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Examining the impact of accounting information–based downside risk on future stock price crash risk

Reyhane Mohamadi, Rahman Saeedi*, Mohsen Dastgir

Department of Accounting, Isf, Islamic Azad University, Esfahan, Iran

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Abstract

Investors tend to be more reluctant to purchase stocks that have historically experienced sharp price declines. Consequently, firms must understand the determinants of stock price crash risk in order to prevent crash events when making investment decisions, managing risks, and protecting shareholder wealth. One of the key factors influencing future stock price crash risk is accounting information–based downside risk, which is measured through earnings-based downside risk, accruals-based downside risk, and operating cash flow–based downside risk. Accordingly, this study investigates the effect of accounting information–based downside risk on future stock price crash risk. The statistical population of the study consists of firms listed on the Tehran Stock Exchange, and the sample includes data from 105 firms over 11-years period from 2014 to 2024. A systematic elimination sampling method was employed. The research model was estimated using multivariate regression analysis based on panel data. The findings indicate that earnings-based downside risk, accruals-based downside risk, and operating cash flow–based downside risk, as measures of accounting information–based downside risk, have a statistically significant effect on future stock price crash risk.

Keywords: Earnings-based downside risk, Accruals-based downside risk, Operating cash flow–based downside risk, Future stock price crash risk
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1 Introduction

The risk of stock price crashes and sharp declines, along with diverse viewpoints surrounding unexpected stock price volatility, has attracted considerable attention from capital market stakeholders in recent years. Such volatility typically manifests in two forms: stock price surges and stock price crashes. Nevertheless, investors tend to focus more on stock price crashes than on price surges, as crash events lead to a reduction in stock returns and, consequently, to investor losses. For this reason, stock price crash risk has received greater attention from researchers compared with stock price jumps [43].

Since stock price crashes result in losses for shareholders and investors and may also trigger a broader downturn in the capital market, identifying and examining the factors influencing this phenomenon is of critical importance [14]. One of the major challenges faced by capital markets following stock price crashes is the emergence of pessimism and uncertainty among investors regarding equity investments. Such loss of confidence ultimately leads to capital outflows

*Corresponding author
Email addresses: Reyhaneh.Mohammadi6118@iau.ac.ir (Reyhane Mohamadi), r.saeedi@khuisf.ac.ir (Rahman Saeedi), dastmw@iau.ac.ir (Mohsen Dastgir)

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from the stock exchange. Therefore, identifying, preventing, and developing models capable of predicting stock price crash events are of substantial importance for capital market regulators and policymakers [1]. Investors generally seek to invest in projects, initiatives, and markets that allow them to achieve their expected returns with a high degree of confidence. When markets are characterized by uncertainty, investors must first assess the level of risk before making investment and stock purchase decisions. One of the main challenges in investment evaluation is investors' tendency to focus excessively on stock returns while neglecting risk optimization approaches, such as return maximization and loss minimization strategies [4].

The determinants of stock price crash risk are multifaceted. However, a fundamental assumption in the literature is that managers exercise discretion in withholding or delaying the disclosure of bad news, which accumulates over time and, once released collectively, exerts a substantial negative impact on stock prices, ultimately leading to stock price crashes. It is assumed that several firm-level factors influence stock price crash risk. Among these factors is accounting information–based downside risk, which is measured through earnings-based downside risk, accruals-based downside risk, and operating cash flow–based downside risk [41]. Accordingly, understanding the effect of these factors on future stock price crash risk is of great importance to investors and shareholders. Therefore, the primary objective of this study is to examine the impact of accounting information–based downside risk on future stock price crash risk.

2 Theoretical Framework and Literature Review

Given the globalization of markets and the emergence of unforeseen investment opportunities, investors require timely and reliable information to support their decision-making processes. Today, the association between financial opacity, managerial concealment, insufficient disclosure, and stock price crashes is well established. A key element underlying stock price crash events is the existence and accumulation of bad news regarding a firm's fundamental value and the subsequent release of such information to the stock market [19]. The issue of sudden stock price changes has attracted considerable attention from academics and market professionals alike. These price movements occur in two forms: stock price crashes and stock price jumps. Given the importance investors attach to stock returns, the phenomenon of stock price crashes—which leads to severe declines in returns—has received greater scholarly attention than stock price surges [36].

The motivation for studying stock price crash risk lies in its critical role in determining expected stock returns, return volatility, and the choice of appropriate asset pricing models [9]. When managers succeed in withholding bad news for extended periods, negative information accumulates within the firm, causing stock prices to become artificially inflated on the downside. Once the accumulated negative information reaches a critical threshold, the likelihood of its transmission to outside investors increases. The sudden disclosure of such information leads to a substantial decline in stock prices, which can be described as a stock price crash [27]. Accordingly, such opportunistic managerial behavior prolongs investors' misperceptions regarding the firm's true economic fundamentals [21, 26]. Maintaining this distortion is inherently unsustainable in the long run, and when the volume of negative information becomes excessively large, managers are more likely to capitulate. At that point, the accumulated bad news is released abruptly into the market, triggering a stock price crash [2]. Accounting information–based downside risk is among the factors capable of influencing future stock price crash risk [41]. Prior studies indicate that investors place greater emphasis on downside losses than on upside profit potential and are therefore more sensitive to losses than to gains [18, 25]. Consistent with this view, Koonce et al. [30] demonstrate that economic factors influence the evaluation of negative and positive expectations differently in risk management, with greater emphasis placed on potential loss outcomes. However, earnings volatility and other existing accounting-based downside risk measures are typically constructed from both downside and upside variations with equal weights. Consequently, relatively limited research has explicitly examined accounting information–based downside risk [41].

Konchitchki et al. [29] were the first to develop accounting-based downside risk measures and to examine their pricing implications in U.S. capital markets. These measures of accounting information–based downside risk focus on downside variability—specifically, performance realizations falling below expected levels—in firm performance metrics, most notably return on assets. Conceptually, accounting information–based downside risk is similar to stock price crash risk; however, the two constructs are derived from different data sources. While stock price crash risk is measured using stock return data, accounting information–based downside risk is constructed from financial statement information. Accounting information–based downside risk may predict future stock price crash risk through two potential channels. First, because accounting information–based downside risk is derived from publicly disclosed financial information, it conveys precise negative information about declines in expected future cash flows and reduces opinion heterogeneity in the long run [6]. This process helps constrain potential ex ante overpricing and, consequently, reduces future stock price crash risk. Second, higher accounting information–based downside risk indicates that corporate managers have

disclosed negative information. A substantial body of prior research demonstrates that managerial hoarding of bad news is a key driver of stock price crash risk [24, 26, 28]. If higher accounting information–based downside risk is associated with a reduction in managerial bad news hoarding, a lower likelihood of stock price crashes is expected [41].

In examining the relationship between accounting information–based downside risk and stock price crash risk, Wei et al. [41] focus on downside risk in accounting earnings as well as its underlying components. According to Dechow [11] and Dechow et al. [12], earnings consist of two components: accruals and operating cash flows. By analogy, downside earnings risk can be decomposed into accrual-based downside risk and operating cash flow–based downside risk. Operating cash flows are less subject to managerial manipulation and are therefore considered more reliable by some investors than accruals. However, operating cash flows differ from accruals in that they do not capture revenues earned or expenses incurred but not yet settled in cash. As a result, operating cash flows may be relatively less informative than accruals in reflecting a firm's operating conditions. Given the distinct nature of accruals and operating cash flows, these components are expected to portray a firm's underlying risk from different perspectives. Accordingly, it can be expected that earnings-based downside risk and its two components—accrual-based downside risk and operating cash flow–based downside risk—have significant implications for future stock price crash risk [41].

Shami et al. [38] investigate the effect of financial distress risk on stock price crash risk, with particular emphasis on business strategy. Their findings indicate a statistically significant effect of Altman's financial distress risk measure on the negative skewness of stock returns, which serves as a proxy for stock price crash risk. The results also reveal the moderating role of business strategy in the relationship between Altman's financial distress risk and the negative skewness of stock returns associated with crash risk. Shaker Taheri and Khodaveisi [37] examine the impact of economic uncertainty on liquidity risk and stock price crash risk in banks listed on the Tehran Stock Exchange. Their findings demonstrate that economic uncertainty has a positive and statistically significant effect on both liquidity risk and stock price crash risk.

Pahlavan et al. [35] explore the mediating role of earnings predictability and earnings comparability in the effect of the governance dimension of sustainability performance reporting on stock price crash risk and stock liquidity. The results show that the governance component of sustainability performance reporting enhances earnings comparability, increases stock liquidity, and reduces future stock price crash risk. Additional findings indicate that earnings comparability plays a mediating role in the relationship between governance-oriented sustainability reporting and both future stock price crash risk and stock liquidity. In contrast, earnings forecast accuracy does not have a statistically significant effect on future stock price crash risk or stock liquidity.

Ghasemi et al. [15] examine the role of accounting information quality and audit risk in the relationship between social trust and stock price crash risk in banks. Their results reveal a negative and statistically significant relationship between social trust and stock price crash risk, as well as a negative and statistically significant relationship between accounting information quality and stock price crash risk. Conversely, audit information risk is found to be positively and significantly associated with stock price crash risk. Moreover, accounting information quality does not moderate the relationship between social trust and stock price crash risk, nor does audit information risk serve as a moderating variable in this relationship.

Bahri Sales and Ebrati [5] investigate firm-specific characteristics affecting stock price crash risk. The findings indicate that growth opportunities, firm size, and firm performance have a negative and statistically significant effect on stock price crash risk, whereas agency costs exhibit a positive and statistically significant effect. In contrast, stock price crash risk is found to be independent of overall firm risk. Goudarzi Farahani et al. [17] examine stock price crash risk and its determinants among firms listed on the Tehran Stock Exchange. Their results show a positive and statistically significant relationship between stock price volatility and both stock price crash risk and future stock returns. Additionally, the number and volume of trades are positively and significantly related to stock price crash risk.

Taheri and Hadadi [39] analyze the effect of free cash flows on stock price crash risk, emphasizing the moderating role of earnings management in firms listed on the Tehran Stock Exchange. The findings indicate that free cash flows have a positive and statistically significant effect on firms' stock price crash risk, while income smoothing negatively and significantly moderates this relationship. Finally, Imani et al. [22] investigate the impact of liquidity and political risks on stock price crash risk in banks listed on the Tehran Stock Exchange. The results show that both liquidity risk and political risk have a positive and statistically significant effect on stock price crash risk in these banks.

Jabarzadeh Kangar Louei et al. [23] examine the relationship among accounting information disclosure, stock price synchronicity, and stock price crash risk, with an emphasis on corporate governance quality. The results indicate that accounting information disclosure has a positive and statistically significant effect on stock price synchronicity. Moreover, the findings show that accounting information disclosure does not have a statistically significant effect on

stock price crash risk. Additional results suggest that corporate governance quality does not significantly affect the relationship between accounting information disclosure and stock price synchronicity. Finally, the findings indicate that corporate governance quality does not have a statistically significant impact on the relationship between accounting information disclosure and stock price crash risk.

Lari Dasht Bayaz et al. [31] investigate the relationship between accounting disclosure, stock price synchronicity, and stock price crash risk. This study also examines the interactive effect of accounting disclosure on the relationship between stock price synchronicity and stock price crash risk. The findings reveal a positive and statistically significant relationship between accounting disclosure and stock price synchronicity. In addition, the results indicate a negative and statistically significant relationship between accounting disclosure and stock price crash risk. However, the findings show that accounting disclosure does not have a statistically significant effect on the relationship between stock price synchronicity and stock price crash risk.

Darabi and Riazi [10] examine opaque financial reporting and its impact on stock prices of firms listed on the Tehran Stock Exchange. The results show a statistically significant relationship between opaque financial reporting and future stock price crash risk in firms with low free-float shares.

Glambosky et al. [16] investigate the relationship between operational hedging and stock price crash risk. Regression results support the role of variable costs, which act as a natural hedge against revenue volatility, and indicate that stronger operational hedging leads to a reduction in future stock price crash risk. Notably, the negative relationship is stronger for firms experiencing declining revenues and engaging in higher levels of accruals management.

Zhang et al. [44] examine the relationship among corporate excess cash holdings, economic policy uncertainty, and stock price crash risk. The findings reveal a positive and statistically significant association between excess corporate cash and stock price crash risk, suggesting that surplus liquidity may exacerbate agency problems and increase stock price volatility. Further analysis indicates that economic policy uncertainty plays a moderating role in this relationship.

Ling et al. [33] investigate the effect of excessive dividend payments on future stock price crash risk. The results show that overpaid dividends are positively associated with the likelihood of future stock price crash risk. The findings also indicate that high-quality corporate governance and financial analyst coverage can mitigate the positive effect of dividend payouts on crash risk. Zhao et al. [45] show that aggressive strategies increase stock price crash risk; however, this effect is relatively weaker in state-owned enterprises. Wei and Zhang [42] examine whether significant inconsistencies between financial and non-financial measures can be used to identify stock price crash risk. The results indicate that greater discrepancies between financial indicators (e.g., revenue growth rate) and non-financial indicators (e.g., sales volume growth rate, production volume growth rate, and inventory growth rate) are associated with higher stock price crash risk.

Wang et al. [40] investigate the relationship among information disclosure quality, earnings management, and stock price crash risk. The results show that higher disclosure quality is associated with lower stock price crash risk. These findings contribute to the corporate governance literature and provide direct guidance for managers seeking to improve the quality of information disclosure. Murata and Shigeyuki [34] examine the relationship between environmental, social, and governance (ESG) disclosure and stock price crash risk. The results indicate that ESG disclosure reduces future stock price crash risk; however, the magnitude and predictive power of ESG disclosure vary across regions. Wei et al. [41] investigate the effect of accounting information–based downside risk on stock price crash risk. Their findings show that earnings-based downside risk and accrual-based downside risk can negatively predict future stock price crash risk. This negative relationship is particularly pronounced among firms with stronger corporate governance. However, operating cash flow–based downside risk does not exhibit predictive power for stock price crash risk. Finally, Li et al. [32] examine the relationship between the timing of annual report disclosures and future stock price crash risk. The results indicate that firms that shift the timing of their annual report disclosures from periods of high market attention to periods of low market attention are associated with a higher likelihood of future stock price crashes.

3 Research Hypotheses

Hypothesis 1: Earnings-based downside risk has a statistically significant effect on future stock price crash risk.

Hypothesis 2: Accrual-based downside risk has a statistically significant effect on future stock price crash risk.

Hypothesis 3: Operating cash flow–based downside risk has a statistically significant effect on future stock price crash risk.

4 Research Methodology

This study is classified as a descriptive–correlational research and falls within the domain of accounting and financial research, as it examines the relationships and correlations among the research variables using regression models. In terms of research purpose, this study is considered empirical basic research, as it seeks to discover scientific laws and principles and aims to develop knowledge and theory at both general and specific levels. Moreover, the study is descriptive in nature, as descriptive research explains and interprets phenomena as they exist, without manipulation. This type of research involves the collection of data for the purpose of testing hypotheses or answering questions related to the current status of the subject under investigation.

In this study, multivariate regression models based on panel data techniques are employed to analyze the data. The software packages Microsoft Excel, EViews, and Stata are used for data processing and analysis. The statistical population of the study consists of firms listed on the Tehran Stock Exchange; therefore, the spatial scope of the research is limited to companies listed on the Tehran Stock Exchange. The temporal scope of the study covers the period from 2014 to 2024.

A systematic elimination sampling method is used to select the research sample, based on the following criteria:

1. To ensure comparability of financial information, firms' fiscal year-ends must coincide with the end of March.
2. To maintain data homogeneity, firms operating in banking, financial and credit institutions, insurance, and leasing industries are excluded.
3. The firm's shares must have been traded at least once every three months during the study period.
4. Firms must not have changed their fiscal year during the study period.
5. The data required for the variables examined in this study must be available.

After applying these constraints, a total of 105 firms are selected as the final research sample.

5 Research Models and Variable Measurement

In this study, to test the first, second, and third research hypotheses, Models (1), (2), and (3) are employed, respectively, consistent with Wei et al. [41]. In Models (1), (2), and (3), if the coefficient β_1 is statistically significant, the first, second, and third research hypotheses, respectively, are not rejected.

Model (1):

$$\begin{aligned} CRASH\text{-}R_{i,t+1} = {} & \beta_0 + \beta_1 DRROA_{i,t} + \beta_2 Turnover_{i,t} + \beta_3 RET_{i,t} + \beta_4 SIGMA_{i,t} + \beta_5 SIZE_{i,t} \\ & + \beta_6 LEV_{i,t} + \beta_7 ROA_{i,t} + \beta_8 MTB_{i,t} + \beta_9 DASSET_{i,t} + \beta_{10} DSALE_{i,t} \\ & + \beta_{11} DDIV_{i,t} + \beta_{12} CASH_{i,t} + \beta_{13} PPE_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Model (2):

$$\begin{aligned} CRASH\text{-}R_{i,t+1} = {} & \beta_0 + \beta_1 DRTCA_{i,t} + \beta_2 Turnover_{i,t} + \beta_3 RET_{i,t} + \beta_4 SIGMA_{i,t} + \beta_5 SIZE_{i,t} \\ & + \beta_6 LEV_{i,t} + \beta_7 ROA_{i,t} + \beta_8 MTB_{i,t} + \beta_9 DASSET_{i,t} + \beta_{10} DSALE_{i,t} \\ & + \beta_{11} DDIV_{i,t} + \beta_{12} CASH_{i,t} + \beta_{13} PPE_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Model (3):

$$\begin{aligned} CRASH\text{-}R_{i,t+1} = {} & \beta_0 + \beta_1 DROCF_{i,t} + \beta_2 Turnover_{i,t} + \beta_3 RET_{i,t} + \beta_4 SIGMA_{i,t} + \beta_5 SIZE_{i,t} \\ & + \beta_6 LEV_{i,t} + \beta_7 ROA_{i,t} + \beta_8 MTB_{i,t} + \beta_9 DASSET_{i,t} + \beta_{10} DSALE_{i,t} \\ & + \beta_{11} DDIV_{i,t} + \beta_{12} CASH_{i,t} + \beta_{13} PPE_{i,t} + \varepsilon_{i,t} \end{aligned}$$

where:

- $CRASH\text{-}R_{i,t+1}$: Future stock price crash risk of firm i in year $t+1$
- $DRROA_{i,t}$: Earnings-based downside risk of firm i in year t

- $DRTCA_{i,t}$: Accrual-based downside risk (total accruals) of firm i in year t
- $DROCF_{i,t}$: Operating cash flow–based downside risk of firm i in year t
- $Turnover_{i,t}$: Stock trading volume of firm i in year t
- $RET_{i,t}$: Stock return of firm i in year t
- $SIGMA_{i,t}$: Stock return volatility (sigma) of firm i in year t
- $SIZE_{i,t}$: Firm size of firm i in year t
- $LEV_{i,t}$: Financial leverage of firm i in year t
- $ROA_{i,t}$: Return on assets of firm i in year t
- $MTB_{i,t}$: Market-to-book ratio of firm i in year t
- $DASSET_{i,t}$: Asset growth of firm i in year t
- $DSALE_{i,t}$: Sales growth of firm i in year t
- $DDIV_{i,t}$: Dividend payout of firm i in year t
- $CASH_{i,t}$: Cash holdings of firm i in year t
- $PPE_{i,t}$: Property, plant, and equipment of firm i in year t

Dependent Variable

This study includes future stock price crash risk as the dependent variable, which is measured as follows:

Future Stock Price Crash Risk (CRASH-R)

Consistent with prior studies by Kim et al. [26], Callen and Fang [7], and Andreou et al. [3], this study employs negative conditional skewness of stock returns to measure future stock price crash risk.

Negative Conditional Skewness of Stock Returns (NCSKEW)

To measure stock price crash risk, firm-specific monthly returns are first calculated using Equation (5.1):

$$W_{j,t} = \ln(1 + \varepsilon_{j,t}) \tag{5.1}$$

where:

- $W_{j,t}$ denotes the firm-specific monthly return of firm j in month t during the fiscal year;
- $\varepsilon_{j,t}$ represents the residual (error term) of firm j's stock return in month t, obtained from the regression model specified in Equation (5.2).

$$r_{j,t} = \alpha_j + \beta_{1,j} r_{m,t-2} + \beta_{2,j} r_{m,t-1} + \beta_{3,j} r_{m,t} + \beta_{4,j} r_{m,t+1} + \beta_{5,j} r_{m,t+2} + \varepsilon_{j,t} \tag{5.2}$$

where:

- $r_{j,t}$ is the stock return of firm j in month t during the fiscal year;
- $r_{m,t}$ denotes the market return in month t. Market monthly returns are calculated by subtracting the market index at the beginning of the month from the index at the end of the month and dividing the result by the index at the beginning of the month.

Using the firm-specific monthly returns, negative conditional skewness (NCSKEW) is then calculated as follows:
Chen et al. [8] argue that signals of stock price crashes begin to emerge one year prior to the occurrence of such events, and one of these signals is the presence of negative skewness in stock returns. Accordingly, firms that experience negative skewness in stock returns in the previous year are more likely to face stock price crashes in the subsequent year. Similarly, Hong and Stein [20] suggest that negative skewness of stock returns serves as an alternative measure of asymmetry in the return distribution.

The negative conditional skewness of stock returns is calculated using Equation (5.3):

$$NCSKEW_{j,t} = -\frac{N(N-1)^{3/2}\sum W_{j,t}^3}{(N-1)(N-2)(\sum W_{j,t}^2)^{3/2}} \tag{5.3}$$

where:

- $NCSKEW_{j,t}$ is the negative conditional skewness of monthly stock returns of firm j during fiscal year t;
- $W_{j,t}$ is the firm-specific monthly return of firm j in month t;
- N denotes the number of months for which returns are calculated.

Independent Variable

Accounting-Based Downside Risk (ABDR): In this study, to calculate accounting-based downside risk, following the studies of Konchitchki et al. [29] and Wei et al. [41], three measures are used:

1. Earnings-based downside risk (DRROA)
2. Accrual-based downside risk (DRTCA)
3. Operating cash flow–based downside risk (DROCF)

These measures are calculated according to Equations (5.4), (5.5), and (5.6) as follows:

Equation (5.4): Earnings-based downside risk

$$DRROA_{i,t} = \log\left(\frac{1+RLPM_2(\tau_{i,t})}{1+RUPM_2(\tau_{i,t})}\right) = \log\left\{\frac{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}<\tau_{i,t}}(\tau_{i,t}-\gamma_{i,t})^2\right]^{1/2}}{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}\geq\tau_{i,t}}(\gamma_{i,t}-\tau_{i,t})^2\right]^{1/2}}\right\} \tag{5.4}$$

where:

- $\gamma_{i,t}$: Actual earnings of firm i in year t (net income / total assets)
- $\tau_{i,t}$: Target (expected) earnings of firm i in year t
- N: Total number of residuals (here, 3 to 5 years are used for calculating ABDR, depending on availability)
- $RLPM_2(\tau_{i,t})$and $RUPM_2(\tau_{i,t})$denote the lower and upper partial moment roots, respectively.

A higher value indicates greater accounting-based downside risk.

Equation (5.5): Accrual-based downside risk

$$DRTCA_{i,t} = \log\left(\frac{1+RLPM_2(\tau_{i,t})}{1+RUPM_2(\tau_{i,t})}\right) = \log\left\{\frac{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}<\tau_{i,t}}(\tau_{i,t}-\gamma_{i,t})^2\right]^{1/2}}{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}\geq\tau_{i,t}}(\gamma_{i,t}-\tau_{i,t})^2\right]^{1/2}}\right\} \tag{5.5}$$

where:

- $\gamma_{i,t}$: Actual total accruals of firm i in year t (total accruals / total assets)
- $\tau_{i,t}$: Target total accruals of firm i in year t

Equation (5.6): Operating cash flow–based downside risk

$$DROCF_{i,t} = \log\left(\frac{1+RLPM_2(\tau_{i,t})}{1+RUPM_2(\tau_{i,t})}\right) = \log\left\{\frac{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}<\tau_{i,t}}(\tau_{i,t}-\gamma_{i,t})^2\right]^{1/2}}{1+\left[\frac{1}{N}\sum_{\gamma_{i,t}\geq\tau_{i,t}}(\gamma_{i,t}-\tau_{i,t})^2\right]^{1/2}}\right\} \tag{5.6}$$

where:

- $\gamma_{i,t}$: Actual operating cash flow of firm i in year t (operating cash flow / total assets)
- $\tau_{i,t}$: Target operating cash flow of firm i in year t

To calculate ABDR for each year, it is first necessary to estimate the target (expected) earnings, total accruals, and operating cash flows for each firm in each year. One of the most widely used approaches for estimating expected earnings is time-series regression models. In this study, following Wei et al. [41], expected earnings, expected total accruals, and expected operating cash flow are estimated using Equations (5.7), (5.8), and (5.9) respectively, following a three-year rolling regression window for each industry (similar to Fama & French [13]).

Equation (5.7): Expected earnings (ROA)

$$\begin{aligned} ROA_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \beta_2 SALE_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 LEVERAGE_{i,t-1} \\ + \beta_5 STD_ROA_{i,t-1} + \beta_6 OC_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{5.7}$$

- $ROA_{i,t}$: Return on assets (net income / total assets) of firm i in year t
- $ROA_{i,t-1}$: Return on assets of firm i in year $t-1$
- $SALE_{i,t-1}$: Total sales / total assets in year $t-1$
- $SIZE_{i,t-1}$: Firm size (natural logarithm of market value of equity) in year $t-1$
- $LEVERAGE_{i,t-1}$: Financial leverage (total debt / total assets) in year $t-1$
- $STD_ROA_{i,t-1}$: Standard deviation of ROA over the past three years in year $t-1$
- $OC_{i,t-1}$: Operating cycle (log of sum of inventory turnover and accounts receivable period) in year $t-1$

Equation (5.8): Expected total accruals (TCA)

$$\begin{aligned} TCA_{i,t} = \beta_0 + \beta_1 TCA_{i,t-1} + \beta_2 SALE_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 LEVERAGE_{i,t-1} \\ + \beta_5 STD_ROA_{i,t-1} + \beta_6 OC_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{5.8}$$

where:

- $TCA_{i,t}$: Total accruals (total accruals / total assets) of firm i in year t
- $TCA_{i,t-1}$: Total accruals of firm i in year $t-1$

Equation (5.9): Expected operating cash flow (OCF)

$$\begin{aligned} OCF_{i,t} = \beta_0 + \beta_1 OCF_{i,t-1} + \beta_2 SALE_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 LEVERAGE_{i,t-1} \\ + \beta_5 STD_ROA_{i,t-1} + \beta_6 OC_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{5.9}$$

where:

- $OCF_{i,t}$: Operating cash flow (operating cash flow / total assets) of firm i in year t
- $OCF_{i,t-1}$: Operating cash flow of firm i in year $t-1$

Control Variables

- Stock Trading Volume (Turnover): Natural logarithm of the firm's annual stock trading volume.
- Stock Return (RET): Annual stock return of the firm.
- Sigma (SIGMA): Standard deviation of the firm's monthly stock returns.
- Firm Size (SIZE): Natural logarithm of total assets.
- Financial Leverage (LEV): Ratio of total debt to total assets.

- Return on Assets (ROA): Ratio of net income to total assets.
- Market-to-Book Ratio (MTB): Ratio of the market value of equity (number of shares × market price per share) to the book value of equity.
- Asset Growth (DASSET): (Current year total assets − Previous year total assets) ÷ Previous year total assets.
- Sales Growth (DSALE): (Current year total sales − Previous year total sales) ÷ Previous year total sales.
- Dividend Payout (DDIV): Dummy variable; equals 1 if the firm paid cash dividends, 0 otherwise.
- Cash Holdings (CASH): Ratio of cash to total assets.
- Property, Plant, and Equipment (PPE): Ratio of tangible fixed assets to total assets.

6 Findings

6.1 Determination of Data Type

The summary results of the F-Limer test are presented in Table 1. As observed, the p-values for all three models are greater than 0.05, indicating that the pooled data method is appropriate.

Table 1: F-Limer Test

Hypothesis	F-Limer Statistic	Probability	Result
Hypothesis 1	0.996554	0.4936	Pooled
Hypothesis 2	0.996026	0.4951	Pooled
Hypothesis 3	0.995929	0.4953	Pooled

Source: Researcher's findings

6.2 Regression Model Assumptions

Before fitting the model to the data, the assumptions of the regression model were examined:

1. Test for Autocorrelation of Residuals

   Based on the Wooldridge test statistics shown in Table 2, none of the three models exhibit autocorrelation.

Table 2: Wooldridge Test for Autocorrelation

Model	Test Statistic	Probability
Hypothesis 1	0.5603	0.341
Hypothesis 2	0.6556	0.200
Hypothesis 3	0.3256	0.976

Source: Researcher's findings

2. Test for Heteroscedasticity of Residuals

   As shown in Table 3, the null hypothesis of homoscedasticity is rejected, indicating the presence of heteroscedasticity. Therefore, the Generalized Least Squares (GLS) method was used to estimate the models.

Table 3: Test for Homoscedasticity

Model	Wald Statistic	Probability
Hypothesis 1	766.12	0.0000
Hypothesis 2	1027.92	0.0000
Hypothesis 3	658.19	0.0000

Source: Researcher's findings

Table 4: Regression Results for Testing Hypothesis 1

Variable	Coefficient	Std. Error	t-Statistic	Probability
Earnings-Based Downside Risk	0.46214	0.10682	4.326307	0.0000
Stock Trading Volume (Turnover)	0.153075	0.12559	12.18812	0.0000
Stock Return (RET)	0.015695	0.14638	1.072195	0.2861
Sigma (SIGMA)	0.051687	0.41355	1.249825	0.2142
Firm Size (SIZE)	0.247716	0.116652	2.123551	0.0361
Financial Leverage (LEV)	0.003895	0.001858	2.096298	0.0385
Return on Assets (ROA)	0.028339	0.13454	2.106342	0.0376
Market-to-Book Ratio (MTB)	0.001912	0.37799	0.050592	0.9597
Asset Growth (DASSET)	-7.8E-08	1.36E-08	-0.644367	0.5208
Sales Growth (DSALE)	-0.223913	0.112954	-1.982344	0.0501
Dividend Payout (DDIV)	-0.411425	0.204946	-2.007476	0.0473
Cash Holdings (CASH)	-7.61E-05	7.87E-06	-2.62197	0.0258
PPE	0.021555	0.18361	1.173969	0.2431
Constant	-2043.722	927.6672	-2.203077	0.0298

6.3 Results of Hypothesis 1

To test the significance of the overall model, the F-statistic was used, and for the significance of regression coefficients, the t-statistic was employed. Adjusted R^2 was used to evaluate the relationship between dependent and independent variables. The estimation results for Hypothesis 1 are presented in Table 4. Given the probability value obtained for the F-statistic which is less than 0.05, the null hypothesis, which is the lack of significance of the entire model, is rejected, and this indicates that the research model is significant. The value of the coefficient of the variable of the downside risk based on earnings is an indicator for evaluating the first hypothesis, if the said coefficient is significant, it indicates the confirmation of this hypothesis. The probability value of the t-statistic for this variable is equal to 0.0000 and is less than the error level of 0.05, therefore it can be said that the first hypothesis of the research is accepted at the error level of 5 percent. Also, the sign of the coefficient of this variable is positive, which indicates that the downside risk based on earnings has a positive and significant effect on the risk of future stock price decline.

6.4 Results of Testing the Second Hypothesis

The estimation results of the model for the second hypothesis are presented in Table 5.

Table 5: Data Analysis Results for Testing Hypothesis 2

Variable	Coefficient	Std. Error	t-Statistic	Probability
Accrual-Based Downside Risk (DRTCA)	0.34819	0.09223	3.775261	0.0003
Stock Trading Volume (Turnover)	0.44413	0.09308	4.771305	0.0000
Stock Return (RET)	-0.16956	0.20037	-0.846253	0.3994
Sigma (SIGMA)	0.41206	0.21943	1.877847	0.0632
Firm Size (SIZE)	0.149789	0.043310	3.458495	0.0008
Financial Leverage (LEV)	0.939203	0.120359	7.803343	0.0000
Return on Assets (ROA)	-0.000241	0.002106	-0.114279	0.9092
Market-to-Book Ratio (MTB)	0.190675	0.034229	5.570579	0.0000
Asset Growth (DASSET)	-0.019320	0.030885	-0.625545	0.5330
Sales Growth (DSALE)	-1.04E-08	3.22E-08	-0.447501	0.6554
Dividend Payout (DDIV)	-0.088932	0.111348	-0.798686	0.4263
Cash Holdings (CASH)	-1.078389	0.228656	-4.716207	0.0000
Property, Plant, and Equipment (PPE)	4.84E-09	2.56E-09	1.889763	0.0616
Constant	-1694.573	819.9142	-2.066769	0.0412

Source: Researcher's findings

According to the p-value of the F-statistic, which is less than 0.05, the null hypothesis of an insignificant overall model is rejected, indicating that the research model is significant.

The coefficient of accrual-based downside risk is the indicator for evaluating Hypothesis 2. Since the t-test probability for this variable is 0.0003, which is less than the 5% significance level, it can be concluded that Hypothesis 2 is accepted at the 5% significance level. The positive sign of the coefficient indicates that accrual-based downside risk has a positive and significant effect on future stock price crash risk.

6.5 Results of Testing the Third Hypothesis

The estimation results of the model for the third hypothesis are presented in Table 6.

Table 6: Data Analysis Results for Testing Hypothesis 3

Variable	Coefficient	Std. Error	t-Statistic	Probability
Operating Cash Flow–Based Downside Risk (DROCF)	0.647202	0.43038	15.03783	0.0000
Stock Trading Volume (Turnover)	-0.071953	0.19238	-3.740221	0.0003
Stock Return (RET)	0.158394	0.63710	2.486164	0.0145
Sigma (SIGMA)	0.303227	1.23659	2.452133	0.0159
Firm Size (SIZE)	0.007433	0.04039	1.840357	0.0686
Financial Leverage (LEV)	-0.008544	0.25829	-0.330787	0.7415
Return on Assets (ROA)	0.024540	0.26850	0.913971	0.3628
Market-to-Book Ratio (MTB)	-0.108747	0.49183	-2.211057	0.0292
Asset Growth (DASSET)	9.59E-09	2.39E-09	4.003876	0.0001
Sales Growth (DSALE)	-0.297961	1.68682	-1.766400	0.0803
Dividend Payout (DDIV)	0.684607	0.203213	3.368917	0.0011
Cash Holdings (CASH)	-1.62E-05	9.76E-06	-2.324125	0.0221
Property, Plant, and Equipment (PPE)	2032798.0	1227512.0	1.656031	0.1007
Constant	0.008417	0.011665	0.721564	0.4722

Source: Researcher's findings

According to the p-value of the F-statistic, which is less than 0.05, the null hypothesis of an insignificant overall model is rejected, indicating that the research model is significant.

The coefficient of operating cash flow–based downside risk is the indicator for evaluating Hypothesis 3. Since the t-test probability for this variable is 0.0000, which is less than the 5% significance level, it can be concluded that Hypothesis 3 is accepted at the 5% significance level. The positive sign of the coefficient indicates that operating cash flow–based downside risk has a positive and significant effect on future stock price crash risk.

7 Discussion and Conclusion

The results of the first hypothesis of the study indicated that earnings-based downside risk has a significant effect on future stock price crash risk. Similarly, the results of the second hypothesis showed that accrual-based downside risk has a significant impact on future stock price crash risk. The results of the third hypothesis demonstrated that operating cash flow–based downside risk also significantly affects future stock price crash risk. These findings are consistent in terms of significance with previous studies by Imani et al. [22], Lari Dasht Biyaaz et al. [31], Darabi and Riazi [10], and Wei et al. [41].

In this study, earnings-based downside risk, accrual-based downside risk, and operating cash flow–based downside risk were used as measures of accounting information–based downside risk. These accounting information–based downside risk measures focus on unexpected variability in firm performance metrics, particularly return on assets. Conceptually, accounting information–based downside risk is similar to stock price crash risk; however, they are constructed from different datasets. While stock price crash risk is measured based on stock return data, accounting information–based downside risk is measured using financial statement data.

Accounting information–based downside risk can predict future stock price crash risk through two potential channels:

1. Information Content Channel: Accounting information–based downside risk derived from publicly disclosed financial data conveys precise negative information regarding expected future cash flows and reduces opinion heterogeneity over the long term. This helps limit potential overpricing in advance, thereby reducing the likelihood of future stock price crashes.
2. Negative Disclosure Channel: Higher accounting information–based downside risk indicates that firm managers have disclosed negative information. Consequently, it is expected that accounting information–based downside risk has a significant impact on future stock price crash risk.

7.1 Practical Implications

The findings of this study may provide policymakers with a deeper understanding of how to respond to and mitigate investor pessimism in equity markets, particularly during financial downturns. Additionally, these results

offer practical insights for investors, who should closely monitor a firm's accounting information–based downside risk, as inadequate disclosure and sudden increases in negative information exacerbate stock price crash risk.

In any scientific and applied research process, there are a set of conditions and factors beyond the researcher's control that may potentially affect the results and their generalizability. Paying attention to these limitations can enhance readers' understanding of the research findings and their applicability to similar contexts.

7.2 Research Limitations

One of the limitations of this study is the existence of inflation during the research period, as the variables were calculated using financial statements prepared based on historical cost. If the financial statements were adjusted for inflation, the study's results might differ from the current findings. Furthermore, extrapolating past trends to the future is reasonable only if past conditions persist, such as political, economic, and legal environments remaining consistent. This issue may affect the generalizability of the results and pose a limitation to the research.

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