

Measuring the Impact of Digital Transformation on Mitigating Stock Market Crash Risks: A Long-term and Short-term Perspective

Xiaoxuan Ren^{1,2,a,*}, Qian Nie^{1,2,b}, Changyao Chen^{1,c}

¹*School of Economics and Management, Yunnan Normal University, Juxian Street, Kunming, PR China*

²*Digital Finance Development and Management Laboratory of Yunnan Provincial Education Department, Kunming, PR China*

a. 1151483630@qq.com, b. 939971904@qq.com, c. ccyccy8001@163.com

**corresponding author*

Abstract: Amidst the swift advancements in artificial intelligence and big data, digital transformation has emerged as a cornerstone for enterprises to bolster competitiveness and streamline operational efficiency. Nevertheless, the volatility of financial markets and the specter of stock market crashes impede the vibrant growth of listed firms. This study endeavors to meticulously examine the impact of digital transformation on stock price stability, adopting both short- and long-term perspectives. Initially, pertinent word vectors associated with digital transformation are curated to establish a mining lexicon, which informs the utilization of text mining methodologies to extract insights from listed companies' annual reports spanning 2012 to 2022. Following data synthesis and analysis, a definitive digital transformation index is derived. Key findings reveal that enterprise digital transformation notably dampens stock price collapse risks, with this mitigating effect progressively amplifying over time. Ultimately, integrating theoretical and empirical insights, we offer recommendations tailored to enterprises, governments, and investors.

Keywords: Text mining, digital transformation, stock market crash, long-term impact.

1. Introduction

An extreme occurrence within the financial realm, a stock market collapse, wields profound and damaging consequences. Beyond inflicting substantial monetary setbacks upon market stakeholders, it threatens to unleash a ripple effect across the entire financial architecture and the tangible economy. This catastrophic event implies profound depletion of investors' assets, in some instances, leading to the complete erosion of their investments. Individually, such a downturn can be devastating to investors, eroding their financial standing. Furthermore, it undermines market trust, disrupts liquidity and transaction volumes, hindering the capital market's progressive growth. Amidst the rapid advancements in big data and artificial intelligence, we've embarked upon a novel epoch characterized by data-centricity and intelligent decision-making strategies. In this context, the digital transformation of enterprises has transformed from a discretionary endeavor into an indispensable prerequisite for survival and success.

2. Literature Review

2.1. Definition of Related Concepts

Digital transformation, broadly defined, utilizes digital tech to drive enterprise innovation and enhancement. It progresses in three phases, emphasizing process innovation and competitiveness. Digital tech ensures data flow, breaks silos, and permeates all aspects for full digitalization, fostering interconnectivity and knowledge sharing.

A stock market crash signifies a dramatic, unexpected fall in share prices or extreme price swings. Key traits are its abruptness, asymmetry, and spillover effects. Hong et al. [1] suggested integrating diverse investor perspectives to better comprehend crashes. Initial studies centered on market-wide factors, whereas Jin et al. [2] introduced firm-specific explanations. Kothari et al. [3] noted that managerial self-interest can conceal adverse info, fostering misreported performance and bubbles. These bubbles' bursting precipitates market crashes. Domestically, crashes are seen as steep price declines from mass investor selling, posing grave risks to investors' interests and market stability.

2.2. Current Research

A comprehensive review of research literature underscores that enterprise digital transformation generally mitigates stock market crash risks. While it affects stock prices via information quality, dissemination, and investor preferences, its influence is nuanced. Studies by HAJLI [4] and FRYNAS [5] reveal that information quality, pivotal in crash risk assessment, may paradoxically trigger crashes due to management's suppression of adverse news. Qi Yidong et al. [6] discovered that digital transformation's networked, flat structure alters information flow, diminishing managerial autonomy in operations, thereby lowering crash risks from opportunistic behavior. Ma Hui et al. [7] argue that digitalization curbs insiders' incentives and ability to conceal unfavorable info, lessening future crash risks. Zhou Lei et al. [8] concur, showing higher digitalization levels reduce crash risks by bolstering internal controls, deterring opportunism, and minimizing operational hazards. Guo Hengtai et al. [9] found digital transformation enhances financial disclosure transparency by transforming structured data into unstructured formats like images and audio, diminishing stock price synchronization. Lastly, Li Wei et al. [10] contend that digitalization improves corporate governance, weakening earnings management motives, and thus aiding in crash risk reduction.

3. Theoretical analysis and research hypothesis

Enterprises undergoing digital transformation harness advanced technologies like big data and cloud computing to refine market insights, streamline decision-making, and bolster risk management. This transformation mitigates stock market crash risks via diverse pathways: bolstering information transparency, refining risk anticipation and reaction, and enhancing operational proficiency. This mitigating impact is poised to amplify with time, fueled by the cumulative benefits of heightened visibility, improved forecasting prowess, and ongoing optimizations stemming from digitalization.

Based on this, the following research hypothesis is proposed:

H1: Digital transformation of enterprises can mitigate the risk of stock market collapse.

H2: The mitigating effect of enterprise digital transformation on stock market collapse risk will gradually increase over time.

4. Research Design

Given that the digital transformation trend has only emerged in recent years, in order to ensure the timeliness and informativeness of the research data, this paper selects the data of listed companies in

China from 2012 to 2022. In order to ensure the accuracy and reliability of the study, this paper will further exclude companies with severe data gaps or non-compliant reporting, and exclude companies marked as ST (Special Treatment) or *ST (Delisting Risk Warning) during the research period and exclude financial listed companies.

To test the impact of a company's current digital transformation on the risk of a stock price collapse, the following model was built (while controlling for year, individual, and industry):

$$NCSKEW_{it} = \beta_0 + \beta_1 Dig_{it} + \beta_2 ROE_{it} + \beta_3 Cashflow_{it} + \beta_4 Dual_{it} + \beta_5 Top5_{it} + \beta_6 TobinQ_{it} + \beta_7 Ins_{it} + \sum Year + \sum Id + \sum Ind + \varepsilon_{it} \quad (1)$$

$$NCSKEW_{it} = \beta_0 + \beta_1 LDig_{it} + \beta_2 ROE_{it} + \beta_3 Cashflow_{it} + \beta_4 Dual_{it} + \beta_5 Top5_{it} + \beta_6 TobinQ_{it} + \beta_7 Ins_{it} + \sum Year + \sum Id + \sum Ind + \varepsilon_{it} \quad (2)$$

$$NCSKEW_{it} = \beta_0 + \beta_1 L2Dig_{it} + \beta_2 ROE_{it} + \beta_3 Cashflow_{it} + \beta_4 Dual_{it} + \beta_5 Top5_{it} + \beta_6 TobinQ_{it} + \beta_7 Ins_{it} + \sum Year + \sum Id + \sum Ind + \varepsilon_{it} \quad (3)$$

Among them, *NCSKEW* is the negative skewness coefficient; *Dig* is the digital transformation index for the current period; *L.Dig* is the first-order digital transformation lag; *L2.Dig* is the second-order digital transformation lag; *ROE* is the equity net profit margin; *Cashflow* is the cash flow ratio; *Dual* is the dual role rate; *Top5* is the shareholding ratio of the top 5 shareholders; *TobinQ* is the Tobin Q value; *Ins* is the institutional investor holding ratio; *Year* is the year control variable; *Id* is the individual control variable; *Ind* is the industry control variable; σ is the random disturbance term.

Table 1: Variable Definition.

Variable types	Name	Definition
Dependent variable	NCSKEW	Negative yield skewness coefficient
	DUVOL	Stock return volatility ratio
Independent variable	Dig	Text Analysis Method-Based Measurement Indicators for Enterprise Digital Transformation
	L.Dig	The company's digital transformation index from a year ago
	L2.Dig	The company's digital transformation index from two years ago
Controlled variables	ROE	Return on Equity
	Cashflow	The ratio of EBITDA (earnings before interest, taxes, depreciation, and amortization) to interest expense
	Dual	Is the chairman and the general manager the same person?
	Top5	The ratio of the holding shares of the top 5 shareholders to the total number of shares
	TobinQ	The ratio of market value to replacement value
	Ins	The ratio of institutional investors' holding to the total number of outstanding shares

5. Empirical Analysis

5.1. Benchmark regression

Table 2 reports the results of the benchmark regression, in model (1), the coefficient of *Dig* is -0.000317, which is significant, indicating a significant negative correlation between the Digital Transformation Index (*Dig*) and *NCSKEW*, meaning that as the level of digital transformation increases, the value of *NCSKEW* will decrease accordingly, implying that the risk of stock market crash is reduced; in model (2), the coefficient of *L.Dig* (the lagged one-period value of the Digital Transformation Index) is -0.000452, which is highly significant; in model (3), the coefficient of *L2.Dig* (the lagged two-period value of the Digital Transformation Index) is -0.000499, which is also highly significant. The coefficients of both lagged values indicate that the effects of digital

transformation not only have a significant impact on reducing stock market crash risk in the current period, but also have a persistent impact over time, thereby verifying Hypothesis H1 and H2.

Table 2: Benchmark Regression Result.

Variable	(1)	(2)	(3)
	NCSKEW	NCSKEW	NCSKEW
Dig	-0.000317** (0.000135)		
L.Dig		-0.000452*** (0.000138)	
L2.Dig			-0.000499*** (0.000153)
Constant	-0.336* (0.173)	-0.324* (0.175)	-0.402** (0.186)
Id	Control	Control	Control
Ind	Control	Control	Control
Year	Control	Control	Control
Observations	32493	30996	28246
R ²	0.024	0.028	0.029
Number of enterprises	4670	4528	3967

When the digital transformation index increases by one unit, NCSKEW will correspondingly decrease by about 0.000317 units, and this relationship is statistically significant ($p < 0.05$), indicating that digital transformation has a significant impact on reducing stock market crash risk in the current period; the one-period lagged value of the digital transformation index has a greater impact on NCSKEW and this impact is also very significant ($p < 0.01$), meaning that the degree of digital transformation in the previous period has a significant impact on reducing the stock market crash risk in the current period, and this reduction effect is greater than that of the current period; the two-period lagged value of the digital transformation index continues to strengthen its impact on NCSKEW and remains highly significant ($p < 0.01$). This shows that the long-term effect of digital transformation plays an important role in continuously reducing stock market crash risk. In summary, digital transformation not only has a significant impact on reducing stock market crash risk in the current period, but this impact persists and gradually intensifies in subsequent periods.

5.2. Robustness test

In Table 3, models (1), (2), and (3) present the regression results for replacing the explanatory variable. In model (1), the coefficient of Dig is significantly negative (-0.000236***), indicating a negative correlation between the Digital Transformation Index (*Dig*) and *DUVOL*. In other words, as the level of digital transformation increases, the risk of a sharp decline in the stock price (measured by *DUVOL*) tends to decrease. In model (2), the coefficient of *L.Dig* (the one-period lagged value of the Digital Transformation Index) is also significantly negative (-0.000303***); in model (3), the coefficient of *L2.Dig* (the two-period lagged value of the Digital Transformation Index) also shows a significant negative coefficient (-0.000353***). The significant negative coefficients for both lagged values indicate that the positive impact of digital transformation is not only visible in the current period but also persistent, able to continue reducing the risk of a sharp decline in stock prices in future periods.

Model (4), (5), and (6) in Table 3 provide regression results without controlling for industry fixed effects, and the coefficient of the Digital Transformation Index (*Dig*) is significantly negative,

indicating that as the degree of digital transformation of enterprises increases, the value of *NCSKEW* will decrease. Therefore, digital transformation has a significant impact on reducing stock market crash risk in the current period. The lagged values of the Digital Transformation Index (including one-period lag and two-period lag) also have a significant negative impact on *NCSKEW*, and this impact persists in subsequent periods. This shows that the long-term effects of digital transformation are helpful in stabilizing stock performance and continuously reducing stock market crash risk.

Table 3: Robustness test.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	DUVOL	DUVOL	DUVOL	NCSKEW	NCSKEW	NCSKEW
Dig	-0.000236*** (8.78e-05)			-0.000306** (0.000132)		
L.Dig		-0.000303*** (9.03e-05)			-0.000439*** (0.000135)	
L2.Dig			-0.000353*** (9.97e-05)			-0.000456*** (0.000150)
Constant	-0.197* (0.113)	-0.189* (0.114)	-0.212* (0.122)	-0.307*** (0.0424)	-0.319*** (0.0435)	-0.352*** (0.0452)
Id	Control	Control	Control	Control	Control	Control
Ind	Control	Control	Control	Not Control	Not Control	Not Control
Year	Control	Control	Control	Control	Control	Control
Observations	32493	30996	28246	32493	30996	28246
R ²	0.028	0.033	0.034	0.023	0.027	0.029
Number of enterprises	4670	4528	3967	4670	4528	3967

6. Research Conclusions and Countermeasures

6.1. Research Conclusions

Extensive research underscores the profound mitigating impact of corporate digital transformation on stock price collapse risks. This effect transcends the short term, progressively intensifying with time. Corporate digitalization not only buffers stock prices in the immediate future, diminishing collapse risks, but also fosters long-term stability whose significance grows more evident. This revelation offers corporate strategists a fresh perspective: leveraging digital transformation to bolster organizational resilience and uphold greater stability amidst market volatility.

6.2. Countermeasures

Drawing upon the aforementioned research outcomes, this paper outlines the following strategic policy suggestions:

Firstly, corporations ought to acknowledge the pivotal role of digital transformation in mitigating stock price collapse risks and proactively adopt pertinent technologies and methodologies. By refining production, management, and marketing approaches, they can enhance their adaptability to market shifts. Secondly, governments are advised to embark on comprehensive analyses of the diverse digital transformation requirements and obstacles faced by various industries, subsequently devising tailored policy interventions. Specifically, they could offer enhanced technical backing and financial incentives to traditional sectors, notably manufacturing, to facilitate their transition.

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