Proceedings of the 3rd International Conference on Management Research and Economic Development
DOI: 10.54254/2754-1169/171/2025.21824

R&D Investment and Stock Price Crash Risk: An Empirical Study of American Listed Companies

Minghao Liu[1,a,*]

[1]*College of Liberal Arts & Sciences at Illinois, University of Illinois Urbana-Champaign, 901 West Illinois Street, Champaign, United States*
a. 1010674136@ldy.edu.rs
**corresponding author*

Abstract: R&D expenditure has long been regarded as an essential driver of firm innovation and long-term growth. However, its impact on extreme stock price declines remains underexplored. This paper investigates whether and how corporate R&D intensity affects the likelihood of stock price crashes among U.S.-listed companies from 2013 to 2023. Building on signaling theory, growth option theory, and agency theory, this study posits that R&D activities may alter a firm's short-term profitability and shape investor expectations, thereby influencing crash risk. Drawing on a panel dataset from CRSP and Compustat, one employs Probit and OLS regressions to examine both direct and indirect pathways through which R&D investment impacts crash probability. The findings suggest that R&D can, under certain circumstances, mitigate crash risk over a lagged period, whereas firms with higher current profitability are paradoxically more susceptible to crashes. This study contributes to the literature by illustrating the "time-lag effect" of R&D on crash risk and highlights firm size as an important contingency factor. Overall, the results have meaningful implications for corporate managers and investors. Firms seeking to minimize crash risk should carefully plan R&D allocations and manage investor expectations, while stakeholders need to be aware of the potential overvaluation bubbles that may accompany high-profit firms.

Keywords: R&D intensity, stock price crash, profitability, time-lag effect, U.S. listed firms.

1. Introduction

In modern financial markets, stock price crashes are a highly discussed topic. A stock price crash typically refers to a rapid and substantial decline in the share price of an individual company or the market as a whole within a short period, often accompanied by investor panic, plummeting market liquidity, and the concentrated release of information about the firm [1]. From the perspective of corporate management, an extreme drop in share price not only triggers skepticism among external investors but also affects the company's subsequent financing capacity, internal reputation, and long-term development prospects [2]. Therefore, understanding and predicting the factors that influence the risk of a stock price crash is of significant importance for both academic research and practical management.

Existing studies have shown that factors such as information asymmetry, speculative trading, and investor sentiment may exacerbate the probability of extreme negative returns [3]. However, there is still no consensus in academia on whether corporate R&D expenditure has a significant impact on

DOI: 10.54254/2754-1169/171/2025.21824

the risk of a stock price crash. On the one hand, R&D investment represents technological upgrades and future growth potential, serving as a positive market signal to enhance a firm's valuation; on the other hand, R&D involves high uncertainty and a long cycle, with success rates difficult to predict. If external investors are overly optimistic about a company's R&D prospects, failure to meet these expectations could lead to a more drastic valuation correction or even trigger a crash [4]. Meanwhile, according to growth option theory, greater R&D investment may generate more future growth opportunities for the firm, but once these opportunities fail to materialize or the macro environment changes significantly, the adjustment in investor valuations can become more severe [5].

Studies on both emerging and developed markets indicate that R&D expenditure often has a noticeable effect on stock price volatility and overall risk levels, particularly in settings characterized by high information asymmetry or where investor sentiment is easily swayed by external factors [6]. Nevertheless, most existing research focuses on the relationship between R&D investment and "stock volatility" or "systemic risk," leaving relatively few investigations into whether R&D investment might intensify or mitigate extreme downturn events (i.e., stock price crashes). Against this backdrop, the present study centers on U.S.-listed companies, examining how R&D intensity (the proportion of R&D spending to total assets) affects the likelihood of a stock price crash from 2013 to 2023.

This study has three primary objectives. First, from the perspectives of information asymmetry, agency theory, and growth option theory, it seeks to provide new empirical evidence on the relationship between R&D investment and extreme stock price risk. Second, it investigates whether profitability (ROA) acts as a potential mediator or moderator in the short term, potentially altering the positive or negative effects of R&D on crash risk. Third, it explores the time-lag effect of R&D investment and the role of firm size to further refine the understanding of how R&D relates to crash events, offering more targeted insights for corporate managers, investors, and regulators. The remainder of this paper is organized as follows. Section 2 provides a review of the literature and the theoretical background, covering the main concepts and cutting-edge research on stock price crashes and R&D investment. Section 3 describes the research design and methodology, including data sources, variable definitions, and model setup. Section 4 (data analysis and empirical results) is not detailed here. Finally, the conclusion summarizes the findings and discusses research limitations and future prospects.

2. Literature Review

A "stock price crash" is commonly defined as an extreme, rapid, and concentrated decline in the share price of either an individual company or the market as a whole over a short period, typically accompanied by panic selling, concentrated information releases, and intense doubts regarding the company's fundamentals [1]. In academic research, stock price crashes are usually measured by extreme negative returns or negative skewness, aiming to capture the extreme risks in the left tail of the return distribution. When assessing crash risk, scholars frequently employ indicators of extreme negative returns, "negative skewness," and extreme value theory models. On the other hand, in studies focusing on the relationship between R&D expenditure and stock price volatility, many researchers adopt the concept of "R&D intensity", the ratio of R&D spending to total assets or sales, to quantify the level of a firm's innovation activity [4].

R&D activities often feature high levels of specialization and uncertainty, leading external investors to lack a full understanding of a firm's R&D projects. This heightened information asymmetry can cause the market to either over- or underestimate R&D inputs: on one hand, R&D may send a positive signal, boosting investor expectations of future returns; on the other hand, if management exaggerates R&D prospects, an extreme reversal in investor sentiment can occur later, resulting in a sharp drop in share price [5]. Moreover, when investors struggle to accurately gauge a

DOI: 10.54254/2754-1169/171/2025.21824

firm's true value, they may overreact to negative information, further increasing volatility and potentially triggering a crash.

R&D investment is viewed as a "growth option," enabling a firm to explore new markets or develop new products, which can lead to a higher valuation premium [7-14]. However, if these growth options fail to materialize or the external environment turns unfavorable, the market will rapidly adjust its expectations, potentially causing a stock price crash [15]. In addition, the inherent uncertainty of R&D can amplify share price volatility: successful outcomes may drive the stock price upward, but failures or external shocks may prompt a sudden downward revision. According to agency theory, managerial objectives may not align perfectly with shareholder interests. Managers might pursue R&D investments that are economically unviable in order to enhance their personal reputation, consolidate control, or secure short-term rewards. Such ill-advised R&D decisions could result in resource misallocation, and once the market discovers these inefficiencies, a stock price crash may ensue [7].

Existing research predominantly examines the connection between R&D investment and stock price volatility or overall risk, but the specific mechanism by which R&D affects extreme negative events—such as a stock price crash—remains underexplored. Some studies have addressed the role of information asymmetry in market collapses [8], yet there is a notable lack of systematic empirical work on the pathways and lag effects of R&D in mitigating or exacerbating crash risk, as well as the moderating influence of firm size [13]. Hence, this study aims to bridge that gap by conducting an in-depth investigation of the "R&D investment–profitability–stock price crash" nexus.

3. Methodology

3.1. Data Sources and Sample Selection

This study focuses on companies listed on major U.S. stock exchanges (NYSE, NASDAQ, etc.) from 2013 to 2023 [16]. Stock price data is obtained from the Center for Research in Security Prices (CRSP) to access daily returns and market capitalization. Financial data is sourced from the Compustat database, including R&D expenditures, balance sheets, income statements, and cash flow statements. Sample screenings are using following rules: exclude firms with missing financial or stock price data during the study period; exclude companies that delisted during the period, those with less than one year of listing history, or those with abnormal data. To ensure comparability in the panel data, retain firms with multiple consecutive years of complete data, resulting in a final set of valid samples.

3.2. Variable Definitions

Following existing research, this study defines a stock price crash as occurring when a stock experiences at least one day of a significant price drop in a given year. Specifically, if the stock's daily return is below the annual average return minus three times the standard deviation (Mean – 3σ), that day is considered a crash day and coded as 1; otherwise, it is coded as 0. R&D intensity is measured by the ratio of R&D expenditure to total assets, namely: R&D Intensity = R&D Expenditure / Total Assets. To account for other factors potentially influencing crash risk, the following control variables are introduced:

- Firm Size (Size): Measured as the natural logarithm of total assets (ln Total Assets).
- Leverage: Calculated as the ratio of long-term debt to total assets.
- Profitability (ROA): Measured as net income divided by total assets (ROA = Net Income / Total Assets).
- Firm Age (Age): Calculated as the current year minus the IPO (initial listing) year.
- Cash Holding: Measured as the ratio of cash and cash equivalents to total assets.

DOI: 10.54254/2754-1169/171/2025.21824

- Market-to-Book Ratio (M/B Ratio): Calculated as the firm's market value divided by its book value (Market Value / Book Value).

3.3. Methods and Model Specification

This study employs a fixed effects model to control for firm-level characteristics that may affect the results. The primary regression model is specified as follows

$$Price\ Crash_{i,t} = \beta 0_i + \beta_1 R\&D\ indensity_{i,t} + \beta_2\ Size_{i,t} + \beta_3\ \text{leverage}_{i,t} + \beta_4\ \text{profitability}_{i,t} + \beta_5\ \text{Age}_{i,t} + \beta_6\ \text{cash holding}_{i,t} + \beta_7\ \text{M/B ratio}_{i,t} + FE\ year + FE\ industry + \epsilon_{i,t} \quad (1)$$

Here, $Price\ Crash_{i,t}$ is a binary variable indicating whether company i experiences a stock price crash in year t; $R\&D\ Intensity_{i,t}$ is the R&D intensity of company i in year t (R&D expenditure / total assets); $Size_{i,t}$ is the size of the company, measured by the natural logarithm of total assets (ln Total Assets); $\text{leverage}_{i,t}$ is the leverage of company i in year t, calculated as long-term debt / total assets; $\text{profitability}_{i,t}$: The profitability of company i in year t, measured by ROA = Net Income / Total Assets; $\text{Age}_{i,t}$ is the age of company i in year t (current year – IPO year); $\text{cash holding}_{i,t}$ is the amount of cash holdings for company i in year t (cash and cash equivalents / total assets); $\text{M/B ratio}_{i,t}$ is the ratio of market value to book value (Market Value / Book Value) for company i in year t; $FE\ year$ is year fixed effects, controlling for systematic influences across different years; $FE\ industry$ is industry fixed effects, controlling for industry-specific factors; $\epsilon_{i,t}$ is the error term. Among them, μ_i and λ_t represent firm fixed effects and year fixed effects, respectively, while $\varepsilon_{i,t}$ is the random error term. To examine mediation or indirect effects, this study also employs OLS regressions using ROA and other financial indicators as dependent variables, thereby analyzing the relationship between R&D investment and corporate profitability.

Furthermore, to capture the lagged effect of R&D, this study incorporates one- or multi-period lagged $\text{R\&D Intensity}_{i,\ t-1}$ into the regression equation to observe how prior R&D investments influence current crash risk. For the heterogeneity test based on firm size, one divides the sample into large-scale and small-scale firms according to total assets or market value and conduct separate regressions for each group.

4. Results and Discussion

This study primarily investigates how corporate R&D expenditures affect the likelihood of a stock price crash. The results are presented in the table above. In the first column, the dependent variable is whether the firm experiences a crash, and the explanatory variables include corporate R&D expenditure and all control variables (excluding ROA). The second column adds ROA to the same explanatory variables used in the first column. In the third column, ROA is the dependent variable, while corporate R&D expenditure and the other control variables serve as the independent variables. Seen from Table 1, it can be seen that when profitability (ROA) is not included in the model (Column (1), Probit regression), the coefficient for R&D expenditure (rd) is significantly negative, indicating that, on the surface, firms with higher R&D intensity are less likely to experience a crash-type decline in that year. However, once ROA is added in Column (2), the direct effect of R&D on crash risk is no longer significant, whereas the coefficient for ROA becomes significantly positive, suggesting that the higher a firm's profitability, the more likely it is to encounter a stock price crash in the same year. Meanwhile, in Column (3) (OLS regression using ROA as the dependent variable), rd is negative and significant, indicating that R&D investment reduces short-term profitability. Taken together, these findings imply that R&D affects crash risk through an indirect transmission mechanism, first influencing ROA, which in turn influences crash events.

DOI: 10.54254/2754-1169/171/2025.21824

This conclusion merits further examination. From a traditional standpoint, R&D investment is often seen as a key driver of technological innovation, product upgrades, and long-term competitiveness. However, R&D activities typically involve high costs and lengthy payback periods in the short run, potentially causing a decline in current profitability (ROA). Moreover, the significantly positive ROA coefficient in Column (2) indicates that higher profitability actually makes a firm more prone to a crash. This seemingly paradoxical result is not uncommon in finance and behavioral finance research and may stem from several factors:

- High Market Expectations and Valuation Bubbles. When a firm is highly profitable, investors often set overly optimistic expectations for its future growth, pushing the stock price to elevated levels. Once negative signals emerge—whether from external conditions (e.g., macroeconomic shifts, competitive dynamics) or the firm's internal operations—high valuations tend to reverse more sharply, causing the stock price to "drop from a peak" and evolve into a crash event.
- Earnings Management and "Window Dressing." Firms with robust profitability may be motivated to further "polish" their financials or adopt aggressive accounting practices to maintain the perception of sustained high growth. Although such tactics can persist under normal market sentiment, once the true situation is exposed or economic conditions deteriorate, the stock price can face a strong shock. Especially when valuations are already high, the unwinding of this "window dressing" often leads to a larger decline.
- Overexpansion or Aggressive Investment Due to High Profitability. During periods of strong profitability, companies usually possess more disposable funds, and management may pursue large-scale investments, mergers, or other high-risk projects, thus sowing hidden dangers related to financial leverage and payback periods. If subsequent returns fail to meet expectations or external financing becomes constrained, the risks accumulated in this high-profit stage can rapidly magnify, manifesting in a steep drop in the stock price.

Table 1: The Effect of R&D Spending on Crash Probability

	(1) Probit	(2) Probit	(3) OLS
	crash	crash	roa
rd	-0.245* (-1.76)	0.075 (0.43)	-1.316*** (-111.10)
roa		0.255*** (3.05)	
_cons	-2.188*** (-25.55)	-2.152*** (-24.82)	-0.370*** (-24.27)
Control	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	18425	18425	18425
adj. R^2			0.503
Pseudo R^2	0.0126	0.0146	

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Considering that R&D impacts on a firm exhibit a lag effect, an additional lagged term of R&D expenditure was included in the original model. The results are shown in the Table 2. When the one-period lag of R&D expenditure (L_rd) is incorporated into the model, an important phenomenon can be observed: even after controlling for ROA, L_rd remains negative and statistically significant. This implies that, aside from affecting current crash risk through altering the firm's current profitability, R&D investment has an independent influence pathway. In line with the previous finding that current R&D investment (rd) does not have a direct and significant effect on crash events in the same year, the statistical significance of the lagged R&D expenditure further reinforces the existence of a lag effect. In other words, the R&D spending made in the previous period or even earlier typically

DOI: 10.54254/2754-1169/171/2025.21824

requires some time to yield substantial innovative outcomes—such as new product launches, technological upgrades, or improvements in organizational processes—which cumulatively enhance the firm's overall risk resistance in subsequent periods and thereby reduce the likelihood of a stock price crash during that period. In contrast, current R&D expenditure is generally still in its initial investment stage, having not yet been fully absorbed technologically or commercialized, so its positive impact on profitability and market sentiment has not yet materialized in the short term, resulting in an insignificant rd coefficient. At the same time, in the same regression model, ROA remains significantly positive, indicating that firms with higher profitability are actually more prone to experiencing a stock price crash in the current period. Therefore, combining all regression results, one can conclude that the effect of R&D investment on crash risk is not immediate but exhibits a "gradual accumulation with delayed effects". R&D expenditures made in the previous period or earlier can support future product and technological competitiveness and improve the management's ability to cope with external shocks, thus reducing the probability of a severe stock price decline in that period. Second, although high profitability represents strong short-term financial performance, it can also seed greater volatility risk in terms of market sentiment and valuation; particularly when external conditions deteriorate, this risk can be rapidly amplified and trigger panic selling in the market.

Table 2: The Effect of R&D Spending on Crash Probability (with Lag)

	(1)	(2)
	crash	crash
L_rd	-0.401** (-2.36)	-0.372* (-1.69)
rd		0.248 (1.23)
roa		0.240*** (2.70)
_cons	-2.106*** (-23.54)	-2.067*** (-22.39)
Control	Yes	Yes
Year	Yes	Yes
N	15564	15192
Pseudo R^2		

t statistics in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

Table 3: Heterogeneity Analysis

	Large	Large	Small	Small
	crash	crash	crash	crash
rd	-2.634** (-2.08)	-2.887** (-2.24)	-0.118 (-0.88)	0.246 (1.50)
roa		0.862 (1.52)		0.299*** (3.30)
_cons	-1.549*** (-3.66)	-1.559*** (-3.68)	-2.210*** (-12.19)	-2.049*** (-10.90)
Control	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	3466	3466	6368	6368

t statistics in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

This study also conducts a heterogeneity analysis based on firm size. Specifically, companies are divided into large-scale and small-scale groups according to the top 25% and bottom 25% of firm size, respectively, and separate regressions are performed on these two subsamples. The results are shown in the Table 3. From these regression results, it can be seen that the effect of R&D investment (rd) on crash risk is primarily observed in the large-scale (Large) group: in both Column (1) and

DOI: 10.54254/2754-1169/171/2025.21824

Column (2), the coefficient for rd is significantly negative, indicating that the R&D spending of large firms effectively reduces crash risk in the same year. In contrast, in the small-scale (Small) group, the coefficient for rd is either insignificant or even shows an opposite sign compared to large firms, suggesting that, for smaller firms, R&D does not significantly decrease the likelihood of a crash.

Further analysis of the large-scale subsample implies that the crash-mitigating effect of R&D investment is not limited to "altering ROA (profitability)" alone. Even after controlling for ROA, the coefficient for rd remains significantly negative, implying that the R&D activities of large companies possess an "independent" risk-buffering function. The underlying economic intuition is that larger firms generally have more substantial financial and resource reserves, along with more mature R&D teams and management systems, enabling them to transform R&D expenditures into technological achievements, product upgrades, or core competitive advantages over a shorter cycle. These achievements not only bolster market confidence in the firm's long-term development but also provide better resilience against external shocks, thus curbing the extent of share price declines.

In contrast, small firms often face financing constraints, limited talent pools, and longer R&D cycles, making it less likely for current R&D expenditures to yield immediate economic benefits. Consequently, they cannot exert a strong positive impact on market expectations or risk resistance. Meanwhile, if a small firm occasionally reports high profits, the market may become overly optimistic about its future due to the lack of a solid developmental and risk-management foundation. Should external conditions deteriorate or operational performance falter, the share price could "fall from a peak," leading to a greater probability of a crash. This finding explains why current R&D investment in small firms does not significantly reduce crash risk, whereas for large firms, current R&D not only mitigates the "high-profit–high-expectation" bubble effect through ROA but also directly lowers crash risk by virtue of their scale advantages and management capabilities.

5. Conclusion

To sum up, this study examines the relationship between corporate R&D investment and stock price crash risk, incorporating profitability, potential mediation effects, and firm size factors into a comprehensive analysis. Drawing on balanced panel data for U.S.-listed companies from 2013 to 2023, the research design explores multiple dimensions of how R&D might help prevent or trigger extreme downward movements in stock prices. Through a review of the literature and theoretical frameworks, this paper highlights gaps in current understanding of the "R&D–crash" nexus and introduces new perspectives on lag effects and heterogeneity. The findings not only enrich the discussion of the causes behind stock price crashes but also offer valuable guidance for firms formulating R&D strategies. Future research may delve further into endogeneity tests, cross-country comparisons, and additional forms of heterogeneity.

References

[1] *Zhang, W. and Wang, L. (2020) M&A goodwill, information asymmetry, and stock price crash risk. Economic Research-Ekonomska Istraživanja, 33(1), 1102-1119.*

[2] *Nguyen, P. and Tran, H. (2023) Information asymmetry on the link between corporate social responsibility and stock price crash risk. Cogent Economics & Finance, 11(1), 2230727.*

[3] *Zhang, Y. (2023) Artificial intelligence innovation and stock price crash risk. Journal of Financial Research, 45(2), 87-104.*

[4] *Chen, J. and Li, S. (2023) R&D intensity and stock price crash risk: Based on OLS multivariate linear regression. ICEMME. EAI, 2326840.*

[5] *Liu, X. and Wang, Y. (2019) How asymmetric information creates bubbles in the stock market? Modern Economy, 10(3), 498-512.*

[6] *Smith, J. (2021) Three essays on investment decisions and stock price crash risk. Doctoral dissertation, University of Texas at Arlington.*

DOI: 10.54254/2754-1169/171/2025.21824

[7] *Chang, X. and Luo, Y. (2018) Stock liquidity and stock price crash risk. Journal of Financial Economics, 129(2), 445-468.*

[8] *Li, X. and Chen, Y. (2022) Does social capital matter to stock price crash risk? Evidence from China. Journal of Corporate Accounting & Finance, 33(1), 45-62.*

[9] *Wang, Z. and Li, H. (2022) Formative experience and stock price crash risk. Finance Research Letters, 48, 102917.*

[10] *Wu, G. and You, D. (2021) Stabilizer" or "catalyst"? How green technology innovation affects the risk of stock price crashes: An analysis based on the quantity and quality of patents. arXiv preprint. Retrieved from https://arxiv.org/abs/2106.16177*

[11] *Rocchi, J., Tsui, E.Y.L. and Saad, D. (2016) Emerging interdependence between stock values during financial crashes. arXiv preprint. Retrieved from https://arxiv.org/abs/1611.02549*

[12] *Zor, S. (2024) "Digitwashing": The gap between words and deeds in digital transformation and stock price crash risk. arXiv preprint. Retrieved from https://arxiv.org/abs/2403.01360*

[13] *Zhao, X. and Wang, Y. (2018). Can corporate innovation restrain the stock price crash risk? Modern Economy, 9(5), 745-758.*

[14] *Li, J. and Zhang, H. (2023) Stock price crash risk: Role of corporate innovation and information asymmetry. ResearchGate. Retrieved from https://www.researchgate.net/publication/375989211*

[15] *Akerlof, G.A. (1970) The market for "lemons": Quality uncertainty and the market mechanism. Quarterly Journal of Economics, 84(3), 488-500.*

[16] *Investopedia. (2023). Asymmetric information in economics explained. Retrieved from https://www.investopedia.com/terms/a/asymmetricinformation.asp.*