GAAP reporting literature by highlighting that this substitution can have large negative implications for investors because the non-GAAP reporting associates with higher crash risk.

4.3 Cross-sectional analyses of managerial incentives, non-GAAP reporting, and crash risk

To buttress our evidence that income increasing adjustments increase a firm's crash risk, we next examine the non-GAAP reporting and crash risk relation in four different settings where we expect managers to be more aggressive in their non-GAAP reporting. We follow the model specification in Table 3, however, we now partition the sample at the median based on the estimated level of aggressive reporting in each of the four settings. We then compare the non-GAAP reporting and crash risk relation across the partitions, and predict that the relation is more positive in the partitions with more aggressive reporting. We present the results in Table 5 and focus on our main variable of interest ($NonGaapFreq^{NG>G}$) for brevity.[19]

We begin by examining settings where prior research finds non-GAAP reporting to be aggressive. First, Brown et al. (2012) find that managers are more aggressive in their non-GAAP reporting when investor sentiment is high, consistent with investors being less rigorous in their scrutiny of non-GAAP metrics in optimistic periods. Therefore, we partition the sample into high and low sentiment groups based on the magnitude of the average investor sentiment index during year *t* (*MktSent*). Second, prior research provides evidence indicating that managers can aggressively report non-GAAP earnings to meet market expectations when GAAP earnings fall short of expectations (Doyle et al., 2013; Black et al., 2017). We therefore examine the setting where managers' non-GAAP earnings just meet analysts' street earnings forecasts (i.e., a surprise of five cents or less), while their GAAP earnings miss the GAAP forecasts. We then calculate the

[19] Because we make directional predictions in our cross-sectional analyses in Table 5, we use one-tailed *t*-tests to compare the coefficients across the partitions (Wooldridge, 2009: p.103).

percentage of quarters during the year in which this occurs (*FreqMBE*) and classify the observations into either a high or low *FreqMBE* group.[20]

In Panel A, we present the market sentiment setting and find that the coefficient on $NonGaapFreq^{NG>G}$ is significantly positive for the high sentiment group but insignificant for the low sentiment group across the crash risk measures. We also find that the coefficient on $NonGaapFreq^{NG>G}$ is significantly larger in the high sentiment group than in the low group across our crash risk measures. Panel B presents evidence on the meet-or-beat setting. The coefficient on $NonGaapFreq^{NG>G}$ for the high group is significant across our crash risk measures. Although this coefficient is also significant for three of the four crash risk variables in the low meet-or-beat group, the coefficient in the high group is significantly larger than the coefficient in the low group at the conventional level for three of the four crash measures. Overall, the thrust of our evidence is consistent with the positive relation between non-GAAP reporting frequency and crash risk being higher when non-GAAP reporting is likely more aggressive.

Next, we examine whether the positive relation between non-GAAP reporting frequency and crash risk is higher for managers who have a greater incentive to inflate stock price, since prices are inflated prior to crashes. First, we expect that managers with higher compensation sensitivity to changes in stock price will have a greater incentive to use non-GAAP reporting to inflate stock prices. We test this conjecture by partitioning our sample based on executives' compensation sensitivity to stock price changes in year *t* (*Delta*). Second, we expect that managers who engage in more opportunistic insider sales will have a greater incentive to inflate stock prices through non-GAAP reporting. We test this conjecture by partitioning our sample based on insiders' opportunistic insider sales in year *t* (*OpptunSales*).

In Panel C, we present the results based on the compensation sensitivity partition (*Delta*). Across each of the crash risk measures, the relation between $NonGaapFreq^{NG>G}$ and crash risk is (1) significantly positive in the high group, (2) insignificant in the low group, and (3) significantly

[20] Since *FreqMBE* can be measured only when a manager reports non-GAAP earnings for at least one quarter during a year (i.e., $NonGaapFreq^{NG>G}>0$), we first focus on the observations with $NonGaapFreq^{NG>G}>0$ and partition this subsample into high and low groups based on the median value of *FreqMBE* at each level of $NonGaapFreq^{NG>G}$. We then add the observations with a zero value of $NonGaapFreq^{NG>G}$ into both high and low subsamples. Therefore, the sum of sample sizes of high and low groups is bigger than the size of the full sample.

higher in the high group than in the low group. In Panel D, we present the results for the opportunistic insider sales partition. The coefficient on $NonGaapFreq^{NG>G}$ is significantly positive for each of the crash risk measures in the high group. Moreover, the coefficient on $NonGaapFreq^{NG>G}$ for the high group is significantly larger than the coefficient in the low group at the conventional level across the crash risk measures. Overall, these results indicate that the positive relation between non-GAAP reporting frequency and crash risk is higher when managers have a stronger incentive to inflate share price.[21]

4.4 Analyses of potential endogeneity

We next address the alternative explanation that our primary results are endogenous and due to unobservable firm characteristics or events that associate with both non-GAAP reporting frequency and future crash risk. Although our cross-sectional analyses in Tables 4 and 5 help to mitigate this concern, we next use a difference-in-differences research design based on a matched sample, centered on Regulation G. Prior research provides evidence that Regulation G improved the quality of non-GAAP reporting (e.g., Heflin and Hsu, 2008; Kolev et al., 2008), particularly for firms with "recurring item" exclusions, where recurring item exclusions consist of earnings components other than those identified as being "non-recurring" by Compustat. As a result, we expect that the regulation improved non-GAAP reporting quality the most for firms with income increasing recurring item exclusions and that the relation between non-GAAP reporting and crash risk sharply declines for these firms around the regulation.

We focus the analysis on the two years before and after Regulation G (2001–2004). Since the Bentley et al. non-GAAP data is not available prior to the regulation, we restrict or analysis to only those firms where managers' non-GAAP reporting choices agree with the I/B/E/S earnings metrics in every quarter from 2003–2004. For these firms, we use I/B/E/S earnings to proxy for managers' metrics during 2001–2002 because the agreement between the two datasets for these

[21] In an untabulated cross-sectional analysis, we follow the design in Panel B, but instead partition the sample based on median value of average income increasing exclusions in year *t* to examine whether exclusion magnitude influences the relation between $NonGaapFreq^{NG>G}$ and crash risk. We find that this relation is significantly higher in the large exclusion magnitude group than in the low exclusion magnitude group, consistent with the general theme in Table 5 that the non-GAAP reporting and crash risk relation is stronger when managers are likely more aggressive in their non-GAAP reporting.

firms is likely very sticky.[22] We next identify firms that most frequently exclude income increasing recurring items before the regulation (based on the median exclusion frequency) with the indicator *NGincrease*. We also identify a comparison group using propensity score matching, focusing this group on firms that do not exclude income increasing recurring items during 2001–2004 since they are less likely to experience a decline in crash risk resulting from Regulation G.[23] Appendix B details this matching process and provides evidence that the matching is effective.

Next, we use the following model to examine whether *NGincrease* firms experience fewer future crashes after Regulation G than before, relative to the comparison firms:

$$\begin{aligned} Crash\ Risk_{i,t+1} = \quad & a_0 + a_1 NGincrease_i + a_2 Post_{i,t} \times NGincrease_i \\ & + \sum a_n Controls + \sum \gamma_t Year_t + \sum w_j Ind_j + e_{i,t}, \end{aligned} \tag{3}$$

where *Post* equals one for observations after the implementation of Regulation G (years 2003 and 2004), and zero otherwise. The other variables are as previously defined. If Regulation G constrains managers' ability to aggressively use non-GAAP reporting, the relation between non-GAAP reporting and crash risk will decline after the regulation and the coefficient on *Post* × *NGincrease* will be significantly negative.[24]

We present the results from estimating Eq. 3 in Table 6. First, we find that the coefficient on *NGincrease* is significantly positive, suggesting that *NGincrease* firms had a greater incidence of crashes relative to the comparison group *prior to* Regulation G. More importantly, the coefficient on *Post* × *NGincrease* is significantly negative across all four measures of crash risk (columns 1–4), consistent with a greater decline in crash risk for *NGincrease* firms after Regulation G. In columns 5–8, we further partition the time period, where *Post* relates to 2003-2004 (years subject to Regulation G), *Post -1* relates to 2002 (one year prior to Regulation G), and

[22] For example, for firms where managers and I/B/E/S agree in their decision to report non-GAAP earnings for every quarter of 2004 and 2005, their non-GAAP reporting choices also agree for every quarter in 2003 (i.e., 100% agreement). Nonetheless, our design misses scenarios where managers report non-GAAP earnings while the I/B/E/S database contains only GAAP earnings, which prior research finds to be observations where managers are particularly aggressive (Bentley et al., 2018). Since Regulation G is most likely to improve reporting quality for aggressive non-GAAP reporting, our research design likely yields conservative inferences.

[23] Specifically, our comparison group could be any of the following types of firms that do not exclude income increasing recurring items during the entire 2001-2004 period: (1) GAAP-only reporting firms, (2) non-GAAP firms with non-recurring item adjustments, or (3) non-GAAP firms with income decreasing recurring item adjustments.

[24] The motivation for this design is similar to the one for the pre- versus post-Sox analysis in Table 11 of Hutton et al. (2009). They find a negative interaction between their post-SOX and opaque reporting variables, consistent with SOX constraining managers' use of opaque reporting that increases crash risk.

the benchmark year is 2001. Across three of the four columns, the interaction between *Post* and *NGincrease* is significantly negative. In contrast, the interaction between *Post -1* and *NGincrease* is insignificant in each column, suggesting that the effect appears only after the implementation of Regulation G, and not before. These results help corroborate the parallel trend assumption of our difference-in-differences design.[25]

5. Crash returns and triggers of crashes

5.1 Long-term returns for non-GAAP crash firms

We next examine the long-term implications for investors holding stocks in non-GAAP reporting firms that experience a crash. Although crashes clearly have negative return implications for equity holders during the week of the crash, it is unclear how far into the future these negative implications extend. For example, if the stock price rebounds shortly after the crash, then crashes expose investors to only short-term losses, but not long-term losses. In contrast, if the negative price implications extend far into the future, then investors will find it hard to mitigate the negative crash effects by holding the stock for a longer period of time.

Figure 2 plots the cumulative market-adjusted returns for non-GAAP reporting firms that experience a crash. We align the crash events in the figure so that they occur in week 0, and calculate cumulative weekly returns based on the price 52 weeks before the crash. The plot provides evidence consistent with the concern regarding crash events. In particular, these firms have increasing average returns (9.02%) in the year before the crash and then experience a large and sudden decline in returns during the crash week (14.46% loss on average). Further, the sudden decrease in returns is not short lived, but persists to some degree and remains significantly negative throughout our 104-week post-event window. The figure thus indicates that these crash events negatively affect not only active investors who hold their investments for a short period of time, but also passive investors who hold their investments for longer periods of time.

5.2 Potential triggers of crashes for non-GAAP firms

Next, we examine the events during a crash week and link these potential crash triggers to

[25] In untabulated analyses, we repeat the analysis in Table 6 using entropy balancing instead of propensity score matching. We find that our inferences remain similar when using the entropy balancing design.

non-GAAP reporting frequency. Since crashes represent a substantial change in investors' beliefs about firm value, we first examine whether crashes are more likely to occur during weeks in which firms disclose information through an 8-K filing. We focus on firms' 8-K disclosures because the SEC requires firms to use 8-Ks to communicate important events relevant to shareholders. Based on our definition of *Crash*, Figure 3 indicates that 75.7% of crash weeks (i.e., weeks with extremely negative stock returns) in year t+1 have an 8-K filing during the week, while only 20.9% of non-crash weeks during year t+1 have an 8-K filing. We also consider the type of event in 8-K filings based on their item number (firms can tag an 8-K filing with more than one item number). We find that the crash week versus non-crash week disparity is largest for filings related to: "Registrant's Business and Operations," "Financial Information," "Corporate Governance and Management," "Regulation FD Events," and "Other Events" (Items 1, 2, 5, 7, and 8, respectively).

In Table 7, we regress $CrashWeek_{t+1}$, an indicator variable for whether there is a crash in a week during year t+1, on $8K_{t+1}$, an indicator variable for the presence of an 8-K filing during the same week, and a similar set of controls as in Eq. 1. In column 1 of Panel A, we find that crash weeks are significantly more likely during weeks with an 8-K filing, as compared to weeks without an 8-K filing. In terms of economic significance, the odds ratio for *8K* indicates that the odds of a crash during weeks in which a firm files an 8-K are over 11 times higher than during weeks without an 8-K filing (untabulated). In column 2, we find that crash weeks are more likely when 8-K filings contain information related to: "Financial Information" (Item 2), "Matters Related to Accounting and Financial Statements" (Item 4), "Corporate Governance and Management" (Item 5), "Regulation FD Events" (Item 7), and "Other Events" (Item 8).

For 8-K filings to negatively influence investors' beliefs about firm value, the disclosures likely contain negative information about the firm. We therefore link negative tone in 8-K filings to crashes in Panel B of Table 7. Since crashes represent significant downward revisions in firm value, we assert that the tone in 8-K filings must be particularly negative during a crash week. For weeks with 8-K items that associate with a higher likelihood of a crash in Panel A (Items 2, 4, 5, 7, and 8), we identify an 8-K filing as having a particularly negative tone if the negative tone in the filing is among the top 25% of negative tone in filings issued during that week with the same

item number ($NegTone^{8KItemx}$). Across each of the 8-K items in Panel B, we find that crashes are more likely to occur when the tone in the filings is more negative.[26]

We next examine whether non-GAAP reporting frequency in year *t* associates with the negative tone in these 8-K filings in year *t*+1. In particular, we regress firms' weekly $NegTone^{8KItemx}$ measures from year *t*+1 on non-GAAP reporting frequency in year *t*. Since firms with more frequent non-GAAP reporting in year *t* are more likely to experience a crash in year *t*+1 and, as Panel B indicates, the crash in year *t*+1 is positively associated with the negative tone in several types of 8-K filings during the crash week, we expect non-GAAP reporting frequency in year *t* to positively associate with $NegTone^{8KItemx}$ in year *t*+1 for these types of 8-K filings. Consistent with this expectation, in Panel C of Table 7, we find that higher $NonGaapFreq^{NG>G}$ positively associates with negative tone in 8-K filings tagged with: Item 2 (Financial Information), Item 5 (Corporate Governance and Management), and Item 8 (Other Events). Finally, in untabulated analyses, we further decompose Item 2 and Item 5 filings based on their sub-item numbers (Item 8 does not contain multiple sub-items), and find that the $NonGaapFreq^{NG>G}$ and $NegTone^{8KItemx}$ relation concentrates in filings related to Item 2.02 – Results of Operations, Item 5.02 – Departure of Directors, and Item 5.07 – Matters for Security Holder Vote.

Overall, these results provide several important insights. First, we find that there is frequently a triggering event for a crash and that firms often disclose the triggering event in an 8-K filing. Second, we provide evidence on the types of events that associate with a crash using the specific items contained in 8-K filings, and find that negative tone in these filings positively associates with the likelihood of a crash. Finally, we provide evidence that firms with higher non-GAAP reporting frequency in year *t* have more negative tone in their 8-K filings that is associated with a crash in year *t*+1. Together, these results indicate that, while frequent non-GAAP reporting allows managers to inflate firm value for a period of time, this practice also makes their firms'

[26] We focus on negative tone, measured as the difference between the number of negative words and positive words in the filing, scaled by total number of words in an 8-K filing, because tone offers a way to operationalize the different forms of bad news or events that managers might discuss in their disclosures. Prior research indicates that tone of corporate disclosure associates with stock market reactions (e.g., Huang et al., 2014; Merkley, 2014). In untabulated analyses, we also find that both negative management earnings forecast revisions and negative quarterly actual earnings surprises are significantly more likely during crash weeks than non-crash weeks.

stock prices more vulnerable to stock price crashes when subsequent disclosures of bad news are inconsistent with investors' optimistic expectations.

6. Additional analyses

6.1 Non-GAAP reporting frequency, investor response, and non-GAAP earnings persistence

As discussed previously, we focus on non-GAAP reporting frequency because we assert that crash risk increases in the extent to which managers routinely encourage investors to focus on non-GAAP earnings throughout the year. To further clarify the reason for the overvaluation, we conduct several additional analyses. First, we examine whether investors' response to non-GAAP earnings increases with non-GAAP reporting frequency. The results, reported in Panel A of Table 8, indicate that investors' response to non-GAAP earnings around earnings announcements increases with non-GAAP reporting frequency. We also find in untabulated analyses that investors respond more strongly to non-GAAP earnings for crash firms than for non-crash firms at the earnings announcement date. Taken together, these results are consistent with the idea that frequent non-GAAP reporting focuses investors on non-GAAP metrics and this focus is particularly high for crash firms.[27] Next, we use a standard persistence design common in the non-GAAP literature (e.g., Kolev et al., 2008; Bentley et al., 2018) to examine non-GAAP reporting quality conditional on non-GAAP reporting frequency. The results, reported in Panel B of Table 8, indicate that firms with more frequent non-GAAP reporting have (1) less persistent non-GAAP earnings and (2) more persistent exclusions.[28] Thus, the greater investor response to non-GAAP earnings in Panel A is inconsistent with the evidence from the persistence tests in Panel B (i.e., higher pricing for less persistent earnings). These results help explain why frequent non-GAAP reporting could lead to overvaluation and increase the likelihood of a stock price crash.

[27] As an alternative test, we match all firms with income increasing non-GAAP exclusions in year *t* to firms without these adjustments based on their return-on-assets in year *t* (to control for firm performance) and their stock returns in year *t*-1 (to control for prior market-based performance). We then take the difference in the buy-and-hold market adjusted returns in year *t* between these two groups of firms and find that the difference is increasing in non-GAAP reporting frequency in year *t*. This result is again consistent with overvaluation increasing in reporting frequency.

[28] Finding that exclusions more positively associate with *both* future operating earnings and future operating cash flows when non-GAAP reporting frequency is higher helps to mitigate the concern that frequency simply captures recurring non-cash expense exclusions. The results in section 6.3.2 further suggest that our main inferences capture a relation between crash and both non-recurring item exclusion frequency and recurring item exclusion frequency.

6.2 Non-missing managerial non-GAAP metrics and street earnings

The Bentley et al. (2018) dataset of managers' non-GAAP metrics has missing values for some firm quarters. As we discussed in our research design, we include these missing values in our non-GAAP reporting frequency variable as if the firm had only provided GAAP-based earnings. We also include a control variable in our analyses to identify observations with missing Bentley et al. data. We next use two alternative variables for reporting frequency to examine whether the missing Bentley et al. data influences our primary inferences in Table 3. First, we recalculate reporting frequency using only those observations with non-missing Bentley et al. data for *every quarter* in the fiscal year. This restriction reduces our sample size from 30,419 to 16,497 firm years. We present the results in Panel A of Table 9 and find evidence consistent with the results in Table 3. Second, we recalculate the non-GAAP frequency variable using analysts' street earnings metrics from I/B/E/S (*StreetFreq*), as opposed to managers' non-GAAP metrics, because I/B/E/S data is not subject to the missing data concern in the Bentley et al dataset. In addition, examining I/B/E/S data is interesting on its own, since prior research indicates that the market pays particular attention to street earnings (Bradshaw and Sloan, 2002; Bhattacharya et al., 2003) and that analysts filter out not only managers' conservative GAAP reporting (Heflin et al., 2015) but also their aggressive non-GAAP reporting (Bentley et al., 2018). Thus, it is unclear whether the relation between non-GAAP reporting and crash risk remains when examining street earnings. In Panel B of Table 9, we find that $StreetFreq^{NG>G}$ has a significantly positive relation with crash risk across all four columns. Overall, the results in Table 9 help mitigate concerns that missing managerial non-GAAP reporting data unduly influence our primary inference.

6.3 Untabulated analyses to further explore the non-GAAP reporting and crash risk relation

6.3.1 Including additional controls

Because we are interested in the relation between non-GAAP reporting frequency and crash risk, it is critical that we control for firms' underlying economics that might be related to both non-GAAP reporting frequency and crash risk. Note that our current research design mitigates this concern in several ways (e.g., including *Return* as a control variable, the cross-

sectional analyses, and the difference-in-differences analysis around Regulation G). [29] Nevertheless, we also conduct a battery of additional analyses to further mitigate this concern. In particular, we find that our primary inferences in Table 3 hold after controlling for the following variables in year *t*: (1) average negative tone of 8-K filings, (2) the number of 8-K filings, (3) the number of 8-K filings with negative tone, (4) the number of 8-K filing item numbers, or (5) each firm's crash risk measure. These primary inferences also hold after controlling for both expected crash risk (Kim et al., 2016a) and the frequency of 8-K filings in year *t*, and we do not find a relation between expected crash risk and non-GAAP reporting frequency more generally.[30] If we examine the non-GAAP reporting frequency and crash risk relation based on firms with above- or below-average negative tone in 8-K filings during year *t*, our primary inferences do not differ across the partitions. This latter result indicates that our primary inferences are not only attributable to firms with negative events in year *t*, but also to firms with non-negative events where managers use non-GAAP reporting to make firm performance appear even better. Finally, our main results continue to hold after controlling for several other factors that prior crash risk studies find to be associated with crash risk.[31]

6.3.2 Crash risk and non-GAAP exclusion type

The extant literature indicates that managers can exclude either recurring (e.g., stock compensation, amortization) or non-recurring (e.g., restructuring, impairments) items when calculating non-GAAP earnings. Therefore, we re-examine the analysis in Table 3 based on the frequency with which managers exclude these types of items. We begin by examining the relation

[29] Moreover, as mentioned earlier, we structure our primary analyses with a lead-lag design so that the crash occurs in the year after the non-GAAP reporting and any related economic events. As a result, even if negative events occur in year *t*, the non-GAAP reporting is critical because it can cause investors to delay their response to the events, which increases the likelihood of a crash in year *t*+1.

[30] To further explore the non-GAAP reporting and crash risk relation, we conduct a Granger causality test (e.g., Granger and Newbold, 1986), which has been widely applied in economic research. Specifically, we estimate two symmetric sets of regressions that regress either *Crash* or $NonGaapFreq^{NG>G}$ on lags of *Crash* and $NonGaapFreq^{NG>G}$. We also include the other control variables from our primary analyses. We continue to find that crash risk significantly increases with lagged non-GAAP reporting frequency, while non-GAAP reporting frequency does not significantly vary with lagged crash risk.

[31] Specifically, we consider the following variables: accounting conservatism (Kim and Zhang, 2016), corporate tax avoidance (Kim et al., 2011a), accounting comparability (Kim et al., 2016a), CEO overconfidence (Kim et al., 2016b), frequency of management earnings guidance (Hamm et al., 2018), financial reporting complexity (Kim et al., 2019), or product market competition (Li and Zhan, 2019). We exclude these variables from our primary analyses, however, because their data requirements overly restrict our sample size.

separately for recurring and nonrecurring item exclusions, finding that reporting frequency for income increasing exclusions positively associates with crash risk for both exclusion categories.[32] Next, we include both recurring and non-recurring item exclusions in the same regression. In this model, the positive relation between frequency and crash risk only exists for recurring item exclusions, however, the recurring item and non-recurring item coefficients are not significantly different. Since these coefficients do not statistically differ, we cannot conclude that recurring and non-recurring item exclusions differentially associate with crash risk.[33]

We find similar inferences if we limit our non-GAAP frequency variable to observations without Compustat-identified non-recurring items (special items) in any quarter during year *t* (implying exclusions more likely relate to recurring items), or firms with non-recurring items in the majority of quarters during year *t* (implying exclusions more likely relate to non-recurring items). In addition, Black et al. (2021) find that managers' recurring item exclusions commonly relate to stock-based compensation and amortization expenses. We find that our primary inferences still hold regardless of whether firms have above- or below- median stock compensation expense or amortization expense. Finally, if we separately calculate *FreqMBE* from Panel B of Table 5 for only firms with recurring or non-recurring item exclusions during the year, we find that the correlation between non-GAAP reporting frequency and *FreqMBE* is similar across the two types of exclusions (0.447 versus 0.407, respectively). Overall, these results indicate that our primary inferences are not solely due to either of the traditional exclusion classifications found in the literature (recurring or non-recurring item), but that our frequency measure also captures other dimensions of non-GAAP reporting quality (see section 6.1).

6.3.3 Crash risk and analysts corroborating managers' non-GAAP earnings

Several studies find that the quality of managers' non-GAAP reporting improves when analysts monitor or corroborate managers' non-GAAP metrics (e.g., Barth et al., 2012; Bentley et

[32] The significant relation between non-GAAP reporting frequency for non-recurring events and crash risk implies that at least some non-recurring events have value-relevant implications and non-GAAP reporting prevents investors from fully pricing these events when they occur. For example, mispricing could occur through shifting recurring expenses into a transitory earnings classification (McVay, 2006; Kolev et al., 2008).

[33] One challenge with this analysis is that managers often exclude both recurring and non-recurring items in calculating their non-GAAP metrics in the same quarter. For example, the correlation between recurring and non-recurring item frequencies for income increasing exclusions is 0.664.

al., 2018; Christensen et al., 2021). As a result, we re-estimate Eq. 1 and measure non-GAAP reporting frequency based on the frequency with which analysts corroborate managers' non-GAAP reporting. We find that crash risk increases with the frequency of managers' corroborated non-GAAP reporting ($NonGaapFreq^{Both}$), while we do not find a significant relation between crash risk and the frequency of managers' independent non-GAAP reporting ($NonGaapFreq^{Manager\text{-}alone}$). This result may seem surprising given the evidence in prior research (e.g., Bentley et al., 2018). One potential explanation for this result is that investors are more skeptical of non-GAAP reporting when analysts do not corroborate managers' metrics, and are therefore less likely to significantly overvalue the firm, while managers have the ability to optimistically bias investors' perceptions when analysts corroborate managers' metrics.[34]

6.3.4 Non-GAAP earnings and crash risk across the post-Reg G sample period

We also examine whether our inferences change throughout our post-Reg G sample period. Prior studies suggest that Regulation G curbed opportunistic non-GAAP reporting in the first few years after Regulation G (Heflin and Hsu, 2008; Kolev et al., 2008). However, many have interpreted the 2010 C&DIs as evidence that the SEC has loosened its stance on non-GAAP reporting (Black and Christensen, 2018), which could have opened the door for some managers to be more aggressive in their reporting. Further, the SEC has expressed concerns about potentially misleading non-GAAP reporting throughout the last decade. It is thus interesting to examine the stability of the non-GAAP reporting and crash risk relation across years in our post-Reg G sample period. To conduct this test, we re-estimate the analyses in Table 3 separately for the earlier (2003–2009) and later (2010–2016) years in our sample. We find that the positive association between $NonGaapFreq^{NG>G}$ and crash risk largely concentrates in the later sample years.[35] This result is consistent with the SEC's increasing concern about potentially misleading non-GAAP reporting

[34] We note, however, that the difference between the coefficients on $NonGaapFreq^{Both}$ and $NonGaapFreq^{Manager\text{-}alone}$ is insignificant for three out of four specifications. The insignificant difference might be due to the power of our analyses since managers and analysts are much more likely to agree than disagree in their reporting. For example, $NonGaapFreq^{Manager\text{-}alone}$ has a mean value of 3.6% in our sample and is non-zero for only 8.3% of observations. Further, the sampling power concern prevents us from further partitioning the frequency variables into income increasing and decreasing exclusions as in Table 3.

[35] During the earlier sample years of our post-Reg G sample, the association between $NonGaapFreq^{NG>G}$ and crash risk is marginally significant for two of our crash risk variables based on two-tailed tests, while the association is at least marginally significant for all four crash risk variables based on one-tailed tests.

in the more recent years, even though prior research finds that the majority of managers report non-GAAP earnings for informative reasons during this time period (Black et al., 2018).[36]

6.4 Untabulated analyses to reconcile our inferences with the non-GAAP literature

Many studies provide evidence that providing informative or value-relevant information is a primary reason that managers disclose non-GAAP earnings (e.g., Black et al., 2018), especially after Regulation G. Although, at first glance, our evidence may appear inconsistent with this common inference, we believe our results align nicely with the literature. First, our results do not imply that the majority of managers use non-GAAP earnings to mislead investors, but instead, that crash risk increases in non-GAAP reporting frequency. To assess the economic magnitude of our evidence, we compare firms that are likely more aggressive in their non-GAAP reporting (those with income increasing exclusions) to two different benchmark groups that are less likely aggressive in their reporting: (1) firms without income increasing exclusions, and (2) firms without income increasing exclusions and that have low reporting opacity (i.e., firms unlikely to withhold bad news through earnings management). We estimate that the incremental effect of aggressive non-GAAP reporting on the incidence of crash events is 3.6% to 6.1%.[37] Thus, we find that a subset of firms are aggressive in their non-GAAP reporting, which leads to a crash, while the vast majority of non-GAAP firms are not overly aggressive.

Our evidence also does not imply that the increased crash risk fully negates the average benefit of non-GAAP reporting by firms more generally. We examine this point by regressing firms' three-year abnormal returns (years *t* through *t*+2) on their non-GAAP reporting frequency for all firms in our sample. Over this three-year period, the average abnormal returns increase in

[36] We also examine whether the non-GAAP reporting and crash risk relation varies based on firm size. First, we find that crash risk is positively correlated with both non-GAAP reporting frequency and firm size, while firm size is positively correlated with non-GAAP reporting frequency. We also find that the positive relation between non-GAAP reporting frequency and crash risk concentrates among larger firms. One potential explanation is that the oversight structure in larger firms makes it more difficult for firms to hide bad news through managing GAAP earnings, and they resort to perception management through non-GAAP reporting, which is not audited (Black et al., 2017).

[37] We find that 25.6% of non-GAAP firms with income increasing exclusions experience a crash in year *t*+1. In contrast, for the two benchmark groups the crash percentage is 22.0% for group 1 and 19.6% for group 2. Therefore, the incremental crash percentage for aggressive non-GAAP reporters is 3.6% (i.e., 25.6% - 22.0%) to 6.1% (i.e., 25.6% - 19.6%). Extrapolating this range to the full sample, we estimate that approximately 1.6% to 2.7% of our overall sample is more likely aggressive in their non-GAAP reporting and experience a crash. Although these ranges are useful, we also recognize that in studying crash risk, we are likely to identify non-GAAP reporting that is particularly aggressive. Other firms may use less aggressive non-GAAP reporting that does not accumulate to the point of a crash, but has some degree of aggressiveness nonetheless.

reporting frequency. For example, returns are 6.5% larger for the most frequent non-GAAP reporting firms, as compared to GAAP-only reporters. Thus, the higher crash risk associated with frequent non-GAAP reporting does not fully negate the benefit of investing in non-GAAP reporting firms over a three-year horizon.

7. Conclusion

We examine whether managers' non-GAAP disclosures influence a firm's crash risk. We find a positive relation between the frequency of non-GAAP reporting and crash risk, and that this relation is attributable to instances where non-GAAP earnings exceed GAAP earnings. We also find that some managers use non-GAAP reporting as a substitute to earnings management for withholding bad news from investors. Specifically, the association between non-GAAP reporting frequency and crash risk concentrates among firms with a low level of earnings management.

Our evidence also indicates that the non-GAAP reporting and crash risk relation concentrates in periods when non-GAAP reporting is likely more aggressive and for managers who have more incentives to inflate stock price. Further, crashes for non-GAAP firms have long-run negative implications for investors, implying that more passive investors who hold their investments for years are also subject to these negative crash effects. Finally, we find a positive association between non-GAAP reporting frequency and the negative tone in firms' subsequent 8-K filings that potentially trigger a crash.

In total, our results are consistent with a subset of managers aggressively reporting non-GAAP earnings to positively influence investors' assessments of firm performance, leading investors to over-estimate firm value. It is important to note, however, that our results do not imply that this increased risk fully negates the average benefit of non-GAAP reporting by firms more generally. Instead, our evidence is consistent with managers aggressively reporting non-GAAP earnings in some situations, which elevates the crash risk for those firms, and our cross-sectional analyses highlight the scenarios where this increased risk is more likely to occur. Further, although we conduct a battery of analyses to mitigate concerns that correlated omitted variables increase both non-GAAP reporting frequency and crash risk, we recognize that we are unable to fully control for all economic events that may influence both variables of interest.

Our study adds to prior research that examines the determinants of crash risk. The traditional view in the literature attributes crashes to managers using earnings management to withhold bad news about firm performance from investors. Our evidence suggests that in addition to withholding bad news through earnings management, managers sometimes use non-GAAP reporting to divert investor attention from the bad news in GAAP earnings, which leads investors to focus on the more optimistic non-GAAP performance metrics and miss cues embedded in GAAP earnings. Furthermore, we provide evidence (1) that managers sometimes appear to substitute non-GAAP reporting for earnings management and (2) on factors that can trigger a crash among non-GAAP reporting firms. Finally, we extend the non-GAAP reporting literature by providing evidence that non-GAAP earnings can either increase or decrease a firm's crash risk, depending on the sign of the non-GAAP exclusions. We are also among the first to provide evidence that non-GAAP earnings can expose investors to extreme negative economic outcomes after Regulation G, which aligns with the SEC's more recent concerns about non-GAAP reporting potentially misleading investors.

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Appendix A
Variable definitions

Variables	Definitions
Dependent Variables	
$Crash_{t+1}$	An indicator variable equal to one for a firm-year that experiences one or more crash weeks during fiscal year t+1 and zero otherwise. Crash weeks are those weeks during which the firm experiences W that is 3.2 standard deviations below the mean firm-specific weekly return in fiscal year t+1. For each firm and year, we estimate mean and standard deviation of firm-specific weekly returns throughout a 12-month return window that ends three months after firm i's fiscal year end.
$NSkewness_{t+1}$	The negative skewness of W over fiscal year t+1.
$LnDuVol_{t+1}$	The natural log value of $DuVol_{t+1}$. $DuVol_{t+1}$ is the ratio of the standard deviation of W for the down weeks to the standard deviation of W for the up weeks, where down and up weeks are those with W below and above, respectively, the mean firm-specific return in fiscal year t+1.
W	Firm-specific weekly return, defined as the natural logarithm of one plus the residual return from estimating the expanded market model for each firm: $r_{j,\omega} = \alpha_j + \beta_{1,j}r_{m,\omega-2} + \beta_{2,j}r_{m,\omega-1} + \beta_{3,j}r_{m,\omega} + \beta_{4,j}r_{m,\omega+1} + \beta_{5,j}r_{m,\omega+2} + \varepsilon_{j,\omega}$, where $r_{j,\omega}$ is the return for firm j in week ω, $r_{m,\omega}$ is the value-weighted CRSP return in week ω. We define the firm's specific weekly return ($W_{j,\omega}$) as the natural log of 1 + $\varepsilon_{j,\omega}$.
$Crash\ Composite_{t+1}$	A composite crash measure based on a principal component analysis on *Crash*, *NSkewness*, and *LnDuVol*.
Variables of Interest	
$NonGaapFreq_t$	The number of quarters in fiscal year t where managers report non-GAAP earnings, divided by the four fiscal quarters. We identify a firm as reporting non-GAAP earnings if non-GAAP EPS from managers (Bentley et al., 2018) differ from GAAP EPS (i.e., total exclusions are not zero). We set total exclusions equal to zero if non-GAAP earnings is missing in Bentley et al. but actual EPS data is available in I/B/E/S.
$NonGaapFreq^{NG>G}{}_t$	The number of quarters with net income increasing total exclusions, resulting in non-GAAP EPS exceeding GAAP EPS, divided by the four fiscal quarters in fiscal year t.
$NonGaapFreq^{NG<G}{}_t$	The number of quarters with net income decreasing total exclusions, resulting in non-GAAP EPS being less than GAAP EPS, divided by the four fiscal quarters in fiscal year t.
Control Variables	
$NSkewness_{t+1}$	The negative skewness of W over fiscal year t.
$Size_t$	The natural log of the market value of equity at the end of fiscal year t.
MTB_t	The ratio of the market value of equity to the book value of equity at the end of fiscal year t.
$Leverage_t$	Company debt scaled by the book value of total assets at the end of fiscal year t. Company debt is the sum of long-term debt and debt in current liabilities.
ROA_{t+1}	Income before extraordinary items in fiscal year t+1 divided by the book value of asset at the end of fiscal year t.
$Return_t$	The mean of W over fiscal year t.
$Sigma_t$	The standard deviation of W over fiscal year t.
$ChgTurnover_t$	The average monthly share turnover over the fiscal year t minus the average monthly share turnover over the fiscal year t-1, where we calculate monthly share turnover as

	the monthly trading volume divided by the total number of shares outstanding during the month.
$Opaque_t$	The prior three years' moving sum of the absolute value of abnormal accruals (over years *t*-2 to *t*) (Hutton et al., 2009). We estimate abnormal accruals using the Modified Jones (1991) model.
$SqOpaque_t$	Squared term of $Opaque_t$.
$MissingNGData_t$	An indicator variable equal to one if the Bentley et al. (2018) dataset is missing non-GAAP earnings data for at least one quarter of our *NonGaapFreq* calculation in year *t*, while the actual EPS data is non-missing in I/B/E/S.
$Year_t$	Indicator variables for fiscal years.
Ind_j	Indicator variables for industry membership based on Fama and French 48 industries.
Other Variables	
$AbnAccruals_t$	Abnormal accruals based on the Modified Jones (1991) model in fiscal year *t*.
$MktSent_t$	The averaged value of investor sentiment index as defined by Baker and Wurgler (2006) over fiscal year *t*. We obtain the data, available during 2003-2015, from http://people.stern.nyu.edu/jwurgler/.
$FreqMBE_t$	Number of firm-quarters in fiscal year *t* where non-GAAP earnings allow the firm to meet or beat analysts' earnings forecasts, divided by the number of quarters with non-missing I/B/E/S GPS data in fiscal year *t*. We identify these meet-or-beat firm-quarters as observations where GAAP EPS < forecasted GAAP EPS (I/B/E/S *GPS*), but $0 \leq$ non-GAAP EPS - forecasted EPS (I/B/E/S *EPS*) ≤ 0.05.
$Delta_t$	The minimum level of Delta among the executives available in the Execucomp database in fiscal year *t*. Delta is the dollar increase in an executive's wealth for a 1% increase in stock price at the fiscal year end.
$OpptunSales_t$	The averaged dollar value of shares that are opportunistically sold by insiders over four quarters in fiscal year *t*. We define opportunistic sales following Cohen et al. (2012).
NGincrease	An indicator variable equal to one for firms whose frequency of income increasing recurring items before Regulation G is higher than the sample median. The frequency of income increasing recurring item exclusions is the number of fiscal quarters in year *t* where I/B/E/S EPS excludes income increasing recurring items, divided by the four quarters in fiscal year *t*. We identify recurring item exclusions by comparing total exclusions and non-recurring exclusions (i.e., the difference between operating income and GAAP earnings (Hsu and Kross, 2011)). *NGincrease* is equal to zero for firms that do not exclude income increasing recurring items from 2001-2004.
Post	An indicator variable equal to one for observations after the implementation of Regulation G (years 2003 and 2004), and zero otherwise (years 2001 and 2002).
Post -1	An indicator variable equal to one for observations in 2002 (one year prior to Regulation G), and zero otherwise.
$CrashWeek_{t+1}$	An indicator variable equal to one for a firm that experiences a crash in a given week during fiscal year *t*+1, and zero otherwise. A crash week is the week during which the firm experiences *W* that is 3.2 standard deviations below the mean firm-specific weekly return in fiscal year *t*+1.
$8K_{t+1}$	An indicator variable equal to one if there is an 8-K filing during a week in year *t*+1, and zero otherwise.
$8K\_Itemx_{t+1}$	An indicator variable equal to one if there is an 8-K filing during a week in year *t*+1 that contains item *x* (*x* = 1 to 8), and zero otherwise.
$NegTone^{8KItemx}{}_{t+1}$	An indicator variable equal to one if the negative tone of the 8-K filings with a certain item *x* (*x*=2, 4, 5, 7, or 8) in a week in year *t*+1 belongs to top quartile among 8-K filings with the same item issued by all firms in the same week, and zero otherwise. Negative tone is the difference between the number of negative words and positive

	words, scaled by the total number of words in an 8K filing. If there are multiple 8-K filings with a certain item in a week, we take the average value of tone across those filings. We obtain the list of words with negative tone and positive tone from Loughran-McDonald Sentiment Word Lists (https://sraf.nd.edu/textual-analysis/resources/).
BHR_q	The buy and hold return over the [−1, +1] window around the earnings announcement date, less the return from the value-weighted market index over that same period.
$FE_{NONGAAP\,q}$	Managerial non-GAAP earnings per share from Bentley et al. (2018) less the I/B/E/S quarter-ahead consensus EPS forecast immediately preceding the earnings announcement, scaled by price as of the prior fiscal quarter-end.
Future Operating Earnings	Operating earnings summed over quarters q+1 to q+4, divided by total assets in quarter q of year t.
Future Operating Cash Flows	Operating cash flows summed over quarters q+1 to q+4, divided by total assets in quarter q of year t.
Non-GAAP Earnings$_q$	Managerial non-GAAP EPS from Bentley et al. (2018) (or diluted GAAP EPS if non-GAAP EPS is missing from Bentley et al. 2018), multiplied by the number of diluted shares outstanding and scaled by total assets.
Exclusions$_q$	Exclusions per share multiplied by the number of diluted shares outstanding and divided by total assets, where exclusions per share is diluted GAAP EPS less non-GAAP EPS from Bentley et al. (2018), and zero if non-GAAP EPS is missing.
$StreetFreq^{NG>G}_t$	The number of quarters with net income increasing total exclusions, resulting in I/B/E/S Actual EPS exceeding GAAP EPS, divided by the four fiscal quarters in fiscal year t.
$StreetFreq^{NG<G}_t$	The number of quarters with net income decreasing total exclusions, resulting in I/B/E/S Actual EPS being less than GAAP EPS, divided by the four fiscal quarters in fiscal year t.

Appendix B

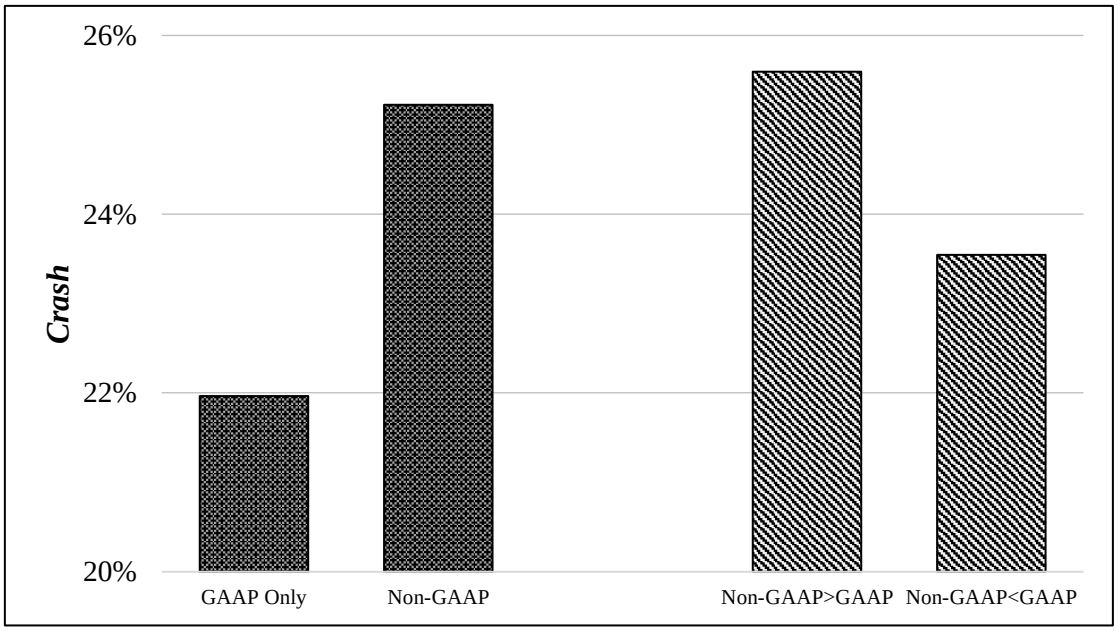
The effectiveness of PSM in difference-in-differences analysis

	Unmatched			Matched		
	NGincrease=1	*NGincrease*=0	Significantly Different?	*NGincrease*=1	*NGincrease*=0	Significantly Different?
$NSkewness_t$	0.056	0.086	No	0.057	0.062	No
$Size_t$	6.593	6.140	**	6.578	6.683	No
MTB_t	3.774	4.195	No	3.783	3.825	No
$Leverage_t$	0.185	0.153	No	0.185	0.201	No
ROA_t	-0.024	0.031	***	-0.020	-0.004	No
$Return_t$	0.002	0.003	No	0.002	0.002	No
$Sigma_t$	0.070	0.068	No	0.069	0.065	No
$ChgTurnover_t$	0.555	0.487	No	0.542	0.508	No
$Opaque_t$	0.124	0.142	No	0.120	0.110	No
$SqOpaque_t$	0.035	0.041	No	0.031	0.028	No

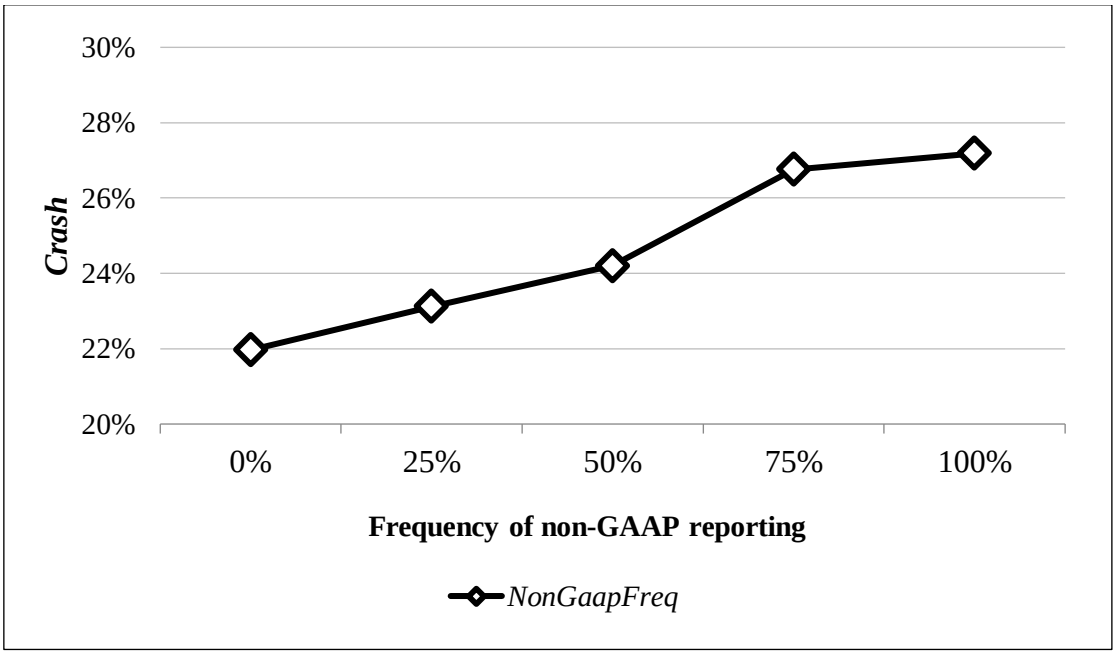
This table compares the mean values for variables in the *NGincrease* = 1 and *NGincrease* = 0 samples before and after propensity score matching (PSM). We use PSM to identify comparable firms across the two samples. We begin by using a Probit model to examine a firm's likelihood of having more frequent non-GAAP reporting with income increasing recurring items exclusions (i.e., our *NGincrease* firms) or not (i.e., our comparison firms) over years prior to Regulation G (i.e., 2001 and 2002). We use the control variables in Eq. 2 as the independent variables in the Probit model, with the exceptions being *Opaque* (*ROA*), which we re-measure using the absolute value of abnormal accruals (ROA) in year *t* (so that we do not have an opacity or ROA window that overlaps with the regulatory event), and *SqOpaque*, which is the squared term of the new version of *Opaque*. We use the predicted probabilities from the Probit model to create our propensity score. Next, we use this propensity score to match our *NGincrease* firms to a subsample of comparison firms via a 1-to-4 nearest neighbor (a caliper width of 0.03) propensity score matching with replacement. We allow for the repeated use of control observations to increase the size of the matched sample and hence the testing power. Other variable definitions are available in Appendix A. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Figure 1
Non-GAAP reporting and stock price crash

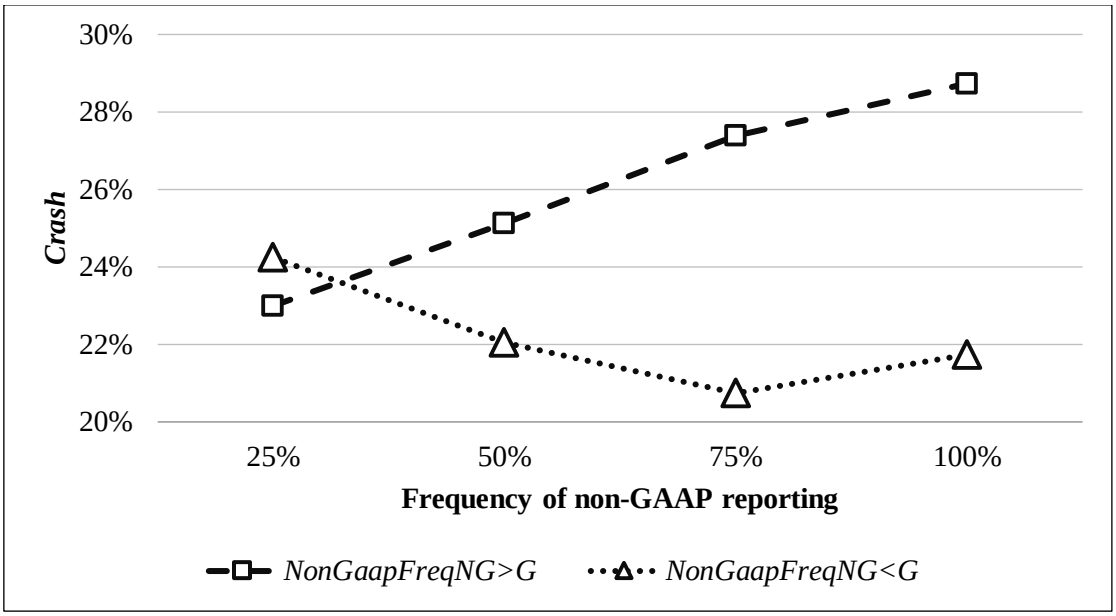
Panel A: Stock price crash and non-GAAP reporting



Panel B: Stock price crash conditional on total non-GAAP reporting frequency

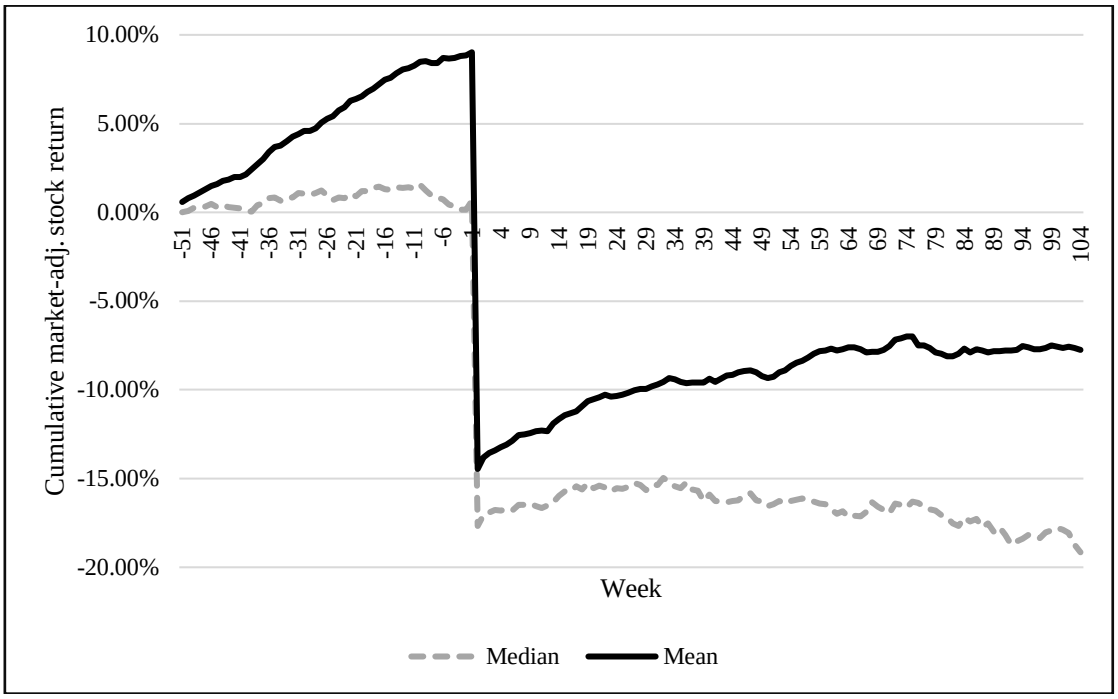


Panel C: Stock price crash conditional on non-GAAP reporting frequency by sign of exclusions



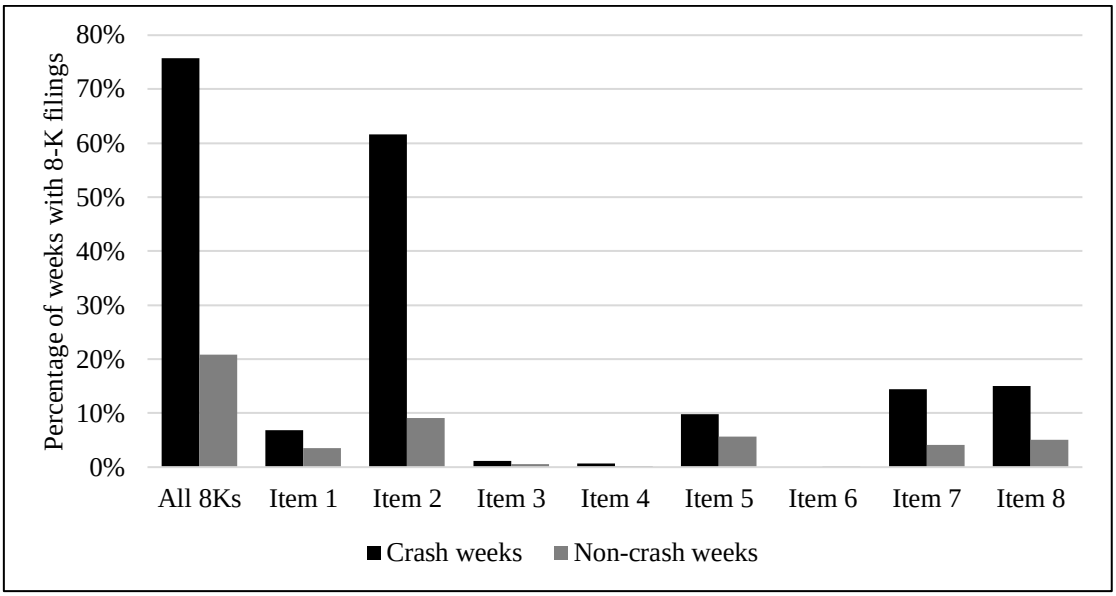
Panel A presents the likelihood of having a crash in year *t*+1 (*Crash*) conditional on non-GAAP reporting in any quarter of year *t*. "Non-GAAP" ("No non-GAAP") represents the cases of a firm reporting non-GAAP earnings in any quarter (not reporting non-GAAP earnings in any quarter) of fiscal year *t*. We identify a firm as reporting non-GAAP earnings if in any quarter non-GAAP EPS from managers (Bentley et al., 2018) differ from GAAP EPS. "Non-GAAP>GAAP" ("Non-GAAP<GAAP") represents the cases of a firm reporting non-GAAP EPS exceeding (being less than) GAAP EPS in any quarter in fiscal year *t*. Panels B and C present the likelihood of having a crash in year *t*+1 (*Crash*) conditional on non-GAAP reporting frequency in year *t*. Non-GAAP reporting frequency is measured as *NonGaapFreq* in Panel B and $NonGaapFreq^{NG>G}$ ($NonGaapFreq^{NG<G}$) in Panel C, respectively. Variable definitions are available in Appendix A.

Figure 2
Stock returns for non-GAAP reporting firms experiencing a crash



This figure presents the cumulative weekly market adjusted stock returns over 52 weeks before and 104 weeks after a crash week (week 0) for non-GAAP reporting firms. Crash weeks are defined as those weeks during which the firm experiences a firm-specific weekly return that is 3.2 standard deviations below the mean firm-specific weekly return in fiscal year *t*+1. Non-GAAP firms are firms that report non-GAAP earnings during fiscal year *t*.

Figure 3
The presence of 8-K filings: crash versus non-crash weeks



This figure reports the percentage of weeks with 8-K filings or 8-K filings with a certain item number. Crash weeks are defined as those weeks during which the firm experiences a firm-specific weekly return that is 3.2 standard deviations below the mean firm-specific weekly return in fiscal year *t*+1. Item 1 is for "Registrant's Business and Operations"; Item 2 is for "Financial Information"; Item 3 is for "Securities and Trading Markets"; Item 4 is for "Matters Related to Accountants and Financial Statements"; Item 5 is for "Corporate Governance and Management"; Item 6 is for "Asset-Backed Securities"; Item 7 is for "Regulation FD Events"; and Item 8 is "Other Events."

Table 1
Descriptive statistics (N = 30,419)

	Mean	Std. Dev.	Q1	Median	Q3
Dependent Variables					
$Crash_{t+1}$	0.234	0.424	0.000	0.000	0.000
$NSkewness_{t+1}$	-0.049	1.034	-0.579	-0.101	0.414
$LnDuVol_{t+1}$	-0.046	0.423	-0.316	-0.061	0.207
$Crash\ Composite_{t+1}$	0.000	1.000	-0.621	-0.192	0.461
Variables of Interest					
$NonGaapFreq_t$	0.275	0.364	0.000	0.000	0.500
$NonGaapFreq^{NG>G}{}_t$	0.225	0.332	0.000	0.000	0.500
$NonGaapFreq^{NG<G}{}_t$	0.050	0.138	0.000	0.000	0.000
Control Variables					
$NSkewness_t$	-0.052	0.922	-0.570	-0.111	0.385
$Size_t$	6.745	1.857	5.446	6.659	7.942
MTB_t	3.201	3.723	1.327	2.089	3.551
$Leverage_t$	0.181	0.175	0.018	0.143	0.287
ROA_{t+1}	0.006	0.152	0.000	0.033	0.075
$Return_t$	-0.001	0.007	-0.005	-0.001	0.002
$Sigma_t$	0.052	0.027	0.032	0.046	0.064
$ChgTurnover_t$	0.035	1.107	-0.307	0.010	0.347
$Opaque_t$	0.376	0.370	0.122	0.270	0.497
$SqOpaque_t$	0.279	0.593	0.015	0.073	0.247
$MissingNGData_t$	0.458	0.498	0.000	0.000	1.000

This table reports summary statistics for variables used in our primary analyses. Variable definitions are available in Appendix A.

Table 2
Non-GAAP earnings and stock price crash risk

	Dependent Variables			
	(1)	(2)	(3)	(4)
	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	$Crash\ Composite_{t+1}$
$NonGaapFreq_t$	0.127***	0.040**	0.017**	0.048***
	(0.004)	(0.035)	(0.030)	(0.009)
$NSkewness_t$	0.089***	0.052***	0.023***	0.053***
	(0.000)	(0.000)	(0.000)	(0.000)
$Size_t$	0.024**	0.030***	0.013***	0.026***
	(0.017)	(0.000)	(0.000)	(0.000)
MTB_t	0.004	0.003*	0.001*	0.003*
	(0.297)	(0.091)	(0.086)	(0.094)
$Leverage_t$	-0.075	-0.065	-0.033**	-0.064
	(0.422)	(0.108)	(0.046)	(0.102)
ROA_{t+1}	-0.530***	-0.398***	-0.151***	-0.363***
	(0.000)	(0.000)	(0.000)	(0.000)
$Return_t$	13.350***	13.232***	6.162***	12.331***
	(0.000)	(0.000)	(0.000)	(0.000)
$Sigma_t$	0.528	-1.050***	-0.567***	-0.819***
	(0.484)	(0.001)	(0.000)	(0.008)
$ChgTurnover_t$	0.027**	0.019***	0.007***	0.017***
	(0.029)	(0.002)	(0.003)	(0.002)
$Opaque_t$	0.261**	0.109*	0.036	0.111**
	(0.040)	(0.061)	(0.128)	(0.046)
$SqOpaque_t$	-0.088	-0.044	-0.009	-0.037
	(0.210)	(0.197)	(0.501)	(0.245)
$MissingNGData_t$	0.011	-0.012	-0.009*	-0.012
	(0.707)	(0.307)	(0.058)	(0.326)
Industry and Year FE	Included	Included	Included	Included
N	30,419	30,419	30,419	30,419
R^2	0.023	0.027	0.032	0.030

This table reports the relation between non-GAAP reporting frequency and stock price crash risk. Variable definitions are available in Appendix A. Constant terms, industry-, and year-fixed effects are included but not reported. We report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Table 3
Sign of non-GAAP exclusions and stock price crash risk

	Dependent Variables			
	(1)	(2)	(3)	(4)
	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	$Crash\ Composite_{t+1}$
$NonGaapFreq^{NG>G}_t$	0.168***	0.066***	0.028***	0.075***
	(0.000)	(0.002)	(0.001)	(0.000)
$NonGaapFreq^{NG<G}_t$	-0.098	-0.093**	-0.041**	-0.087**
	(0.370)	(0.037)	(0.025)	(0.047)
$NSkewness_t$	0.088***	0.051***	0.023***	0.052***
	(0.000)	(0.000)	(0.000)	(0.000)
$Size_t$	0.024**	0.030***	0.013***	0.026***
	(0.018)	(0.000)	(0.000)	(0.000)
MTB_t	0.004	0.003*	0.001*	0.003*
	(0.306)	(0.096)	(0.091)	(0.099)
$Leverage_t$	-0.078	-0.066*	-0.033**	-0.066*
	(0.405)	(0.100)	(0.042)	(0.094)
ROA_{t+1}	-0.530***	-0.398***	-0.151***	-0.363***
	(0.000)	(0.000)	(0.000)	(0.000)
$Return_t$	13.466***	13.306***	6.193***	12.405***
	(0.000)	(0.000)	(0.000)	(0.000)
$Sigma_t$	0.495	-1.068***	-0.575***	-0.837***
	(0.511)	(0.001)	(0.000)	(0.007)
$ChgTurnover_t$	0.027**	0.019***	0.007***	0.017***
	(0.028)	(0.001)	(0.003)	(0.002)
$Opaque_t$	0.258**	0.107*	0.035	0.110**
	(0.043)	(0.065)	(0.135)	(0.050)
$SqOpaque_t$	-0.086	-0.042	-0.008	-0.036
	(0.222)	(0.210)	(0.525)	(0.261)
$MissingNGData_t$	0.011	-0.012	-0.009*	-0.012
	(0.701)	(0.310)	(0.059)	(0.329)
Industry and Year FE	Included	Included	Included	Included
N	30,419	30,419	30,419	30,419
R^2	0.023	0.027	0.032	0.030
F-tests (Prob>Chi-squared):				
$NonGaapFreq^{NG>G} > NonGaapFreq^{NG<G}$				
	(0.01)	(<0.01)	(<0.01)	(<0.01)

This table reports the relation between non-GAAP reporting frequency and stock price crash risk conditional on the sign of net total exclusions. Variable definitions are available in Appendix A. Constant terms, industry-, and year-fixed effects are included but not reported. We report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. The *F*-test *p*-values are based on one-tailed levels of significance because of our directional prediction regarding the tests.

Table 4

GAAP earnings management, non-GAAP reporting, and crash risk

Panel A: Opaque reporting

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$		$NSkewness_{t+1}$		$LnDuVol_{t+1}$		$Crash\ Composite_{t+1}$	
Partition Var. = $Opaque_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}{}_t$	0.078	0.253***	0.030	0.095***	0.013	0.038***	0.035	0.105***
	(0.213)	(0.001)	(0.320)	(0.001)	(0.263)	(0.002)	(0.224)	(0.000)
Other variables	Included		Included		Included		Included	
N	15,209	15,210	15,209	15,210	15,209	15,210	15,209	15,210
R^2	0.020	0.030	0.025	0.038	0.032	0.041	0.028	0.039
Tests of Diff. between High and Low=0:								
$NonGaapFreq^{NG>G}{}_t$ (p-value)	(0.02)		(0.08)		(0.02)		(0.06)	

Panel B: Abnormal accruals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$		$NSkewness_{t+1}$		$LnDuVol_{t+1}$		$Crash\ Composite_{t+1}$	
Partition Var. = $AbnAccruals_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}{}_t$	0.145**	0.198***	0.024	0.119***	0.010	0.049***	0.040	0.117***
	(0.024)	(0.005)	(0.414)	(0.000)	(0.404)	(0.000)	(0.168)	(0.000)
Other variables	Included		Included		Included		Included	
N	15,209	15,210	15,209	15,210	15,209	15,210	15,209	15,210
R^2	0.020	0.028	0.022	0.040	0.027	0.045	0.025	0.041
Tests of Diff. between High and Low=0:								
$NonGaapFreq^{NG>G}{}_t$ (p-value)	(0.28)		(0.04)		(0.02)		(0.02)	

This table reports the relation between non-GAAP reporting frequency and stock price crash risk conditional on the level of earnings management. Variable definitions are available in Appendix A. Other variables in Eq. 2 are included but not reported. We report p-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. We compare the coefficient of $NonGaapFreq^{NG>G}$ between high and low groups using Fisher's Permutation test with bootstrapping.

Table 5

Managerial incentives, non-GAAP reporting, and crash risk

Panel A: Market sentiment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$		$NSkewness_{t+1}$		$LnDuVol_{t+1}$		$Crash\ Composite_{t+1}$	
Partition Var. = $MktSent_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}{}_t$	0.222***	0.092	0.112***	0.030	0.045***	0.014	0.115***	0.037
	(0.002)	(0.166)	(0.000)	(0.305)	(0.000)	(0.245)	(0.000)	(0.192)
Other variables	Included		Included		Included		Included	
N	13,589	14,955	13,589	14,955	13,589	14,955	13,589	14,955
R^2	0.023	0.028	0.033	0.028	0.038	0.032	0.035	0.031
Tests of Diff. between High and Low>0: $NonGaapFreq^{NG>G}{}_t$ (p-value)	(0.02)		(0.02)		(0.02)		(0.03)	

Panel B: Non-GAAP to meet-or-beat earnings forecasts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$		$NSkewness_{t+1}$		$LnDuVol_{t+1}$		$Crash\ Composite_{t+1}$	
Partition Var. = $FreqMBE_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}{}_t$	0.194**	0.148***	0.115***	0.041	0.046***	0.021**	0.114***	0.056**
	(0.014)	(0.007)	(0.002)	(0.104)	(0.002)	(0.037)	(0.001)	(0.021)
Other variables	Included		Included		Included		Included	
N	21,156	25,070	21,156	25,070	21,156	25,070	21,156	25,070
R^2	0.022	0.023	0.029	0.027	0.034	0.032	0.030	0.029
Tests of Diff. between High and Low>0: $NonGaapFreq^{NG>G}{}_t$ (p-value)	(0.28)		(0.04)		(<0.01)		(0.06)	

Table 5 (Cont'd)

Panel C: Sensitivity of compensation to share price								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Partition Var. = $Delta_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}_t$	0.158**	0.025	0.091***	0.007	0.044***	0.004	0.097***	0.009
	(0.042)	(0.765)	(0.008)	(0.854)	(0.001)	(0.815)	(0.004)	(0.793)
Other variables	Included		Included		Included		Included	
N	9,180	9,181	9,180	9,181	9,180	9,181	9,180	9,181
R^2	0.031	0.026	0.026	0.037	0.032	0.042	0.031	0.037
Tests of Diff. between High and Low>0:								
$NonGaapFreq^{NG>G}_t$ (p-value)	(0.05)		(<0.01)		(0.01)		(0.01)	

Panel D: Opportunistic insider sales								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$		$NSkewness_{t+1}$		$LnDuVol_{t+1}$		$Crash\ Composite_{t+1}$	
Partition Var. = $OpptunSales_t$	High	Low	High	Low	High	Low	High	Low
$NonGaapFreq^{NG>G}_t$	0.195***	0.119*	0.084***	0.036	0.037***	0.013	0.093***	0.043
	(0.004)	(0.075)	(0.005)	(0.235)	(0.002)	(0.276)	(0.001)	(0.143)
Other variables	Included		Included		Included		Included	
N	12,754	17,665	12,754	17,665	12,754	17,665	12,754	17,665
R^2	0.029	0.025	0.028	0.032	0.034	0.037	0.032	0.034
Tests of Diff. between High and Low>0:								
$NonGaapFreq^{NG>G}_t$ (p-value)	(0.09)		(0.03)		(0.02)		(0.06)	

This table reports the relation between non-GAAP reporting frequency and stock price crash risk conditional on the level of market sentiment (Panel A), frequency of using non-GAAP reporting to meet or beat analyst earnings forecasts (Panel B), sensitivity of executive compensation to share price (Panel C), and opportunistic insider sales (Panel D). Variable definitions are available in Appendix A. Other variables in Eq. 2 are included but not reported. We report p-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. We compare the coefficient of $NonGaapFreq^{NG>G}$ between high and low groups using Fisher's Permutation test with bootstrapping, where p-values are based on one-tailed levels of significance because of our directional prediction regarding the tests. The samples in Panels A–C are smaller than our full sample because the partition variables are not available for all observations. In addition, we add the observations with a zero value for $NonGaapFreq^{NG>G}$ into both high and low groups in Panel B. Therefore, the sum of the sample sizes in the high and low groups in Panel B is bigger than the size of the full sample.

Table 6
Difference-in-differences design around Regulation G using I/B/E/S data

	Dependent Variables							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	*Crash Composite*$_{t+1}$	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	*Crash Composite*$_{t+1}$
NGincrease	0.732***	0.188**	0.078**	0.221***	0.925**	0.143	0.059	0.200*
	(0.007)	(0.017)	(0.019)	(0.006)	(0.014)	(0.177)	(0.200)	(0.057)
Post × *NGincrease*	-0.982***	-0.269**	-0.112**	-0.317**	-1.175***	-0.225*	-0.093	-0.297**
	(0.008)	(0.025)	(0.029)	(0.011)	(0.008)	(0.098)	(0.103)	(0.030)
Post -1 × *NGincrease*					-0.362	0.089	0.038	0.040
					(0.488)	(0.572)	(0.584)	(0.796)
Other variables	Included	Included	Included	Included	Included	Included	Included	Included
N	2,617	2,617	2,617	2,617	2,617	2,617	2,617	2,617
R^2	0.109	0.113	0.116	0.106	0.109	0.113	0.116	0.106

This table reports the relation between non-GAAP reporting and stock price crash risk using a difference-in-differences research design around Regulation G. We use a propensity score matching (PSM) procedure in our analysis. We describe our PSM procedure and report its effectiveness in Appendix B. Variable definitions are available in Appendix A. Constant terms, industry- and year-fixed effects, and variables identified in Appendix B are included but not reported. We report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Table 7
Potential triggers of crashes

Panel A: Stock price crash weeks and the presence of concurrent 8-K filings

	(1)	(2)
Variables	$CrashWeek_{t+1}$	$CrashWeek_{t+1}$
$8K_{t+1}$	2.493***	
	(0.000)	
$8K\_Item1_{t+1}$ – *(Registrant's Business)*		-0.512***
		(0.000)
$8K\_Item2_{t+1}$ – *(Financial Information)*		2.691***
		(0.000)
$8K\_Item3_{t+1}$ – *(Securities and Trading)*		-0.090
		(0.423)
$8K\_Item4_{t+1}$ – *(Acct. and Financial Stmts)*		0.500***
		(0.001)
$8K\_Item5_{t+1}$ – *(Corporate Governance)*		0.160***
		(0.000)
$8K\_Item7_{t+1}$ – *(Regulation FD)*		0.443***
		(0.000)
$8K\_Item8_{t+1}$ – *(Other Events)*		0.651***
		(0.000)
Other variables	Included	Included
N	1,576,972	1,576,957
R^2	0.116	0.145

Table 7 (Cont'd)

Panel B: Stock price crash weeks and the disclosure of negative news in concurrent 8-K filings

	(1)	(2)	(3)	(4)	(5)
Sample	Weeks with Item 2 in 8-K Filings	Weeks with Item 4 in 8-K Filings	Weeks with Item 5 in 8-K Filings	Weeks with Item 7 in 8-K Filings	Weeks with Item 8 in 8-K Filings
Variables	$CrashWeek_{t+1}$	$CrashWeek_{t+1}$	$CrashWeek_{t+1}$	$CrashWeek_{t+1}$	$CrashWeek_{t+1}$
$NegTone^{8KItem2}{}_{t+1}$	0.104**				
	(0.014)				
$NegTone^{8KItem4}{}_{t+1}$		0.829**			
		(0.017)			
$NegTone^{8KItem5}{}_{t+1}$			0.371***		
			(0.000)		
$NegTone^{8KItem7}{}_{t+1}$				0.297***	
				(0.000)	
$NegTone^{8KItem8}{}_{t+1}$					0.203**
					(0.014)
Other variables	Included	Included	Included	Included	Included
N	109,639	2,637	61,337	47,212	58,894
R^2	0.026	0.069	0.023	0.033	0.027

Panel C: Non-GAAP reporting and the disclosure of negative news in subsequent 8-K filings

	(1)	(2)	(3)	(4)	(5)
Sample	Weeks with Item 2 in 8-K Filings	Weeks with Item 4 in 8-K Filings	Weeks with Item 5 in 8-K Filings	Weeks with Item 7 in 8-K Filings	Weeks with Item 8 in 8-K Filings
Variables	$NegTone^{8KItem2}{}_{t+1}$	$NegTone^{8KItem4}{}_{t+1}$	$NegTone^{8KItem5}{}_{t+1}$	$NegTone^{8KItem7}{}_{t+1}$	$NegTone^{8KItem8}{}_{t+1}$
$NonGaapFreq^{NG>G}{}_t$	0.285***	-0.161	0.129***	0.123	0.118*
	(0.000)	(0.461)	(0.002)	(0.177)	(0.053)
$NonGaapFreq^{NG<G}{}_t$	0.102	0.698	0.126	0.112	-0.007
	(0.394)	(0.144)	(0.178)	(0.470)	(0.946)
Other variables	Included	Included	Included	Included	Included
N	109,639	2,637	61,337	47,212	58,894
R^2	0.036	0.052	0.008	0.023	0.022

This table reports evidence related to the possible triggers of crashes. Panel A reports the relation between stock price crash weeks and the presence of concurrent 8-K filings, in general or by the type of items in 8-K filings. Panel B reports the relation between stock price crash weeks and the discussion of a certain item in concurrent 8-K filings with high negative tone. Panel C reports the relation between non-GAAP reporting frequency and the discussion of a certain item in subsequent 8-K filings with high negative tone. Item 1 is for "Registrant's Business and Operations"; Item 2 is for "Financial Information"; Item 3 is for "Securities and Trading Markets"; Item 4 is for "Matters Related to Accountants and Financial Statements"; Item 5 is for "Corporate Governance and Management"; Item 6 is for "Asset-Backed Securities"; Item 7 is for "Regulation FD Events"; and Item 8 is "Other Events." Variable definitions are available in Appendix A. Constant terms, industry- and year-fixed effects, and controls are included but not reported. Control variables are the same as in Eq. 2 except that we exclude ROA_{t+1} (ROA at the end of year t+1) from the regressions because including this variable may lead to a potential look-ahead bias in a firm-week level analysis. *8-K_Item6* is included in the sample of Panel A but dropped from the tabulated results due to the fact that this item number does not have both crash and non-crash week observations. We report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Table 8
Non-GAAP reporting, investor reactions, and non-GAAP earnings persistence

Panel A: Investor reactions to non-GAAP earnings surprises by non-GAAP reporting frequency

	(1)
	BHR_q
$FreqNonGAAP^{NG>G}_t$	-0.004***
	(0.005)
$FE_{NONGAAP\ q}$	2.616***
	(0.000)
$\boldsymbol{FreqNonGAAP^{NG>G}_t \times FE_{NONGAAP\ q}}$	**0.707*** **
	(0.013)
N	27,656
R^2	0.056

Panel B: Persistence of non-GAAP earnings by non-GAAP reporting frequency

	(1)	(2)
	Future Operating Earnings	*Future Operating Cash Flows*
$FreqNonGAAP^{NG>G}_t$	0.001	0.006*
	(0.737)	(0.086)
Non-GAAP Earnings$_q$	2.296***	2.084***
	(0.000)	(0.000)
$\boldsymbol{FreqNonGAAP^{NG>G}_t \times}$ ***Non-GAAP Earnings***$_q$	**-0.605*** **	**-0.303** **
	(0.000)	**(0.037)**
Exclusions$_q$	0.085	-0.106
	(0.521)	(0.450)
$\boldsymbol{FreqNonGAAP^{NG>G}_t \times}$ ***Exclusions***$_q$	**1.050*** **	**0.444** **
	(0.000)	**(0.036)**
Control variables	Yes	Yes
N	29,878	29,878
R^2	0.562	0.432

Panel A reports the results of regressing market-adjusted earnings announcement returns (*BHR*) on non-GAAP earnings surprises ($FE_{NONGAAP}$) conditional on the frequency of income increasing non-GAAP reporting ($FreqNonGAAP^{NG>G}$). Following Bradshaw et al. (2018), we (1) require stock price in the prior quarter to be at least $1 per share; (2) truncate the sample based on the 1st and 99th percentile of the continuous variables used; and (3) report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the earnings announcement date. Panel B presents tests that examine the persistence of non-GAAP earnings conditional on the frequency of income increasing non-GAAP reporting and using a sample of observations in the fourth fiscal quarters to overlap the future period with the timing of our crash variable. We winsorize the firm-quarter sample based on the 1st and 99th percentile of the variables (i.e., *Future Operating Earnings*, *Future Operating Cash Flows*, *Non-GAAP Earnings*, and *Exclusions*). Variables are defined in Appendix A. We include but do not report the intercept and control variables in Eq. 2 except that we exclude ROA_{t+1} (ROA at the end of year t+1) from the regressions. *p*-values in parentheses of Panel B are based on standard errors clustered by firm. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Table 9
Other robustness tests

Panel A: Non-missing managerial non-GAAP data for all four quarters

	Dependent Variables			
	(1)	(2)	(3)	(4)
	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	$Crash\ Composite_{t+1}$
$NonGaapFreq^{NG>G}{}_t$	0.130**	0.046*	0.021**	0.055**
	(0.022)	(0.070)	(0.044)	(0.026)
$NonGaapFreq^{NG<G}{}_t$	-0.178	-0.160***	-0.067***	-0.146***
	(0.207)	(0.005)	(0.004)	(0.010)
Other variables	Included	Included	Included	Included
N	16,497	16,497	16,497	16,497
R^2	0.029	0.029	0.035	0.033
F-tests (Prob>Chi-squared):				
$NonGaapFreq^{NG>G} > NonGaapFreq^{NG<G}$				
	(<0.01)	(<0.01)	(<0.01)	(<0.01)

Panel B: I/B/E/S data

	Dependent Variables			
	(1)	(2)	(3)	(4)
	$Crash_{t+1}$	$NSkewness_{t+1}$	$LnDuVol_{t+1}$	$Crash\ Composite_{t+1}$
$StreetFreq^{NG>G}{}_t$	0.169***	0.059***	0.026***	0.070***
	(0.000)	(0.001)	(0.000)	(0.000)
$StreetFreq^{NG<G}{}_t$	-0.034	-0.038	-0.012	-0.031
	(0.638)	(0.173)	(0.294)	(0.265)
Other variables	Included	Included	Included	Included
N	30,419	30,419	30,419	30,419
R^2	0.023	0.027	0.032	0.030
F-tests (Prob>Chi-squared):				
$StreetFreq^{NG>G} > StreetFreq^{NG<G}$				
	(<0.01)	(<0.01)	(<0.01)	(<0.01)

This table reports the relation between non-GAAP reporting frequency and stock price crash risk requiring non-missing managerial non-GAAP data for all quarters in a year in Panel A or using I/B/E/S data from 2003-2016 to identify non-GAAP reporting in Panel B. Variable definitions are available in Appendix A except that we replace non-GAAP EPS from managers with I/B/E/S Actual EPS to define $StreetFreq^{NG>G}{}_t$ and $StreetFreq^{NG<G}{}_t$. Constant terms, industry- and year-fixed effects, and controls in Eq. 2 are included but not reported. We report *p*-values in parentheses based on standard errors robust to heteroscedasticity and clustering at the firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. The *F*-test *p*-values are based on one-tailed levels of significance because of our directional prediction regarding the tests.