

Digital lifeboat: Can Fintech development prevent shipwrecks in the textile industry?

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ABSTRACT – REZUMAT

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The textile industry's lengthy supply chains, narrow profit margins, and substantial working capital pressures render financial risk management a critical determinant of sustainable industry development. Digital finance, through technological innovation, offers textile firms novel risk management tools. Drawing on information asymmetry theory and financing constraint theory, this study examines how digital finance affects textile firms' financial risk and the underlying mechanisms. Using 3,443 firm-year observations from Chinese A-share textile industry listed companies spanning 2014–2023, we employ two-way fixed effects models to identify these relationships. Results show that digital finance development significantly reduces textile firms' financial risk levels. Mechanism tests reveal that digital finance operates through two pathways, namely alleviating information asymmetry and easing financing constraints, with these pathways exhibiting complementary effects. Heterogeneity analysis demonstrates that digital finance's risk-mitigating effects are more pronounced in central and western regions, firms with greater media coverage, non-state-owned enterprises, and large firms. These findings provide theoretical foundations and practical guidance for textile firms to leverage digital finance tools to optimise financing strategies and enhance risk management capabilities, while also offering policy insights for promoting digital transformation and high-quality development in the textile industry.

Keywords: textile value chain firms, digital finance, financial risk, information asymmetry, financing constraints

Colacul de salvare digital: poate dezvoltarea Fintech să prevină declinul industriei textile?

Industria textilă, caracterizată prin lanțuri de aprovizionare extinse, marje reduse de profit și presiuni semnificative asupra capitalului de lucru, se confruntă cu provocări financiare care fac din managementul riscului un element esențial pentru dezvoltarea sustenabilă a sectorului. În acest context, finanțarea digitală oferă noi oportunități pentru îmbunătățirea gestionării riscului financiar la nivelul firmelor. Pe baza teoriei asimetriei informaționale și a teoriei constrângerilor de finanțare, acest studiu analizează impactul finanțării digitale asupra riscului financiar al firmelor textile, precum și mecanismele prin care acest efect se produce. Analiza empirică se bazează pe 3.443 de observații de tip firmă-an, corespunzătoare companiilor listate din industria textilă pe piața chineză A-share, pentru perioada 2014–2023 și utilizează modele cu efecte fixe bidirecționale. Rezultatele evidențiază că dezvoltarea finanțării digitale reduce semnificativ riscul financiar al firmelor textile. Testele privind mecanismele de influență arată că acest efect este mediat de reducerea asimetriei informaționale și de relaxarea constrângerilor de finanțare, cele două canale acționând complementar. Analiza heterogenității indică faptul că efectul de diminuare a riscului este mai pronunțat în regiunile centrale și vestice, în cazul firmelor cu o expunere mediatică mai ridicată, al întreprinderilor private și al firmelor mari. Rezultatele furnizează contribuții teoretice și implicații practice pentru firmele textile interesate de optimizarea strategiilor de finanțare și de consolidarea capacității de gestionare a riscului, cât și repere utile pentru elaborarea politicilor menite să sprijine transformarea digitală și dezvoltarea de înaltă calitate a industriei textile.

Cuvinte-cheie: firme din lanțul valoric al textilelor, finanțare digitală, risc financiar, asimetrie informațională, constrângeri de finanțare

INTRODUCTION

The textile industry, a quintessential labour-intensive sector, occupies a pivotal position in the global manufacturing system [1]. According to World Trade Organisation statistics, textile and apparel trade consistently accounts for 5% to 7% of global merchandise trade, with direct employment exceeding 60 million people worldwide. However, textile firms

generally face severe financial challenges, including restricted access to credit, substantial cash flow pressures, and limited risk resilience [2]. These firms typically lack sufficient collateral assets and exhibit low information disclosure transparency, making it difficult for traditional financial institutions to accurately assess their creditworthiness. Consequently, financial institutions adopt credit rationing strategies or require substantial collateral. Intensified financing

constraints not only restrict firms' daily operations and technological upgrading but also significantly elevate financial risk levels, threatening their sustainable development. Against this backdrop, the rapid development of digital finance offers a promising avenue for alleviating the financial distress of textile firms. Through innovations such as big data risk assessment, supply chain finance, and mobile payments, digital finance can transcend the geographic and informational barriers of traditional financial services, providing more accessible and cost-effective financing channels for underserved customers. Therefore, systematically examining how digital finance affects textile firms' financial risk and the underlying mechanisms carries important theoretical and practical implications for understanding how digital technologies empower the real economy and optimise financial resource allocation.

From a theoretical perspective, digital finance's impact on corporate financial risk can be understood through two complementary frameworks: information asymmetry theory and financing constraint theory. Information asymmetry theory posits that information gaps between lenders and borrowers lead to adverse selection and moral hazard problems, which in turn trigger credit rationing and higher financing costs [3]. In the textile industry, information asymmetry is particularly acute due to firms' typically small scale, opaque financial information, and insufficient collateral assets. Traditional financial institutions primarily rely on hard information, namely financial statements, collateral, and third-party guarantees, for risk assessment. However, such information is often outdated and incomplete, failing to accurately reflect textile firms' operating performance and repayment capacity. Digital finance platforms integrate multi-dimensional soft information, including transaction records from e-commerce platforms, logistics data, tax records, and supply chain relationships, to construct more comprehensive and dynamic credit profiles. This big data and machine learning-based risk assessment model significantly reduces information acquisition costs and assessment errors, enabling financial institutions to more accurately identify firms' true risk levels. Improved information disclosure quality reduces capital costs and enhances resource allocation efficiency [4]. Thus, by improving the information environment, digital finance is expected to reduce textile firms' financing costs and the extent of credit rationing, thereby mitigating financial risk.

Financing constraint theory emphasises that the wedge between external and internal financing costs affects firms' investment decisions and financial stability [5]. Due to information asymmetry and agency problems, external financing costs typically exceed internal financing costs. This financing friction leads to underinvestment or excessive reliance on short-term debt, thereby increasing financial risk [6]. For textile firms, low industry profit margins, long asset turnover cycles, and pronounced seasonal fluctuations create high dependence on external financing.

However, traditional financial systems provide relatively limited credit support to small and medium enterprises and labour-intensive industries, resulting in severe financing constraints for textile firms. Digital finance significantly eases these constraints by offering diversified, low-cost, and convenient financing channels. For instance, pure credit loans based on transaction flows and supply chain data directly address the core challenge of small and medium enterprises lacking collateral. Mobile payments and digital wallets improve capital turnover efficiency. Supply chain finance platforms transmit core enterprises' credit to upstream and downstream small and medium enterprises, expanding financing availability. These innovative financing models not only increase firms' liquidity reserves but also optimise capital structure and reduce dependence on single financing channels, thereby enhancing firms' capacity to cope with unexpected payment demands and market volatility, ultimately reducing financial risk.

Although the above theoretical frameworks provide important foundations for understanding the relationship between digital finance and corporate financial risk, existing empirical research exhibits three key limitations. First, current research adopts narrow theoretical perspectives. Most studies explain digital finance's economic consequences through either financing constraint theory or information asymmetry theory in isolation, potentially overlooking the interactive effects and relative importance of these mechanisms [7–9]. In practice, improved information asymmetry can reduce financial institutions' risk premiums, thereby easing financing constraints. Conversely, expanded financing channels incentivise firms to enhance information disclosure quality to secure better financing terms. Therefore, single-perspective approaches inadequately capture the complete picture of how digital finance affects corporate financial risk.

Second, the transmission mechanisms through which digital finance affects corporate financial risk remain unclear. While existing research documents that digital finance improves firms' financing and information environments, how these improvements specifically translate into reduced financial risk, and what the mediation process entails, remains ambiguous. Current literature emphasises direct effects while neglecting mechanism identification.

Specifically, digital finance may affect financial risk through multiple pathways. The first is an information mechanism: digital finance platforms leverage firms' transaction flows, supply chain data, and other alternative information to construct credit profiles, reducing information asymmetry between banks and firms, thereby decreasing credit rationing and risk premiums and ultimately improving cash flow stability and debt servicing capacity. The second is a financing mechanism: digital finance provides diversified, low-cost financing tools that directly alleviate financing constraints, enhancing firms' ability to meet unexpected payment obligations and reducing liquidity risk. Identifying these mediation mechanisms not

only deepens theoretical understanding of digital finance's pathways but also provides micro-foundations for understanding how digital technologies reshape financial resource allocation.

Third, the boundary conditions under which digital finance affects corporate financial risk remain unclear. Existing research rarely examines conditions under which digital finance's impact on financial risk strengthens, weakens, or changes direction, limiting the theory's applicability and predictive accuracy. In reality, digital finance's risk-mitigating effects may vary significantly across firm characteristics, regional environments, and external monitoring intensity. For example, in regions with scarce traditional financial resources, digital finance may generate greater marginal utility. In firms subject to stronger external monitoring, digital finance's information transparency effects may be amplified. Across different ownership structures and firm sizes, digital finance's mechanisms may differ. The effectiveness of small and medium enterprise financing models depends heavily on the institutional environment and market structure [10]. Therefore, identifying these boundary conditions is crucial for understanding digital finance's mechanisms across contexts and enhancing theoretical precision.

Addressing these research gaps carries important theoretical and practical significance. Theoretically, integrating financing constraint theory and information asymmetry theory and systematically identifying digital finance's dual mechanisms for affecting corporate financial risk and their interactive effects advances theoretical development in digital finance research and deepens understanding of how financial technology reshapes corporate risk management. Simultaneously, identifying boundary conditions such as regional environment, external monitoring, ownership structure, and firm size enhances theoretical precision and predictive power. Practically, this research provides decision-making guidance for textile firms to optimise financing strategies and enhance risk management capabilities, while offering empirical evidence for regulators to improve digital finance infrastructure and formulate differentiated support policies.

Existing research extensively explores digital finance's impact on corporate behaviour. Scholars find that digital finance promotes innovation, improves investment efficiency, and enhances operating performance by reducing transaction costs, improving information transparency, and expanding financing channels [7, 8]. Fintech lenders possess distinct advantages in information processing speed and risk pricing accuracy, enabling them to serve customer segments that traditional banks struggle to reach. Recent research also finds that digital finance development improves firms' sustainability performance, indicating that digital finance affects not only financial decisions but also long-term development [11]. However, existing literature primarily examines digital finance's impact on positive outcomes such as

innovation and investment efficiency, with less systematic examination from a risk management perspective of how digital finance affects corporate financial risk levels, especially in labour-intensive, severely financing-constrained industries like textiles, where this question remains inadequately addressed. China's textile industry provides a unique research setting for testing the relationship between digital finance and corporate financial risk. First, as a quintessential labour-intensive industry, textiles' characteristics, including financing difficulties, lengthy supply chains, and thin profit margins, make it an ideal context for testing digital finance's risk management effects. Textile firms occupy important positions in global value chains yet face complex financing constraints and transformation pressures. These industry characteristics create high dependence on external financing while making firms more vulnerable to financing constraints and information asymmetry problems. Second, China's rapid digital finance development provides rich policy and temporal variation for research. China's innovative practices in digital finance, including third-party payments, online lending, and supply chain finance, offer quasi-experimental variation for testing digital finance's impact on corporate financial risk. Third, significant differences in economic development levels, financial market maturity, and institutional environments across Chinese regions provide natural experimental settings for testing heterogeneous effects of digital finance. This research setting not only carries local practical significance but also provides important evidence for the international academic community to understand digital finance's mechanisms in emerging markets and labour-intensive industries.

To address these research gaps, this study examines digital finance's impact on textile firms' financial risk, including underlying mechanisms and boundary conditions. Based on financing constraint theory and information asymmetry theory, we construct an integrated analytical framework, proposing that digital finance reduces corporate financial risk through two pathways: easing financing constraints and alleviating information asymmetry. This study uses data from Chinese A-share textile industry listed companies from 2014 to 2023. The sample covers textiles and related supply chain industries, containing 3,443 firm-year observations. We employ two-way fixed effects models to identify the causal effect of digital finance on corporate financial risk and conduct robustness checks using lagged variables and prefecture-level fixed effects. Results show that digital finance development significantly reduces textile firms' financial risk levels. Mechanism tests indicate that digital finance operates through two pathways, namely reducing information asymmetry and easing financing constraints, with these pathways exhibiting complementary effects. Further heterogeneity analysis reveals that digital finance's risk-mitigating effects are more pronounced in central and western regions, firms with higher media attention, non-state-owned enterprises, and large firms. These findings remain

robust after controlling for firm size, leverage, equity structure, and other factors, and pass multiple robustness checks, including lagged variables and prefecture-level fixed effects.

This research makes several theoretical contributions. First, it extends the theoretical boundaries of research on digital finance's economic consequences. Although digital finance theory is widely applied to explain positive outcomes such as innovation and investment efficiency, its applicability in risk management remains insufficiently tested. By empirically testing the relationship between digital finance and financial risk in textile industry samples, this research expands digital finance theory's scope. The textile industry, with its labour-intensive and capital-intensive characteristics, financing difficulties, lengthy supply chains, and thin profit margins, provides an ideal setting for testing digital finance's risk management effects. Existing research suggests that financial innovation's impact may differ significantly across industries. This research finds that digital finance significantly reduces financial risk even in textiles' unique context, demonstrating digital finance's risk-mitigating effects' strong generalizability while revealing unique mechanisms in labour-intensive industries.

Second, this research reveals digital finance's dual mechanisms for affecting corporate financial risk. Although existing research documents that digital finance affects corporate behaviour, the underlying mechanisms remain unclear. This research finds that digital finance affects financial risk through two pathways: an information mechanism and a financing mechanism. The information mechanism operates through digital finance platforms leveraging big data risk control technology to reduce information asymmetry between banks and firms, decreasing credit rationing and risk premiums and improving cash flow stability. Improved information disclosure quality reduces capital costs and enhances market liquidity [4]. The financing mechanism operates through digital finance, providing diversified, low-cost financing tools that directly ease financing constraints and enhance the capacity to meet unexpected payment demands. Financing constraints significantly affect firms' investment decisions and financial stability [6]. Empirical results support both pathways with complementary effects. Identifying these mediation mechanisms not only deepens theoretical understanding of digital finance's pathways but also provides micro-foundations for understanding how financial technology reshapes corporate risk management.

Third, this research identifies important boundary conditions for digital finance's impact on corporate financial risk. Specifically, in central and western regions where traditional financial resources are relatively scarce, digital finance generates greater marginal utility with more pronounced risk-mitigating effects. In firms with higher media attention, external monitoring pressures reinforce digital finance's information transparency effects, consistent with existing findings on external governance mechanisms' roles

[12–14]. In non-state-owned enterprises lacking implicit government guarantees, digital finance's financing channel expansion proves more critical. In large firms, more sophisticated internal management systems enable fuller utilisation of digital finance tools. By clarifying these boundary conditions, this research enhances digital finance theory's precision in predicting risk management effects and provides new evidence for understanding complementary or substitution relationships between information and financing mechanisms across contexts.

Fourth, this research provides a new theoretical perspective on the relationship between digital finance and corporate sustainability. By revealing how digital finance reduces corporate financial risk, this research provides new empirical evidence for understanding how digital technologies enhance firm resilience and promote sustainable development. Reduced financial risk not only directly improves firms' survival capacity and development potential but also creates more stable financial foundations for long-term investment, technological innovation, and sustainability practices. Practically, this research helps textile firms optimise digital finance application strategies according to their characteristics and external environments, while providing a reference for regulators to formulate differentiated digital finance support policies.

The remainder of this article proceeds as follows. Section 2 reviews related literature and develops research hypotheses based on theoretical analysis. Section 3 introduces the research design, including sample selection, variable measurement, and econometric model specification. Section 4 reports empirical results, including baseline regressions and robustness tests. Section 5 conducts mechanism and heterogeneity analyses. Section 6 concludes by summarising the theoretical and practical implications of research findings and identifying research limitations and future research directions.

THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

Digital finance and corporate financial risk

Corporate financial risk refers to the probability that a firm experiences financial distress, declining debt servicing capacity, or even bankruptcy due to various uncertainties in business operations [15]. For textile firms, financial risk is particularly acute due to distinctive industry characteristics and operational environments [16, 17]. The textile industry, characterised as labour-intensive with predominantly small and medium enterprises, lengthy supply chains, and narrow profit margins, commonly faces restricted credit access, substantial cash flow pressures, and limited risk resilience. Traditional financial systems provide relatively limited credit support to small and medium enterprises and labour-intensive industries, resulting in severe financing constraints for textile firms. Simultaneously, small firm size, opaque financial information, and insufficient collateral exacerbate

information asymmetry, further intensifying financing difficulties and financial risk.

The rapid development of digital finance offers promising avenues for alleviating textile firms' financial distress. Digital finance encompasses financial services delivered through digital technologies such as the internet, big data, cloud computing, artificial intelligence, and blockchain, including digital payments, online lending, supply chain finance, and equity crowdfunding [8]. Compared with traditional finance, digital finance offers advantages of broad coverage, low cost, high efficiency, and minimal barriers to entry, transcending geographic and informational constraints of traditional financial services to provide more accessible and cost-effective financing channels for underserved customers [7].

From a theoretical perspective, digital finance's impact on corporate financial risk can be understood through two complementary dimensions. The first dimension draws on information asymmetry theory, which posits that information gaps between lenders and borrowers generate adverse selection and moral hazard problems, triggering credit rationing and elevated financing costs [3]. Digital finance platforms integrate multi-dimensional soft information, including transaction records from e-commerce platforms, logistics data, tax records, and supply chain relationships, to construct comprehensive and dynamic credit profiles. This big data and machine learning-based risk assessment model significantly reduces information acquisition costs and assessment errors, enabling financial institutions to more accurately identify firms' true risk levels. Improved information disclosure quality reduces capital costs and enhances resource allocation efficiency [4].

Therefore, by improving the information environment, digital finance is expected to reduce textile firms' financing costs and the extent of credit rationing, thereby mitigating financial risk.

The second dimension draws on financing constraint theory, which emphasises that the differential between external and internal financing costs affects firms' investment decisions and financial stability [5]. Due to information asymmetry and agency problems, external financing costs typically exceed internal financing costs. This financing friction leads to underinvestment or excessive reliance on short-term debt, thereby increasing financial risk [18]. Digital finance significantly eases these constraints by offering diversified, low-cost, and convenient financing channels. For instance, pure credit loans based on transaction flows and supply chain data directly address the core challenge of small and medium enterprises lacking collateral. Mobile payments and digital wallets improve capital turnover efficiency. Supply chain finance platforms extend anchor firms' credit to upstream and downstream small and medium enterprises, expanding financing availability. These innovative financing models not only increase liquidity reserves but also optimise capital structure and reduce dependence on single financing channels,

thereby enhancing firms' capacity to cope with unexpected payment demands and market volatility, ultimately reducing financial risk.

Specifically, digital finance's risk-mitigating effects on textile firms manifest in several ways. First, digital finance facilitates capital flows throughout the textile supply chain. Textile firms typically operate within lengthy and complex supply chains spanning raw material procurement, production processing, distribution, and final consumption. Within this extensive network, capital flows directly determine supply chain efficiency and firm survival. However, traditional financial models often fail to meet the financing needs of various supply chain participants, impeding capital circulation and constraining supply chain development. Digital finance, leveraging advanced technologies such as big data and artificial intelligence, more precisely identifies financing needs across supply chain stages and delivers appropriate financial services. A stable and accessible financing environment enhances financing efficiency and reduces the likelihood of capital flow disruptions, playing a crucial role in textile firms' financial stability. Second, diversified financing instruments provided by digital finance help textile firms manage seasonal and cyclical fluctuations. Textile firms frequently face seasonal and cyclical variations that significantly impact capital flows. Beyond traditional bank loans, digital finance offers diversified financing channels, including internet financial platforms with more flexible credit terms, equity crowdfunding, blockchain-based supply chain finance, and accounts receivable financing platforms. This diversification reduces dependence on a single financing source and enhances financing resilience. These financing instruments enable firms to obtain needed capital promptly while substantially reducing search, negotiation, and transaction costs, making small-scale, short-term, flexible financing feasible to support operational expansion during peak seasons and alleviate cash flow pressures during off-seasons. Through judicious use of these financing tools, firms can better manage capital flows and significantly reduce financing and operating costs. This not only directly enhances profitability but also substantially strengthens risk resilience, enabling firms to respond more effectively to market volatility and economic uncertainty, ensuring operational stability and sustainable development.

Third, digital finance development improves firm credit ratings and financing availability. Digital technology and platform economy development transcends traditional supply chain credit models centred on anchor firms, extending beyond original supply chain boundaries to enable credit circulation and expand the scope of industrial digital finance. Large numbers of firms access industrial internet platforms, achieving supply chain transparency [19]. Without relying on anchor firm credit enhancement, firms can convert their own commercial credit into financial credit to obtain financing, alleviating operational risks

stemming from inadequate credit guarantees, insufficient collateral, and limited financing scope [20]. Through comprehensive firm evaluation, lenders identify high-quality borrowers, reducing borrower risk through improved counterparty selection and enabling capital to flow with lower risk, thereby enhancing risk resilience. Both capital suppliers and demanders reduce their respective risks through digital finance applications, enabling optimal allocation of limited resources. This helps firms obtain better-matched financing sources, improving cash flow sustainability and thereby achieving healthy operational development. Simultaneously, enhanced information transparency and regulatory oversight in financial markets help reduce information asymmetry and moral hazard, further lowering firms' financial risk. Based on this analysis, we propose the following hypothesis:

Hypothesis 1: Digital finance development significantly reduces textile firms' financial risk levels.

The mediating role of information asymmetry

Information asymmetry constitutes a fundamental source of financial risk for textile firms. Information asymmetry theory posits that when transacting parties possess unequal information, market failures and resource allocation inefficiencies arise. In financial markets, information asymmetry primarily manifests as borrowing firms possessing superior knowledge of their true operational conditions, repayment capacity, and risk levels compared to lending institutions. This information differential generates adverse selection and moral hazard problems [3]. For textile firms, high information opacity stems from complex supply chains and vulnerability to raw material price and demand fluctuations. Banks and other traditional financial institutions struggle to accurately assess textile firms' true operational performance, repayment capacity, and prospects. Exercising risk aversion, they adopt credit rationing or require substantial collateral or guarantees, resulting in costly and restricted credit access. This directly elevates firms' leverage risk, liquidity risk, and refinancing risk.

Information asymmetry affects not only external financing but also internal governance. Within firms, principal-agent problems generate information asymmetry between shareholders and managers and between controlling and minority shareholders, increasing agency costs [21]. Managers may engage in opportunistic behaviours such as overinvestment, excessive perquisite consumption, or earnings management to maximise personal interests, harming shareholder value. Controlling shareholders may exploit their authority through related-party transactions and fund appropriation to expropriate minority shareholders. These agency problems reduce investment efficiency and cause resource misallocation, potentially leading to declining profitability and deteriorating cash flows, ultimately increasing operational and bankruptcy risk.

Digital finance development provides novel technological approaches to alleviating information asymmetry. Digital finance platforms leverage massive, real-time, unstructured data, including transaction records from e-commerce platforms, logistics information, tax data, and social media activity, to construct comprehensive digital profiles that more accurately and dynamically reflect firms' operating profitability, cash flow status, contract performance, and supply chain relationship stability. This big data and machine learning-based credit evaluation model reduces external investors' costs and difficulties in obtaining soft information about firms, transcending the limitations and lag of traditional financial statements. Existing research demonstrates that fintech lenders possess distinct advantages in information processing speed and risk pricing accuracy, enabling them to serve customer segments that traditional banks struggle to reach [7].

A more transparent information environment not only improves external financing conditions but also strengthens internal governance. When operational information becomes more transparent, managers' and controlling shareholders' behaviours face greater external scrutiny. Market reputation mechanisms and potential financing constraints discipline managerial opportunism and shareholder expropriation. Improved information disclosure quality reduces agency costs and enhances corporate governance, thereby avoiding principal-agent problems, achieving optimal resource allocation, improving decision-making and operational efficiency, supporting sustainable development, and reducing the probability of financial distress.

Specifically, digital finance reduces financial risk through alleviating information asymmetry via several mechanisms. First, credit evaluation models constructed by digital finance platforms using big data technology more accurately identify firms' true risk levels, reducing financial institutions' risk premiums and thereby lowering firms' financing costs. Lower financing costs directly improve cash flow conditions and relieve financial pressure. Second, a more transparent information environment reduces credit rationing and enhances financing availability. When financial institutions can more accurately assess firm risks, they become more willing to extend credit to high-quality firms, thereby easing financing constraints. Third, enhanced information transparency strengthens external monitoring, constraining opportunistic behaviours by managers and controlling shareholders, reducing agency costs, and improving resource allocation and operational efficiency. Higher operational efficiency and more robust cash flows jointly reduce financial risk.

Based on this analysis, we propose the following hypothesis:

Hypothesis 2: Digital finance reduces textile firms' financial risk by alleviating information asymmetry.

The mediating role of financing constraints

Financing constraints refer to difficulties firms face in obtaining capital for investment and operations when external financing costs exceed internal financing costs [22]. Financing constraint theory emphasises that, due to information asymmetry and agency problems, external financing costs typically exceed internal financing costs, and this financing friction affects firms' investment decisions and financial stability [5]. When facing financing constraints, firms may be forced to forego positive net present value investment projects or rely excessively on short-term debt and internal cash flows, thereby increasing financial risk [6].

Textile firms face particularly severe financing constraints. First, as a labour-intensive industry, textiles exhibit relatively low profit margins, lengthy asset turnover cycles, and pronounced seasonal fluctuations, creating high dependence on external financing. However, traditional financial systems provide relatively limited credit support to small and medium enterprises and labour-intensive industries. Financial market imperfections result in limited equity and debt financing channels with high barriers to entry. Bank credit further widens access disparities across ownership structures and firm sizes due to information asymmetry and banks' preference for state-owned, large-scale enterprises. Second, textile firms typically lack sufficient collateral and exhibit opaque financial information, making it difficult for traditional financial institutions to accurately assess creditworthiness, resulting in credit rationing or requirements for substantial guarantees. Intensified financing constraints not only restrict daily operations and technological upgrading but also significantly elevate financial risk levels.

Digital finance development provides novel approaches to easing financing constraints. Digital finance offers innovative financing models, reaches more underserved customers, and broadens textile firms' financing channels. Risk control models built on big data from transaction flows, payments, tax records, and supply chains enable unsecured, pure credit loans that directly address the core challenge of small and medium enterprises lacking collateral. Existing research demonstrates that fintech development has significantly reduced financing barriers for small and medium enterprises and improved financing availability [8]. Accessible financing channels provide important external liquidity sources, helping firms smooth operating cash flow volatility and enhance capacity to meet unexpected payment demands such as equipment maintenance and environmental compliance.

Digital finance eases financing constraints through several mechanisms. First, digital finance provides diversified financing channels, including internet financial platforms, equity crowdfunding, supply chain finance, and accounts receivable financing, reducing dependence on single financing sources and enhancing financing resilience. These financing

instruments substantially reduce search, negotiation, and transaction costs, enabling small-scale, short-term, flexible financing. Second, digital finance platforms leverage big data risk control technology to more accurately assess credit status and repayment capacity, thereby reducing financing barriers and costs. Pure credit loans based on transaction flows and supply chain data directly address the core constraint of small and medium enterprises lacking collateral. Third, digital finance's efficiency and convenience enable firms to quickly obtain capital support [23], promptly addressing operational funding needs and avoiding missed development opportunities or financial distress due to capital shortages.

Easing financing constraints significantly reduces financial risk. Accessible financing channels provide important external liquidity sources, helping firms smooth operating cash flow volatility and enhance their capacity to meet unexpected payment demands. Additionally, efficient resource allocation optimises payment cycles and improves working capital efficiency for upstream suppliers and downstream customers, reducing uncertainty in capital circulation. Healthier capital structure, more robust cash flows, and stronger profitability jointly enhance overall financial resilience and risk-bearing capacity [24]. Existing research demonstrates that easing financing constraints significantly improves investment efficiency and operating performance while reducing financial risk [22].

Based on this analysis, we propose the following hypothesis:

Hypothesis 3: Digital finance reduces textile firms' financial risk by easing financing constraints.

RESEARCH DESIGN

Sample selection and data sources

This study examines A-share listed firms in China's textile and related value chain industries from 2014 to 2023 [1]. Firm-level financial data are obtained from the China Stock Market & Accounting Research (CSMAR) database, while digital finance indicators are drawn from the Digital Financial Inclusion Index published by the Institute of Digital Finance at Peking University. We apply the following screening criteria to the initial sample: (1) exclude specially treated (ST and *ST) firms; (2) exclude firms with missing financial data; and (3) winsorize all continuous variables at the 1st and 99th percentiles to mitigate the influence of outliers. These procedures yield a final sample of 3,443 firm-year observations.

Variable measurement

Dependent Variable: Firm Financial Risk (Z). To measure firm financial risk, this study employs the Z-Score method [25,26], calculated as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad (1)$$

where X_1 = Working Capital/Total Assets, capturing asset liquidity and firm size; X_2 = Retained Earnings/

Total Assets, reflecting cumulative profitability; $X_3 = \text{EBIT}/\text{Total Assets}$, measuring asset profitability; $X_4 = \text{Market Value of Equity}/\text{Book Value of Total Liabilities}$, a financial structure ratio indicating the relationship between equity and debt, thereby measuring solvency; and $X_5 = \text{Operating Revenue}/\text{Total Assets}$, capturing asset turnover and the efficiency of asset utilization.

Independent Variable: Digital Finance Development (Index). We employ the Digital Financial Inclusion Index compiled by the Institute of Digital Finance at Peking University, which represents the most widely adopted measure of regional digital finance development in China. The index incorporates multiple dimensions through a rigorous and objective methodology, aligning with international standards while better capturing China's institutional context. Given its comprehensive coverage and temporal consistency, we adopt this index (scaled by dividing by 100) to measure regional digital finance development.

Control Variables. To isolate the relationship between digital finance and firm financial risk, we include the following firm-level controls: (1) Firm Size (Size), measured as the natural logarithm of total assets; (2) Leverage (Lev), calculated as total liabilities divided by total assets; (3) Largest Shareholder Ownership (Top1), defined as shares held by the largest shareholder divided by total shares outstanding; (4) Listing Age (ListAge), measured as $\ln(\text{current year} - \text{IPO year} + 1)$; (5) Managerial Ownership (Mshare), calculated as shares held by directors and senior management divided by total shares outstanding; (6) Operating Cash Flow (Cashflow), defined as net cash flow from operations scaled by total assets; (7) Current Ratio (Liquid), calculated as current assets divided by current liabilities; and (8) Board Size (Board), measured as the natural logarithm of the number of directors. Additionally, we control for year and firm fixed effects.

Model specification

To examine the relationship between digital finance development and firm financial risk, we estimate the following baseline model:

$$Z_{i,t} = \beta_0 + \beta_1 \text{Index}_{i,t} + \beta_2 \text{Control}_{i,t} + \beta_3 \text{Firm}_{i,t} + \beta_4 \text{Year}_{i,t} + \varepsilon_{i,t} \quad (2)$$

where Z-Score measures firm financial risk, *Index* denotes digital finance development, *Control* represents the vector of firm-level control variables, *Year* and *Firm* capture year and firm fixed effects respectively, and ε is the error term.

EMPIRICAL RESULTS

Descriptive statistics

Following Altman's benchmark thresholds, a Z-Score above 2.675 indicates financial health with low bankruptcy risk; a Z-Score between 1.81 and 2.675 suggests the firm is in a distress zone with potential financial vulnerability; and a Z-Score below 1.81 signals severe financial instability and high default risk.

Figure 1 presents descriptive statistics for our main variables. The firm financial risk measure (Z) exhibits substantial heterogeneity, ranging from 0.009 to 31.636 with a mean of 5.029, indicating considerable variation in financial stability across sample firms. The digital finance index (Index) averages 2.582, with a minimum of 1.262 and a maximum of 3.597, reflecting substantial regional variation in digital finance development, though most cities demonstrate moderate to high development levels.

Correlation analysis

To examine correlations among variables and assess potential multicollinearity, we conduct a Pearson correlation analysis. Figure 1 presents the correlation matrix. The digital finance index (Index) is positively and significantly correlated with the firm financial risk measure (Z), indicating that higher digital finance development is associated with higher Z-scores (i.e., lower financial risk). This finding is consistent with our hypothesis. Additionally, all pairwise correlations are below 0.7, suggesting that severe multicollinearity is unlikely to bias our estimates.

Baseline regression results

Figure 2 presents baseline regression estimates of the effect of digital finance on firm financial risk in the textile industry. Panel A reports results without control variables, while Panel B includes the full set of firm-level controls. In Panel A, the coefficient on Index is positive and statistically significant, indicating that higher digital finance development is associated with greater Z-Scores. In Panel B, after including controls, the coefficient on Index remains positive and significant with a magnitude similar to Panel A, suggesting that our core finding is robust.

Robustness tests

First, the economic effects of digital finance typically manifest with a time lag, as impacts on firm financial health may not materialise contemporaneously. To better capture this temporal structure, we re-estimate our baseline model using a one-period lag of Index. Additionally, this specification helps mitigate potential reverse causality; namely, that improvements in firm financial health might stimulate digital finance adoption, thereby inducing endogeneity bias. Figure 3, Panel A, presents results using the lagged digital finance index. The coefficient on lagged Index remains positive and significant with a magnitude consistent with baseline estimates, indicating that the effect of digital finance on firm financial risk is persistent and robust to alternative temporal specifications. Second, prefecture-level cities exhibit systematic variation in economic development, financial infrastructure, industrial composition, and institutional quality. These time-invariant regional characteristics may jointly influence both digital finance development and firm financial risk, potentially inducing omitted variable bias. To address this concern, we augment the baseline model with city fixed effects to absorb all time-invariant city-level heterogeneity. Figure 3,

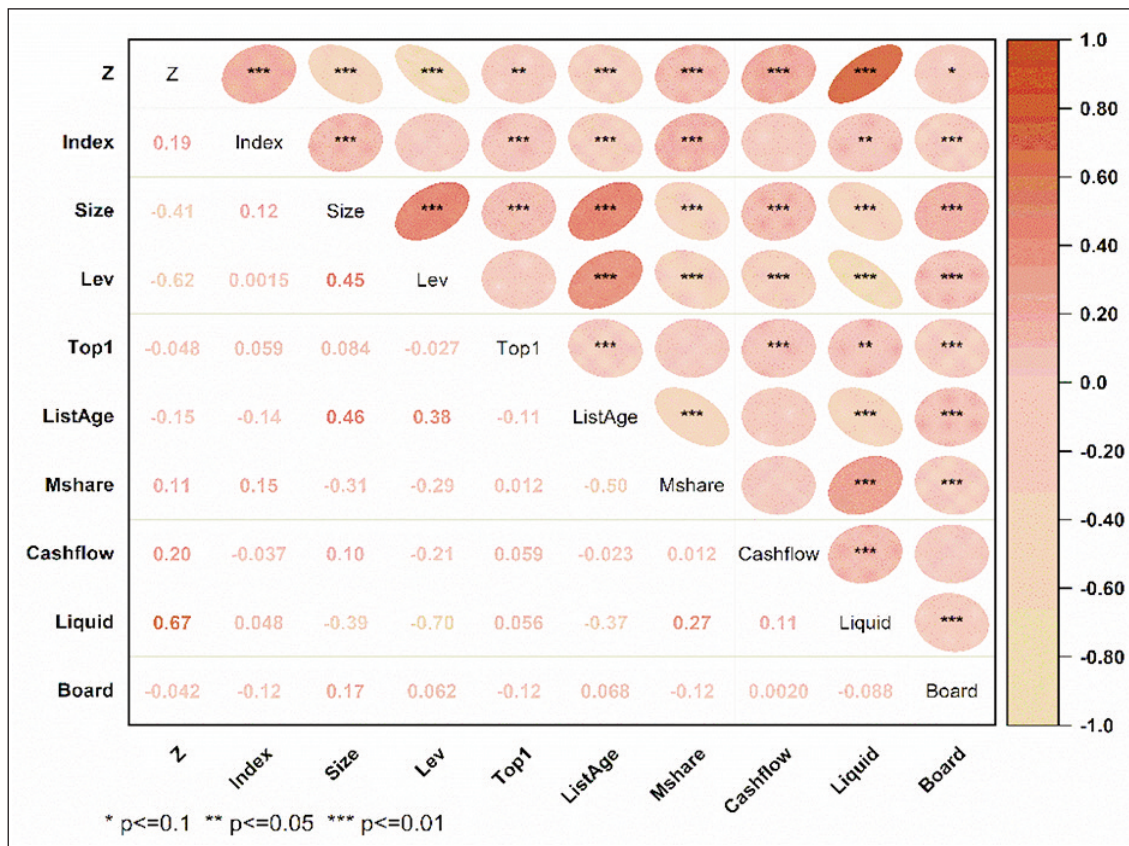


Fig. 1. Pearson correlation matrix

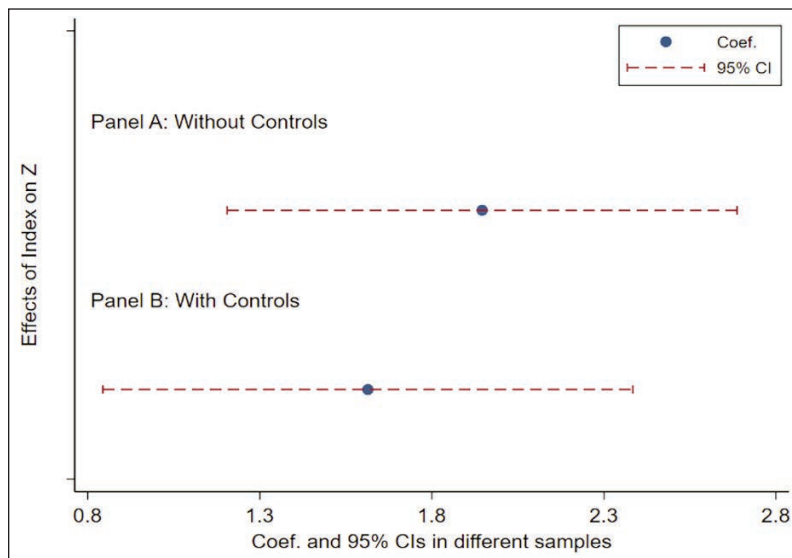


Fig. 2. Baseline regression results

Panel B reports estimates with city fixed effects. The coefficient on Index remains positive and significant, consistent with baseline results, confirming that our findings are robust to controlling for regional heterogeneity. This result suggests that time-invariant city characteristics do not drive our core findings.

FURTHER ANALYSIS

Mechanism analysis

To test whether information asymmetry and financing constraints mediate the effect of digital finance on

firm financial risk, we employ the KV index and KZ index as mediators. The KV index measures firm-level information asymmetry [4], with higher values indicating greater opacity (or equivalently, lower transparency). The KZ index measures financing constraints, with higher values reflecting more severe constraints. To test these mediation channels, we estimate the following models:

$$M_{i,t} = \beta_0 + \beta_1 Index_{i,t} + \beta_2 Control_{i,t} + \beta_3 Firm_{i,t} + \beta_4 Year_{i,t} + \varepsilon_{i,t} \quad (3)$$

where M denotes the mediator, and all other variables are defined as in equation 2.

Figure 4, Panel A reports results for information asymmetry as the mediator. The coefficient on Index is negative

and significant, indicating that digital finance reduces information asymmetry between financial institutions and firms. Reduced information asymmetry lowers risk assessment premiums and due diligence costs for lenders, mitigates market frictions, and improves credit terms. This facilitates efficient capital allocation, enhances firm profitability, and stabilises cash flows. Additionally, greater information transparency strengthens external monitoring and incentivises firms to improve corporate governance, thereby mitigating agency conflicts. These improvements

enhance long-term firm value and financial resilience, ultimately reducing financial risk. These findings support Hypothesis 2.

Figure 4, Panel B, presents results for financing constraints as the mediator. The coefficient on Index is negative and significant, indicating that digital finance alleviates financing constraints by expanding firms' access to diverse, low-cost financing channels. Enhanced external liquidity enables firms to smooth cash flow volatility and reduce liquidity risk. Relaxed financing constraints also enable investment in operational improvements and innovation, boosting efficiency, competitiveness, and profitability. These factors jointly strengthen capital structure, stabilise cash flows, and enhance overall financial resilience. These findings support Hypothesis 3. In summary, by reducing information asymmetry and alleviating financing constraints, digital finance enables textile firms to improve financial planning and resource allocation, thereby enhancing operational stability and financial resilience. These mechanisms allow firms to better navigate volatile market conditions and strengthen their capacity to manage financial risk.

Heterogeneity tests

Regional economic development

To examine regional heterogeneity in the effect of digital finance on firm financial risk, we partition the sample by firm registration location into eastern regions versus central and western regions, and estimate separate regressions for each subsample. The coefficient on Index is positive but smaller in magnitude for eastern firms (significant at the 10% level), whereas the coefficient is larger and significant at the 1% level for firms in central and western regions. This pattern suggests that digital finance has a stronger risk-mitigating effect in less developed regions. One explanation is that eastern regions have more developed traditional financial markets, making firms less reliant on digital finance. In contrast, central and western regions have less developed traditional finance, so digital finance exhibits larger marginal effects in improving access to capital and reducing financial risk.

Media coverage

External monitoring intensity is a key determinant of capital allocation efficiency and firm financial risk. Media coverage not only reflects public attention but

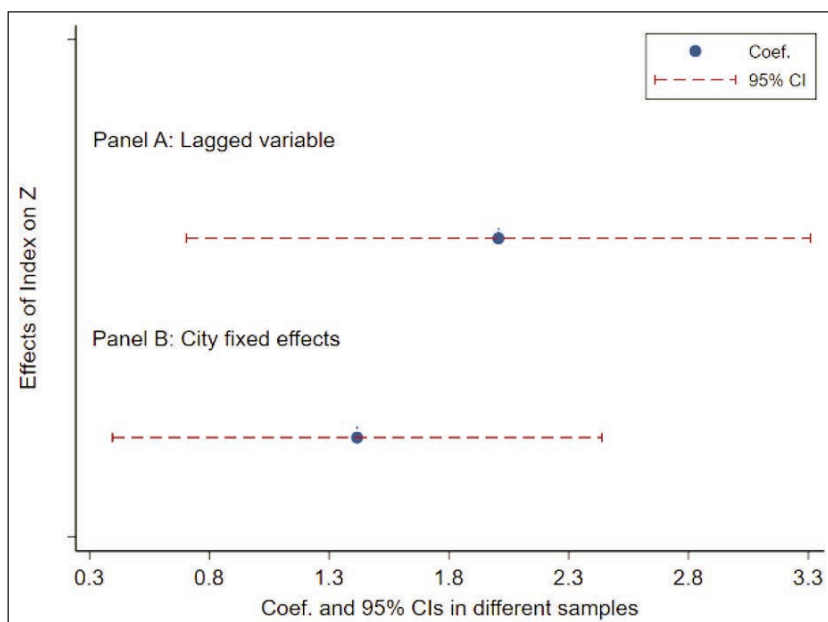


Fig. 3. Robustness testss

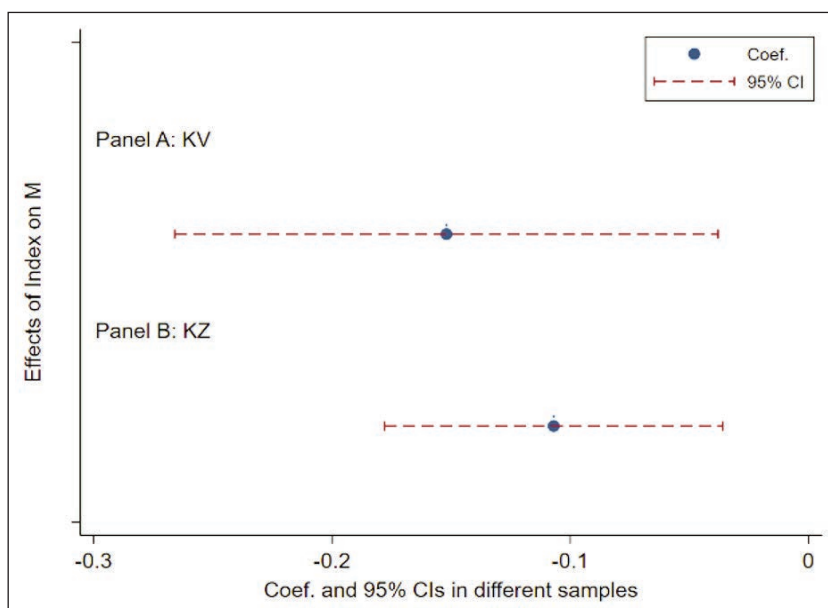


Fig. 4. Mechanism analysis

also influences firm behaviour and disclosure quality through monitoring and reputation effects. We measure media coverage using the total number of print and online news articles mentioning each firm, and partition the sample at the median. Figure 5, Panel B, shows that the coefficient on Index is positive and significant among high-coverage firms, but insignificant for low-coverage firms. This heterogeneity likely reflects that high media coverage strengthens external monitoring, incentivising firms to disclose more information and thereby reducing information asymmetry between firms and capital providers. In more transparent information environments, digital finance's advantages in information processing and capital allocation can be more fully realised, enhancing its effectiveness in reducing financing constraints and

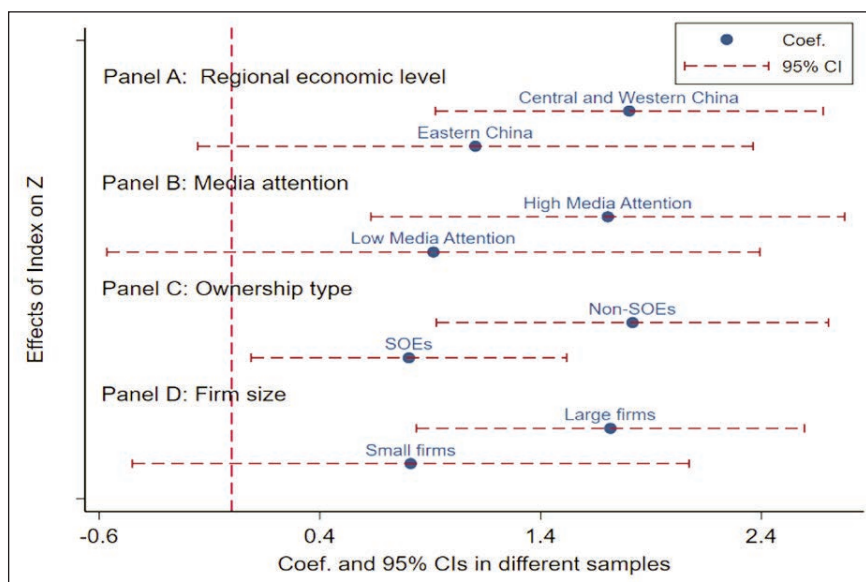


Fig. 5. Heterogeneity Analysis

financial distress. Conversely, low-coverage firms face weaker external monitoring and limited transparency. Although digital finance still improves financing access for these firms, its risk identification capabilities and capital allocation efficiency are constrained by information opacity, diminishing its effectiveness in reducing financial risk.

Ownership structure

Typically, non-state-owned enterprises (non-SOEs) face more severe financing constraints due to the lack of implicit government guarantees or backing, which limits their access to sufficient funding from mainstream financial institutions. Concurrently, heightened information asymmetry significantly escalates external financing costs, imposing an intangible burden that further exacerbates economic and financial pressures. Digital finance, leveraging advanced data capture and deep analytical capabilities, effectively alleviates financing constraints for non-SOEs, breaks development bottlenecks, and expands capital acquisition channels. By fundamentally mitigating information asymmetry, digital finance also suppresses tendencies toward underinvestment or inefficient allocation. This positive feedback mechanism renders non-SOEs more reliant on digital finance for daily operations and R&D innovation, ultimately leading to a robust reduction in financial risk. We partitioned the sample by ownership type into non-SOEs and SOEs to examine the differential impact of digital finance. As shown in figure 5 Panel C, the coefficient for digital finance is significantly positive at the 1% level for non-SOEs, whereas it is only significant at the 5% level for SOEs, with a marked disparity in the coefficient magnitudes. These results indicate that the risk-mitigating mechanism of digital finance is more potent in non-SOEs, highlighting a heterogeneous effect sensitive to ownership structure in terms of easing financing constraints and optimizing resource allocation.

Firm size

Firm size determines bargaining power in capital markets, financing channel diversity, and risk-bearing capacity, potentially moderating the effect of digital finance on financial risk. To test this, we partition the sample by firm size into large and small firms and estimate separate regressions. Figure 5, Panel D, shows that the coefficient on Index is positive and significant only for large firms, while the effect is insignificant for small firms. This heterogeneity likely reflects that large firms have more sophisticated management systems, greater financial transparency, and broader access to financing channels, enabling them to better leverage digital finance's capabilities in capital allocation and risk management, thereby reducing financial risk. Conversely, small firms face constrained access to capital, lower disclosure quality, and fewer managerial resources. Although digital finance still improves financing access for small firms, its marginal benefits are limited by these constraints, diminishing its effectiveness in reducing financial risk.

CONCLUSIONS AND POLICY IMPLICATIONS

This study examines data from Chinese A-share textile industry listed companies spanning 2014 to 2023 to investigate digital finance's impact on corporate financial risk and the underlying mechanisms. Three principal findings emerge. First, digital finance development significantly reduces textile firms' financial risk levels. Second, mechanism tests indicate that digital finance operates through two pathways, namely alleviating information asymmetry and easing financing constraints, with these pathways exhibiting complementary effects. Third, heterogeneity analysis reveals that digital finance's risk-mitigating effects are more pronounced in central and western regions, firms with higher media attention, non-state-owned enterprises, and large firms.

Theoretical contributions

This research makes several theoretical contributions.

First, this study extends the theoretical boundaries of research on digital finance's economic consequences. Although digital finance theory is widely applied to explain positive outcomes such as corporate innovation and investment efficiency, its applicability in risk management remains insufficiently tested. By empirically examining the relationship between digital finance and financial risk in textile industry samples, this research expands digital finance theory's scope. The textile industry, characterised by

labour-intensive and capital-intensive operations, financing difficulties, lengthy supply chains, and narrow profit margins, constitutes an ideal setting for testing digital finance's risk management effects. Existing research suggests that financial innovation's impact may differ significantly across industries. This study finds that digital finance significantly reduces financial risk even within the textile industry's distinctive context, demonstrating that digital finance's risk-mitigating effects possess strong generalizability while revealing the unique mechanisms through which digital finance operates in labour-intensive industries.

Second, this research reveals digital finance's dual mechanisms for affecting corporate financial risk. Although existing research documents that digital finance influences corporate behaviour, the underlying mechanisms remain unclear. This study finds that digital finance affects financial risk through two pathways: an information mechanism and a financing mechanism. Through the information mechanism, digital finance platforms leverage big data risk control technology to reduce information asymmetry between banks and firms, decreasing credit rationing and risk premiums and improving cash flow stability. Improved information disclosure quality reduces capital costs and enhances market liquidity. Through the financing mechanism, digital finance provides diversified, low-cost financing instruments that directly ease financing constraints and enhance firms' capacity to meet unexpected payment demands. Financing constraints significantly affect firms' investment decisions and financial stability. Empirical results support both pathways operating simultaneously with complementary effects. Identifying these mediation mechanisms not only deepens theoretical understanding of digital finance's pathways but also provides micro-foundations for understanding how financial technology reshapes corporate risk management.

Third, this research identifies important boundary conditions for digital finance's impact on corporate financial risk. Digital finance's effects on financial risk vary significantly across regional environments, external monitoring intensity, ownership structures, and firm sizes. In central and western regions where traditional financial resources are relatively scarce, digital finance generates greater marginal utility with more pronounced risk-mitigating effects. In firms with higher media attention, external monitoring pressures reinforce digital finance's information transparency effects, consistent with existing findings on the roles of external governance mechanisms. In non-state-owned enterprises lacking implicit government guarantees, digital finance's expansion of financing channels proves more critical. In large firms, more sophisticated internal management systems enable fuller utilisation of digital finance tools. By clarifying these boundary conditions, this research enhances digital finance theory's precision in predicting risk management effects and provides new

evidence for understanding complementary or substitution relationships between information and financing mechanisms across contexts.

Fourth, this research provides a new theoretical perspective on the relationship between digital finance and corporate sustainable development. By revealing how digital finance reduces corporate financial risk, this study offers new empirical evidence for understanding how digital technologies enhance firm resilience and promote sustainable development. Reduced financial risk not only directly improves firms' survival capacity and development potential but also creates more stable financial foundations for long-term investment, technological innovation, and sustainability practices.

Policy implications

This study's findings carry important policy implications for firms, financial institutions, and government regulators.

Implications for firms

The findings regarding digital finance's dual mechanisms suggest that textile firms designing financing strategies should attend not only to broadening financing channels but also to improving information disclosure quality. Specifically, firms should proactively engage with digital finance platforms and accumulate digital footprints through e-commerce transactions and supply chain coordination to enhance the completeness and accuracy of their credit profiles. This proactive approach to information disclosure not only reduces financing costs but also strengthens trust relationships with financial institutions, thereby securing more stable financing support. The heterogeneity findings indicate that firms should calibrate their digital finance application strategies according to their characteristics and external environments. In central and western regions where traditional financial resources are scarce, firms can rely more heavily on digital finance channels. In environments with higher media attention, firms should complement digital finance with more comprehensive information disclosure to amplify digital finance's effects. Non-state-owned enterprises, lacking implicit government guarantees, should place greater emphasis on establishing market-based credit mechanisms through digital finance platforms. Large firms should leverage their managerial advantages and data resources to optimise financial management and risk control systems through digital means.

Implications for financial institutions

The finding that digital finance reduces corporate financial risk by alleviating information asymmetry and easing financing constraints points the way for financial institutions to innovate their products and services. Financial institutions should increase investment in big data risk control and artificial intelligence credit assessment technologies, developing more precise risk pricing models, particularly suited to small and medium enterprises and labour-intensive firms that traditional credit assessment systems struggle to serve. Supply chain finance represents an

important innovation direction: by integrating transaction data from anchor firms and their supply chain partners, financial institutions can more accurately assess small and medium enterprises' true operational conditions and repayment capacity, enabling more flexible financing arrangements. The regional heterogeneity findings indicate that financial institutions should adopt differentiated market strategies, intensifying digital finance product promotion in central and western regions to fill gaps left by traditional financial services. Additionally, financial institutions should establish long-term cooperative relationships with firms, reducing information asymmetry through continuous data accumulation and credit building to achieve a better balance between risk and return.

Implications for government regulators

The finding that digital finance significantly reduces textile firms' financial risk provides empirical support for regulatory authorities formulating digital finance development policies. First, regulators should strengthen digital finance infrastructure, including information technology platforms, data sharing systems, and digital payment and risk management systems, particularly in central and western regions and areas with insufficient traditional financial coverage. Robust infrastructure ensures firms can access financial resources more conveniently and improves capital allocation efficiency. Second, regulators should promote deeper integration of digital finance with the real economy, using policy guidance to encourage financial institutions to provide more targeted financing solutions for small and medium enterprises and non-state-owned enterprises. The heterogeneity findings indicate that regulatory policies should not treat all firms uniformly but should formulate differentiated support policies according to regional environments and firm characteristics. For example, intensifying digital finance promotion in central and western regions, providing dedicated financing support for non-state-owned enterprises, and guiding large firms to leverage digital means to optimise financial management. Third, regulators should strengthen oversight and risk control of digital finance. Although digital finance helps reduce corporate financial risk, it may itself introduce systemic or operational risks. Relevant regulatory frameworks should be improved to strengthen information disclosure, data security management, and transaction monitoring, ensuring that digital finance maintains sound operation while improving firms' financing convenience. Regulatory authorities can also use policy guidance to standardise digital finance product design and application processes, preventing potential risks from excessive leverage or capital misallocation. Finally, regulators should establish evaluation frameworks for digital finance development, regularly monitoring digital finance's impact on different industries, regions, and types of firms, and adjusting policy directions promptly to ensure that digital finance genuinely serves the high-quality development of the real economy.

Research limitations and future directions

This research has several limitations that point to directions for future research.

First, regarding the measurement of financial risk, this study employs the Z-Score model to assess corporate financial risk levels. This model was developed based on data from U.S. manufacturing listed companies. Although the textile industry is part of the manufacturing sector, its specific operational characteristics, including high inventory turnover pressure, seasonal volatility, high sensitivity to raw material prices, substantial labour cost shares, and intense price competition, may differ significantly from those of the general manufacturing firms used to calibrate the model. The model's weights and thresholds may not fully capture the risk characteristics specific to the textile industry. Future research could construct risk indicator systems better suited to textile firms' characteristics, incorporating cash flow status, debt servicing capacity, and operational efficiency metrics to analyse digital finance's impact on textile firms' financial conditions more accurately and thereby provide more precise financial risk assessments.

Second, regarding the deepening of mechanism analysis, the mechanism tests in this study rely primarily on proxy variables for measurement, which represent a degree of approximation. Although this quantitative approach validates the mediating roles of the information mechanism and financing mechanism, it has difficulty fully capturing the specific decision-making considerations and cognitive factors firms encounter when facing digital finance development, as well as the potentially complex interactions between these two mechanisms. Future research could employ qualitative methods such as survey questionnaires, in-depth interviews, or case studies to investigate these issues more thoroughly, clarifying the sequencing and interactions between these two mechanisms to present a more complete picture of firms' actual decision-making processes.

Finally, regarding the research context generalizability, this study focuses on Chinese A-share textile industry listed companies. China's institutional environment has distinctive characteristics that may exert potential influence on research findings and thereby limit the direct generalizability of conclusions. China's top-down financial regulatory system and policy orientation may make firms more receptive to digital finance, potentially amplifying the observed effects. Additionally, the rapid development and widespread adoption of digital finance in China, which may be more mature than in other markets, could make digital technology-based risk mitigation mechanisms more effective. Furthermore, the sample is limited to publicly traded listed companies and does not encompass small and medium non-listed enterprises. Listed companies typically possess better information disclosure quality and stronger resource access capabilities, and their utilisation of and outcomes from digital finance may differ significantly from non-listed enterprises. When facing financing

constraints, non-listed enterprises may rely more heavily on digital finance due to resource limitations or may be unable to fully leverage digital finance tools due to weaker digitalisation capabilities. Testing this study's findings in different institutional and organisational contexts is essential. Future research should conduct cross-country comparative studies in countries with differing degrees of financial market development, digitalisation levels, and regulatory environments, such as mature market economies in Europe and North America, or other emerging market economies. Equally important, future research should attempt to incorporate non-listed companies

and small and medium enterprises into the analysis to examine the validity and generalizability of this study's proposed mechanisms across different organisational scales, ownership structures, and resource constraints. This would help validate the external validity of the core mechanisms identified in this research while providing opportunities to explore potential substitution or complementarity relationships between digital finance and traditional financial regulation and market mechanisms, thereby contributing to a more comprehensive understanding of digital finance's risk management effects in a global context.

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