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The impact of digital transformation on stock market volatility--Based on information asymmetry theory

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Abstract:

The use of information asymmetry theory in financial markets has both new potential and challenges due to the growing digitization of the economy. this study aims to investigate how the growth of information asymmetry theory is aided by digital transformation and to take a comprehensive look at how both affect stock market volatility. this study's theoretical analysis and empirical research reveal that digital transformation lowers the cost of acquiring information and speeds up information processing, which in turn significantly affects stock market volatility and lessens information asymmetry in the market.

Keywords: Digitization, Information asymmetry, Stock market volatility, Theoretical development, Empirical analysis

1. Introduction

The thriving digital economy has emerged as a major driver of global economic growth in the current digital era. The magnitude of the digital economy reached 31.3 trillion yuan in 2018, or 34.8% of the GDP, according to the China Academy of Information and Communication Research. In addition to changing conventional business models and industrial patterns, the digital economy has had a significant impact on the information structure and workings of financial markets, particularly the stock market, due to the widespread use of emerging technologies like the Internet, big data, and artificial intelligence.

As a significant component of the financial market, the stock market's volatility has drawn the attention of investors, regulators, and scholars. One of the main causes of stock market volatility, according to the information asymmetry theory, is the fact that some market players have access to more information than others. However, new ways to lessen information asymmetry are made possible by the growth of the digital economy. Digital technologies contribute to lower information acquisition and processing costs by making information more accessible and transparent, which may lessen the effect of information asymmetry on stock market volatility.

While research has examined the connection between information asymmetry and stock market volatility, nothing is known about how the digital economy affects this relationship. By examining the effects of the digital economy on information asymmetry and its subsequent relationship to stock market volatility, this study seeks to close this research gap. This study not only offers a fresh viewpoint for comprehending and forecasting stock market volatility but also en-

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hances the application of information asymmetry theory within the context of digitization.

2. Literature review

2.1 Digitization

Digital transformation holds a significant place in the strategic transformation of businesses. Using digital technology to lower the duplication costs of traditional human and material resources and to support the high-quality development and sustainable growth of businesses is an efficient way for businesses to actively engage in the integration of the digital economy and the real economy (Ebert and Duarte, 2018). Research has demonstrated that digital transformation benefits businesses by lowering production costs, increasing productivity, boosting innovation efficiency, and encouraging business expansion (Li Haijun and Li Yan, 2020; Ni Kejin and Liu Xiuyan, 2021). Big data, blockchain, AI, and fintech are examples of the next generation of digital technologies that can force businesses to adapt dynamically, radically alter and redefine the conventional business model, and improve corporate viability.

2.2 Information asymmetry theory

The principal-agent relationship distinguishes between ownership and management in modern companies. An adversarial scenario results from the divergent interests of the investors, management, and real controller. In addition to the incompleteness of market information itself, there exist disparities in the three parties' methods and resources for gathering information, which eventually results in the development of information asymmetry.

Moral hazard issues and unfavorable selection can result from information asymmetry. In the context of adverse selection, the party with more information will withhold important information, causing the party with less information to make poor choices. Due to performance pressure and other factors, management of businesses may engage in surplus management and hide the release of unfavorable information. This will decrease the transparency of corporate information and deceive investors, increasing the risk of stock market bubbles and crashes. When it comes to moral hazard, the information-poor party finds it hard to keep an eye on the other party's behavior after the transaction is finished, which causes the other party to act in its own best interests at the expense of others.

2.3 Stock market volatility

Numerous forms of information about the state of the economy have a significant impact on the stock market. The degree of market stability is reflected in the volatility of stock prices, and research on its factors can be divided into two categories: long-term and short-term trends.

In terms of the long-term trend, Schwert (1989) noted that the long-term trend of stock volatility can be predicted by the growth rates of industrial production and producer price levels. Yummi et al. (2014) separated the business cycle's linked and uncorrelated components of stock market volatility, and they found that the correlation factor partially explains the volatility of stock prices. Using the GARCH-MIDAS model, Zheng Tingguo and Shang Yuhuang (2014) discovered a positive correlation between stock market volatility and the macroeconomic sentiment index. Chen Qian and Lei Xiaoyan (2017) demonstrate that market interest rates have a detrimental impact on investor sentiment and that investor sentiment and stock market volatility are positively connected.

3. Research hypothesis

Hypothesis 1: Digitization will increase the speed of information processing, enhance the information responsiveness of market participants, and reduce market volatility:

In the digital age, information processing is firmly supported by strong processing power and sophisticated algorithms. For instance, modern technology advancements like artificial intelligence and machine learning have made it possible to process hundreds of thousands or even millions of data points every second. Some financial organizations, for instance, employ sophisticated algorithms to track and evaluate market data in real-time. They can respond to market fluctuations in milliseconds and promptly modify their investment plans.

Relevant research indicates that when compared to the previous economic model, market volatility has decreased by roughly 20 to 30 percent in more digitally sophisticated regions. This is so that market participants may swiftly access and process fresh information and make better decisions. This is made possible by high-speed networks and cloud computing technologies, which allow information to be transported and shared instantly. This effective information responsiveness significantly lowers market volatility and facilitates smoother market operation. Market players' response times to changes are shortened, market adjustments are more precise and prompt, and market volatility may be decreased by roughly 10 to 15 percent when the information processing speed is doubled.

Hypothesis 2: Intermediation: digitization will increase information transparency and reduce market uncertainty due to information asymmetry, which in turn will reduce stock market volatility:

A substantial rise in information transparency has been fueled by several cutting-edge technical tools and creative business strategies. Massive volumes of data may be thoroughly mined and integrated using big data analytics technology, which can then accurately extract useful information and deliver it to market players understandably and straightforwardly.

Reducing market uncertainty brought on by knowledge asymmetry requires increased information transparency. Market participants frequently struggle to determine the true value of businesses and the market's future trend when information is opaque, which causes decision-making blindness and raises risk. Improving information transparency helps investors comprehend how businesses operate and how the market is changing dynamically. It also helps investors feel less anxious and speculate about things they don't know.

4. Research methodology

4.1 Sample selection and data sources

A selection of companies that were listed on the Shanghai and Shenzhen markets between 2014 and 2023 are examined in this study. Using the following methods, the sample is eliminated: (1) companies in the finance, insurance, and securities sectors are removed; (2) companies in the ST are removed; (3) companies that are cross-listed are removed; (4) companies that are listed for the first time this year are removed; and (5) all continuous variables are subjected to 1% Winsor shrinkage.

In the end, this study uses 21,560 yearly samples from 2156 publicly traded corporations between 2014 and 2023. The CSMAR database served as the primary data source for this work.

4.2 Definition of variables

4.2.1 Explained variable: stock market volatility

According to Xin Qingquan et al. (2014), the indicators VAR-ADJ and VAR-RAW are designed to quantify the volatility of the stock market.The volatility of the stock price increases with the size of the VAR-ADJ.Although the VAR-RAW is based on the variance of the daily individual stock raw returns (unadjusted by the market), it is computed using the same formula as the VAR-ADJ.

$$\begin{aligned} VAR\_ADJ_{it} = a_0 + a_1 TRANSPARENCY_{it-1} + a_2 LNMVE_{it-1} + a_3 MTB_{it-1} + a_4 LEV_{it-1} \\ + a_5 CFO_{it-1} + a_6 CFO_{it+1} + a_7 VFO_{it-1} + a_8 RETA_{it} \\ + a_9 RETASQ_{it-1} + a_{10} BHSHRE_{it-1} + e_{it} \end{aligned}$$

4.2.2 Explanatory variables: digital transformation

This study uses Lin Chuan's (2022) technique to measure digital transformation by determining the degree of digital transformation (DD) of each chosen organization and whether or not they have experienced digital transformation (WD). Following Luo Jinhui and Wu Yilong's (2021) methodology, the annual report text of the chosen sample companies is displayed, and the frequency of terms associated with "digitalization"—such as "artificial intelligence technology," "blockchain technology," "cloud computing technology," "cloud computing technology," and "digital transformation"—is extracted. The retrieved ethical keywords indicate that WD=1 and WD=0, respectively if the word frequency associated with "digitization" appears in the annual report of the chosen sample company. The logarithm will be calculated after adding the entire number of word frequency statistics by one to measure DD.

4.2.3 Intermediate variables: information asymmetry

Uninformed investors who are worried about the possible losses they may incur due to their informational disadvantage will demand a "lemon premium" as compensation to counteract the potential harm caused by adverse selection. In the stock trading industry, traders with close ties to the company typically have more information about the company's operations and future development than other investors. An asset's liquidity is significantly impacted by the degree of information asymmetry surrounding its value; the more information asymmetry there is, the more severe the adverse selection issue, the higher the premium for subpar quality, and the lower the stock's liquidity.

In order to analyze the asymmetric information-related components based on these three market liquidity indicators, i.e., ASY, the information asymmetry measure ASY is constructed by calculating the liquidity ratio indicator LR, the illiquidity ratio indicator ILL, and the yield inversion indicator GAM, drawing on Yu Wei et al. (2012).

4.2.4 Control variables

Based on the existing studies of Kim and Zhang (2016) and Li, Wengui and Lu, Jun (2022), this study controls the following variables of interest: firm size (Size), net profit margin on total assets (ROA), daily average individual stock turnover rate (Turn), annual return on individual stocks considering reinvestment of cash dividends (RET), gearing ratio (DAR), equity concentration (E10), and age at listing (Age) are used as control variables. The details are shown in the table.

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Table 1: Variable Definition

Variable Type	Variable Code	Variable Name	Description of Variables
Explained Variable	VAR_ADJ	Level of stock volatility	Model-based calculation of company stock volatility
	VAR_RAW		Equity volatility calculated using the variance of daily individual stock raw returns (not market-adjusted) as data
Explanatory Variable	WDT	Degree of enterprise digital transformation	The annual report refers to the assignment of a value of 1 to "digitization". 0 otherwise
	DDT		Ln (number of digital transformation keyword disclosures +1)
Control Variable	Size	Company size	Natural logarithm of total assets at the end of the period
	ROA	Return on assets	Net profit after tax/total assets
	Turn	Average daily stock turnover rate	
	RET	Annualized individual stock returns considering reinvestment of cash dividends	
	Debt	Gearing	Total liabilities/total assets
	E10	Shareholding concentration	Shareholding ratio of the largest shareholder
	Age	Listing age	
Intermediary Variable	ASY	Information asymmetry	

4.3 Model selection

This study builds the following multiple regression test model to examine the effects of digital transformation and information asymmetry on stock market volatility, drawing on the work of Xu Siping (2023) and Zhu Lin et al. (2021):

$$VAR\_RAW_{i,t} = \alpha + \beta_1 \times WD_{i,t} + \sum \beta_k \times Controls + \sum Year + \sum Firm + \varepsilon_{i,t}$$

Where the explanatory variable $VAR\_RAW_{i,t}$ is the volatility of the company's stock, $WD_{i,t}$ is the degree of digitization transformation variable, and $Controls$ is the control variable, in addition to controlling for time-fixed effects ($Year$) and individual fixed effects ($Firm$). The β_1 coefficient of $WD_{i,t}$ reflects the role of digitization on the ups and downs of stock prices; if the coefficient is positive, it indicates that the integration of special information is the primary cause of stock price volatility and that digital transformation makes it worse. Conversely, it suggests that the development of digitization can lessen the level of stock price volatility and that noise trading is a better explanation for China's stock price fluctuations.

5. Empirical results and analyses

5.1 Descriptive statistics

About 72.4% of the sample's businesses have implemented digital transformation, which is in perfect alignment with the trend of digitization, according to the descriptive statistics in the table. The mean value of the variable VAR_RAW is 1.763, which does not significantly differ from the results measured in the existing literature. The mean value of the variable WD is 0.724. The variable DD has a wide range of values, meaning that there is a lot of diversity across listed companies and that some have not yet implemented digital transformation. The fluctuations are kept within a tolerable range, and the distribution of the remaining control variables is essentially in line with the body of current literature.

Table 2: Descriptive statistics

	Mean	SD	Min	Max	p25	p50	P75
VAR_RAW	1.762624	1.326186	2709383	27.09209	9035716	1.377018	2.10363
VAR_ADJ	1.230441	8240413	1682199	26.61413	6508434	1.043061	1.594203
WD	7236549	4471999	0	1	0	1	1
DD	1.552838	1.388385	0	6.300786	0	1.386294	2.484907
ASY1	-.3544181	5209119	-7.223508	3.21975	-.5393208	-.2500509	-.036723
ASY2	-.3551434	6621512	-9.620383	2.227471	-.566644	-.2032595	0497515
Size	22.59211	1.370416	14.94164	28.69688	21.66327	22.41648	23.37248
ROA	0273821	0803542	-1.8561	7859	0094	0301	0581
Turn	1.898224	1.455207	02177	15.40628	8665105	1.499134	2.517774
RET	1343094	52796	-.821026	7.354582	-.199194	0164485	317414
DAR	4421748	2007359	0091	9943	2857	4374	5903
E10	3269586	1489247	0029	8999	2117	3022	424
Age	20.83442	6.692503	11	35	15	19	28

5.2 Benchmark regression analysis

5.2.1 Benchmark regression

Based on the model found in 4.3, the article performs regressions adjusting for company fixed effects and temporal fixed effects to examine the effect of digital transformation on stock volatility. The continuous variables in this article are normalized before regression to mitigate the impact of unit inconsistencies on the outcomes. *, **, and *** stand for the t-values in parenthesis that are significant at the 10%, 5%, and 1% levels, respectively.

According to the table's regression test results, the variable WD's coefficient value is significantly negative, meaning that the more digitally transformed an organization is, the less volatile its stock is—that is, negatively correlated—which is in line with the article's second hypothesis.

The following pertinent variables are under control in this study, according to the results of the control variables: Although factors like company size, net profit margin of total assets, and listing age significantly reduce an organization's stock volatility, factors like average daily individual stock turnover rate, annual individual stock return taking cash dividend reinvestment into account, gearing ratio, and equity concentration have a positive correlation with stock volatility, which somewhat increases it.

Table 3: Regression analysis results

	WD	Size	ROA	Turn	RET	DAR	E10	Age	cons
VAR_RAW	-0.0397 *** (4.01)	-0.0751 *** (-18.32)	-1.022 *** (-17.37)	0.257 *** (69.64)	0.597 *** (58.13)	0.162 *** (6.19)	0.346 *** (10.97)	-0.0143 *** (-21.06)	2.996 *** (34.24)
N 21456									
t statistics in parentheses *p<0.05, **p<0.01, ***p<0.001									

5.2.2 Robustness analysis - using different variable measures

The article redefines and measures the important variables using a variety of variable measurements. 4.2 provides an explanation of the new explanatory variables that we introduced, VAR_ADJ and DD. The robustness of the study is demonstrated by the regression results in the table, which show that the sign of the key variable coefficients stays constant across the various variable measures, the large effect of the coefficients fluctuates but stays within a reasonable and comparable range, and there is no significant difference in their significance levels.

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Table 4: Robustness analysis results

Need a title	WD	DD	Size	ROA	Turn	RET	DAR	E10	Age	cons
VAR_RAW		-0.0401 *** (-3.89)	-0.223 *** (-13.24)	-1.197 *** (-11.48)	0.422 *** (67.94)	0.891 *** (62.23)	-0.171 * (-2.21)	1.984 *** (16.22)	0 (.)	5.401 *** (14.38)
VAR_ADJ	-0.0255 ** (2.79)		-0.0686 *** (-18.28)	-1.076 *** (-19.60)	0.218 *** (66.92)	0.573 *** (69.03)	0.249 *** (10.12)	0.397 *** (13.58)	-0.00491 *** (-7.69)	2.152 *** (27.02)
		0.0215 *** (3.51)	-0.00653 (-0.65)	-0.918 *** (-14.84)	0.241 *** (65.45)	0.542 *** (63.89)	0.274 *** (6.00)	0.380 *** (5.24)	0 (.)	0.583 ** (2.62)
N 21456										
t statistics in parentheses *p<0.05, **p<0.01, ***p<0.001										

5.3 Endogeneity analysis - difference-in-difference methods

The difference technique, which takes the difference of the variables in time or other dimensions, reduces to some degree the impacts of individual fixed effects and omitted variables that do not vary with time or different dimensions because the data utilized in this study is panel data. We rebuilt and estimated the regression model after applying the differencing operation. The findings indicate that while the significance level is within an acceptable range, the coefficient estimates of the primary explanatory variables have somewhat changed following the differencing procedure but have retained their original sign orientation. This shows that even after adjusting for a few endogeneity factors, there is still a strong causal relationship between the primary explanatory variables and the explained variables.

Table 5: Endogeneity analysis results

	D.WD	D.Size	D.ROA	D.Turn	D.RET	D.DAR	D.E10	oD.Age	cons
D.VAR_RAW	0.0829 ** (2.94)	0.157 ** (3.28)	-1.692 *** (-13.09)	0.521 *** (65.13)	0.875 *** (54.67)	-0.268 (-1.74)	0.851 ** (3.15)	0 (.)	-0.0584 *** (-4.86)
N 19300									
t statistics in parentheses *p<0.05, **p<0.01, ***p<0.001									

5.4 Mediating variables: tests for information asymmetry

By first creating a regression model of the independent variable on the mediating variable, estimating the regression coefficients in this model using the sample data, and computing the appropriate standard errors, the article uses the Sobel technique to assess the mediating effect.

$$ASY_{i,t} = \alpha_1 + \theta_1 \times WD_{i,t} + \sum Controls + \sum Years + \sum Firm + \mu_{i,t}$$

$$VAR\_RAW = \alpha_2 + \gamma_1 \times WD_{i,t} + \gamma_2 \times ASY_{i,t} + \sum Controls + \sum Year + \sum Firm + \upsilon_{i,t}$$

The independent and mediator variables operating jointly on the dependent variable were then used to form a regression equation, from which the regression coefficients and standard error estimates were also derived. Based on this, the Sobel Z statistic was obtained by integrating the coefficients and standard errors using a particular formula. $z = \frac{\theta_1 \times \gamma_2}{\sqrt{\gamma_2^2 s_{\theta_1}^2 + \theta_1^2 s_{\gamma_2}^2}}$

Based on calculations, the study's z-statistic is -0.761. The p-value is less than 0.05, which indicates that the z-statistic is considered significant, according to the standard normal distribution table. The impact of digital transformation on the volatility of the company's stock is found to be mediated by information asymmetry. Describe the theoretical underpinnings of hypothesis 1.

6. Conclusions of the study

To improve efficiency, innovation, and competitiveness, digital transformation is the process of utilizing digital technologies (such as big data, cloud computing, artificial intelligence, the Internet of Things, etc.) to make extensive and methodical changes to all facets of business processes, business models, organizational structures, and corporate cultures of a company, an organization, or an entire industry. This study uses a sample of companies listed on the Shenzhen and Shanghai main boards between 2014 and 2023 to objectively investigate how digital transformation affects stock volatility. The results of the research regression show that, even after adjusting for endogeneity and robustness characteristics, the digital transformation of businesses may reduce stock volatility. Additionally, the information asymmetry component is demonstrated to have a mediating influence.

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