

Article

The Impact of Digital Transformation on Organizational Resilience: The Role of Innovation Capability and Agile Response

Jingyi Zhang ¹, Hanxi Li ¹ and Hong Zhao ^{1,2,*}

¹ School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, China; zhangjingyi201@mailsucas.ac.cn (J.Z.); lihanxi24@mailsucas.ac.cn (H.L.)

² Sino-Danish College, University of Chinese Academy of Sciences, Beijing 101408, China

* Correspondence: zhaohong@ucas.ac.cn

Abstract: In the face of a VUCA environment, organizational resilience has become a critical factor in sustaining enterprise performance. This study explores how digital transformation influences organizational resilience through its impact on the key components of organizational systems, specifically innovation capability and agile response. Using data from Chinese A-share listed firms over the period 2007–2023, the study finds that digital transformation significantly enhances organizational resilience, with robust results across various tests. The analysis highlights that digital transformation strengthens resilience by optimizing innovation capability and improving agility within organizational systems. Heterogeneity tests reveal that these effects are particularly strong in firms located in eastern and central regions, operating in capital-intensive industries, and at growth or maturity stages. These findings underscore the systemic role of digital transformation in building adaptive, resilient organizations that can better navigate uncertainty and complexity. This study contributes to understanding the dynamic interplay between digital technologies and organizational systems, offering practical insights for enterprises aiming to leverage digital transformation for sustainable growth and high-quality economic development.

Keywords: digital transformation; organizational resilience; innovation capability; agile response



Academic Editor: Timothy Ferris

Received: 2 January 2025

Revised: 20 January 2025

Accepted: 21 January 2025

Published: 24 January 2025

Citation: Zhang, J.; Li, H.; Zhao, H. The Impact of Digital Transformation on Organizational Resilience: The Role of Innovation Capability and Agile Response. *Systems* **2025**, *13*, 75. <https://doi.org/10.3390/systems13020075>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

In traditional corporate strategic management practices and research, economic performance has long been regarded as the primary goal of enterprise management. However, in recent years, a series of global “black swan” events, such as the COVID-19 pandemic, the Russia-Ukraine conflict, and frequent disruptions in global supply chains, have underscored the VUCA (volatility, uncertainty, complexity, and ambiguity) characteristics of the external business environment. This increasingly complex and dynamic environment poses significant challenges to the survival and growth of enterprises, many of which face the dilemma of “Strong in rigidity, weak in resilience”. For example, during the pandemic, not only did traditional retail giant J.C. Penney file for bankruptcy, but even the world’s largest car rental company, Hertz, struggled to maintain operations, highlighting the vulnerability of enterprises to external shocks. Against this backdrop, organizational resilience, as a critical capability for enterprises to transform crises into opportunities, has garnered increasing attention from both industry and academia [1]. Organizational resilience not only determines a company’s ability to maintain operational stability during sudden crises but also influences its recovery speed and adaptability post-crisis. In recent years, digital

transformation, as a strategic shift away from traditional management models, has become an important means of enhancing organizational resilience [2]. For instance, technologies such as big data analytics, cloud computing, and intelligent manufacturing enable companies to identify potential risks more effectively, optimize resource allocation, and improve emergency response capabilities and organizational flexibility. These advancements allow enterprises to better navigate the challenges posed by uncertainty and complexity [3]. Therefore, exploring how digital transformation impacts organizational resilience is not only of significant theoretical value but also provides practical guidance for companies to address future uncertainties.

The literature has increasingly examined the relationship between digitalization and organizational resilience, emphasizing two key aspects. First, digital transformation can blur the traditional boundaries of enterprises, thereby enhancing resilience by fostering greater agility and responsiveness in internal operations. Additionally, it contributes to strengthening internal controls and altering the mechanisms through which organizations acquire and apply knowledge [4,5]. In the relationship with external stakeholders, digital transformation can effectively enhance the bargaining power of the enterprise, which is conducive to strengthening the enterprise's ability to control external resources, to build a more resilient supply chain [6]. Secondly, the existence of the 'digital paradox' has been highlighted. The digital transformation of enterprises is a complex systematic project with high costs and low efficiency, and even though enterprises have invested large amounts of resources in digital transformation, it is often difficult for them to achieve the expected growth in revenues in a short period, which threatens their survival and long-term development. However, some scholars, based on the theory of disruptive innovation, believe that digital technology, as a disruptive element, subverts the original development path and value creation model of enterprises, thus possibly reducing their resilience. For example, Scholz posits that digitalization, as both a technological and strategic transformation, entails substantial uncertainties, exposing organizations to technological, operational, and derivative risks, thereby generating a "digital negative-energy" effect [7].

These insights reveal certain limitations in current research. First, although previous studies often link digital transformation to corporate performance, its role in fostering organizational resilience—a multidimensional construct—remains insufficiently explored. Second, the existing literature tends to adopt simplistic measures of organizational resilience, such as sales growth rates or firm survival duration, which fail to reflect its multidimensional nature in practical contexts. Third, while some studies analyze the effects of digital transformation on resilience or other performance outcomes through perspectives like cost reduction and human resource optimization [8], the mechanisms underlying these effects remain unclear. The black box of how digital transformation influences resilience has yet to be fully unpacked. Specifically, critical mediating variables, such as innovation capability and agile response, have not received sufficient attention in existing research. Based on the above analyses, this paper intends to explore two main questions:

R1: What is the impact of digital transformation on business resilience?

R2: What are the mechanisms and effects behind digital transformation on corporate resilience?

Selecting A-share listed companies in Shanghai and Shenzhen from 2007 to 2023 as the research sample, this paper explores the intrinsic relationship between digital transformation and enterprise toughness through a combination of theoretical analysis and empirical tests. It is found that digital transformation can significantly improve organizational resilience, and this result remains robust and valid after endogeneity treatment and robustness tests. Furthermore, the analysis identifies two key channels through which digital transformation strengthens organizational resilience: corporate innovation capability and agile response.

Compared with previous studies, this paper may have marginal contributions in the following three aspects. First, it establishes a two-dimensional framework of enterprise resilience indicators, expanding both the conceptual scope and measurement of resilience. By focusing on the dimensions of risk resistance and recovery, the study enriches the understanding of enterprise resilience and provides more targeted, practical empirical insights for organizations. Second, the paper systematically examines the impact of digital transformation on enterprise resilience from a micro-level perspective, analyzing the internal mechanisms through which digital transformation influences resilience. Specifically, it highlights innovation capability and agile responsiveness as critical channels, clarifying the intrinsic pathways by which digital transformation enhances resilience. Finally, the findings offer valuable theoretical insights into achieving sustainable enterprise development and advancing the integration of the digital economy with the real economy. This study demonstrates that digital transformation can significantly enhance organizational resilience. Furthermore, the heterogeneity analysis reveals that its impact varies across different contexts. These findings provide both academic support for deepening the integration of digital and real economies and practical guidance for formulating precise digitalization policies. In doing so, the study underscores the pivotal role of digitalization as a driving force for economic development.

In the following section, we profile the theoretical background for this study and develop research hypotheses. Subsequently, we detail the data set and models, followed by the presentation of empirical results. Finally, we conclude by discussing both the theoretical and practical implications of our findings, along with the limitations encountered.

2. Theoretical Analysis and Hypothesis Development

2.1. Theoretical Analysis

The concept of resilience originates in physics and psychology, where it refers to elasticity, adaptability, and resistance. Meyer extended this concept to the field of management, conceptualizing resilience as the capacity of organizations to respond effectively to significant crises. Within this framework, resilience is primarily valued not for its role in “capitalizing on market opportunities”, but for its ability to “withstand and navigate adversity” during crises and economic downturns [9,10]. Some studies have argued that corporate resilience is not only dependent on corporate resources and structure but is also deeply rooted in the cognitive processes and social interactions of managers and employees. To address this broader perspective, this paper applies social cognitive theory (SCT) to the study of resilience. SCT highlights the dynamic interplay among individuals’ behaviors, cognition, and their social environment, making it a valuable complement to traditional approaches in organizational resilience research [11,12].

Cognition plays a critical role in shaping organizational resilience. Crisis perception within an organization is often mediated through internal human resources, where employees’ perceptions, attitudes, and behaviors directly influence the organization’s collective response strategies [13]. According to crisis management theory (CMT), crises perceived as threats can trigger negative emotional responses among employees, such as anxiety and fear, which may impair decision-making processes and hinder effective operational execution. In contrast, perceiving crises as opportunities often fosters flexibility, creativity, and proactive problem solving, enabling organizations to identify novel pathways for development. This optimistic view of crises can significantly enhance organizational resilience by uncovering growth opportunities and providing a competitive advantage during periods of adversity [14]. Consequently, organizations should not only focus on post-crisis recovery but also proactively foster a positive perception of crises. Cultivating a

mindset oriented toward problem solving and opportunity recognition among employees can be an essential step in enhancing organizational resilience [13,15].

While cognitive responses represent the initial phase of crisis reaction, post-cognitive coping behaviors are often more instrumental in determining whether an organization can successfully resolve a crisis, restore normalcy, or achieve transformative growth. Organizational actions in response to adversity can typically be categorized into two types: acute short-term responses and strategic long-term adjustments. Acute short-term responses include immediate actions such as resource mobilization, crisis communication, and emergency decision making, all of which aim to rapidly contain the crisis and prevent further escalation [16]. Conversely, strategic long-term adjustments focus on enhancing organizational adaptability and resilience through fundamental post-crisis changes. Examples include technological innovation, organizational restructuring, and fostering stronger collaboration with external stakeholders. Empirical evidence suggests that organizations implementing strategic long-term adjustments not only recover more effectively but also demonstrate heightened resilience in subsequent crises [15].

The resource-based view (RBV) asserts that a firm's competitive advantage originates from the unique resources and capabilities it owns and effectively leverages [17]. The strategic value of these resources is not merely tied to ownership but is fundamentally dependent on how effectively they are utilized, coordinated, and integrated into the firm's operations [18]. External social networks can also play a crucial role in helping firms navigate adversity, particularly when resources are scarce. Partners, suppliers, customers, and other stakeholders within the firm's external network can provide essential support, such as sharing information, offering material resources, or providing technical assistance, to help the organization overcome challenges [19]. For instance, during a supply chain disruption, strong relationships with long-term partners can enable firms to quickly adjust their supply chains and reallocate resources, mitigating the crisis's adverse effects [20]. While the existing literature provides valuable insights into the factors influencing organizational resilience, particularly from the perspectives of human resource management, organizational restructuring, and external stakeholder relationships, there is a noticeable gap in exploring the role of digital transformation in enhancing organizational resilience. Specifically, there is limited research examining the relationship between digital empowerment and organizational resilience, as well as the heterogeneity of intermediary mechanisms in this process. This gap provides a valuable opportunity for the present study to contribute to the literature by exploring the impact of digital transformation on organizational resilience.

2.2. Research Hypotheses

2.2.1. Digital Transformation and Organizational Resilience

Digital transformation is a defining feature of the digital economy era, with early studies focusing primarily on industries such as publishing, journalism, and manufacturing, often characterized by fragmentation and a sector-specific approach [21]. These early investigations predominantly addressed business transformation at a superficial level. As research evolved, scholars adopted a systems perspective into digital transformation, recognizing it as the upgrading and transformation of business operations and value chains through digital infrastructure, technologies, and innovations [22]. Building on social cognitive theory, this paper suggests that digital transformation strengthens an enterprise's resilience perception and fosters behaviors that promote resilience.

At the level of resilience perception enhancement, the upgrading of production technologies through digital transformation creates a demand for higher-skilled labor, effectively displacing lower-skilled workers and optimizing the human capital structure [8]. This process results in a workforce that is more cognitively flexible, psychologically resilient,

and equipped with skills that enhance the capacity to withstand and recover from risks. Furthermore, digital transformation fosters a shared mental model among internal staff, improving communication and coordination within teams, which collectively contribute to enhanced organizational resilience during crises. Digital tools, such as online training platforms and performance management systems, provide both employees and managers with a more intuitive understanding of organizational performance during challenging times, thus promoting resilience-enhancing behaviors. Additionally, data-driven trend analyses allow organizations to develop clearer long-term strategies, strengthening their ability to survive and thrive in uncertain environments.

At the level of resilience-enhancing behaviors, digital transformation drives the adoption of automated and standardized processes, which reduce human error. Technologies such as robotic process automation (RPA) and enterprise resource planning (ERP) systems have standardized and streamlined business processes, thereby improving organizations' ability to maintain continuity in the face of external shocks [23]. Digital transformation often accompanies organizational restructuring, particularly in the form of modular organizational structures. These structures divide enterprises into relatively autonomous units, each with a degree of decision-making power. Such modularity allows for localized adjustments in response to external changes, preserving the overall stability of the organization [24]. Moreover, digital transformation redefines relationships between enterprises and their stakeholders. Digital technologies enable real-time communication and information sharing with stakeholders via various channels, such as social media, digital platforms, and data analytics tools. This enhances supply chain transparency and enables faster responses to stakeholder needs and feedback, thereby strengthening trust and loyalty. Digital transformation is inherently networked [25], and Peláez argues that sustainability demands from stakeholders play a significant role in driving the digital transformation of enterprises [26]. In service industries, such as banking, stakeholder orientation is particularly pronounced, as evidenced by Rodrigues [27], who developed a decision model exploring the interaction of multi-stakeholder cognitive drives with AI technologies, digital transformation, and cybersecurity. Digital technologies also facilitate a shift in value co-creation from a supply-driven to a demand-driven model, enhancing user experience and motivation while reducing demand-side risks [28].

Thus, we propose the following hypothesis:

H1: Digital transformation positively promotes organizational resilience.

2.2.2. Mechanisms of Digital Transformation's Impact on Organizational Resilience

Organizational resilience is defined as an entity's capacity to learn from past experiences, effectively manage crises at specific points in time, and foster the development of new capabilities to anticipate future challenges [29,30]. This paper argues that digital transformation, on the one hand, cultivates a stronger demand for technology, which enhances a firm's innovation capabilities and strengthens its ability to withstand risks, thus empowering innovation capabilities. On the other hand, digital transformation enhances the flow and penetration of information, optimizes human capital structures, and boosts factor productivity [8], thus enabling agile response capabilities.

From the perspective of innovation capability empowerment, enterprises actively integrate digital technology into their operations, optimizing business models and improving innovation outputs, such as patents, to support continuous innovation efforts [31]. Digital transformation also facilitates the flow of knowledge and improves information transparency, which can enhance the innovation capacity of foreign subsidiaries, overcome geographical and strategic barriers, and lead to incremental improvements in innovation [32]. Innovation is crucial for firms to develop and sustain competitive advantage [5],

and research by Tsiapa and Batsiolas [33] suggests that firms with strong technological innovation capabilities demonstrate greater resilience following crises. In the digital era, firms with robust innovation capacities are more likely to engage in extensive supply chain and industrial network integration, thereby reducing financing constraints and strengthening their ability to recover from supply chain disruptions [34]. Furthermore, firms with high innovation capabilities often diversify their product and service offerings, reducing reliance on a single business model. Compared to firms without digital transformation, digitally advanced firms benefit from policy development, financial backing, infrastructure, and technical services, all of which help reduce costs and risks, improve competitiveness, and contribute to the global digital economy [35].

Regarding agile response empowerment, agility is defined as an organization's ability to quickly sense, decide, and execute, typically facilitated by flexible structures and IT support [4]. Digital technologies enable both supply and demand sides to share information, synchronize operations, anticipate market changes, and adjust products and services accordingly [36]. Digital transformation necessitates not only technological adoption but also organizational and cultural adjustments to foster decentralized, self-organizing teams within the firm. These adjustments promote smoother information flow and faster decision making [23]. There is a well-established positive correlation between agility and resilience; agility enables organizations to respond to external shocks more rapidly, make dynamic adjustments, and continuously iterate processes, enhancing adaptive capacity [37].

Based on these considerations, we propose the following hypotheses:

H2: Innovation capability plays a mediating role in the impact of digital transformation on organizational resilience.

H3: Agile response plays a mediating role in the impact of digital transformation on organizational resilience.

2.2.3. Heterogeneity in the Contribution of Digital Transformation to Organizational Resilience

Organizational research must consider heterogeneity at multiple levels, including macro-level regional factors, micro-level production inputs, and the firm's life cycle stage. These diverse characteristics can lead to significant variations in how digital transformation impacts organizational resilience.

Geographical differences in development levels and innovation capacity in China create varying degrees of impact on the scope and effectiveness of digital transformation. In economically developed regions, robust infrastructure, innovation capabilities, and policy support facilitate more rapid and effective digital transformation. Conversely, in less developed regions, weak infrastructure, talent shortages, and insufficient policy support constrain the pace of digitalization, placing enterprises at a relative disadvantage in terms of technology adoption and market competition.

Firms can generally be categorized based on the primary production resources they rely on: labor-intensive, capital-intensive, and technology-intensive enterprises [38]. Each type of firm leverages digital transformation in distinct ways to enhance their adaptive capacity and coping strategies [39]. Labor-intensive firms primarily depend on the quality and quantity of their workforce, with the challenge lying in integrating human resources with new digital technologies. Capital-intensive firms often possess more stable business processes and may adopt digital technologies more slowly, but once integrated, these technologies offer long-term benefits. Technology-intensive firms, which already have a foundation in digitalization, face the challenge of developing and implementing cutting-edge technologies to maintain their leadership in innovation and competition [40].

Additionally, firms at different stages of their life cycle exhibit varying resource allocations, strategic choices, and innovation capabilities [41]. Growth-stage enterprises typically focus on expanding market share and improving efficiency through digital transformation [42], while mature enterprises aim to reduce costs, improve service models, and enhance customer relationships. For firms in decline, digital transformation serves as a means to slow the decline or restructure the business. However, these firms often face greater challenges due to limited resources and technological capabilities. Research indicates that declining firms must focus on cost control, risk management, and identifying new growth opportunities through digital technologies to improve market adaptability and resilience [43].

Based on this analysis, we propose the following hypothesis:

H4: The impact of digital transformation on organizational resilience exhibits heterogeneity across firms in different regions, production factor intensities, and life cycle stages.

H4a: The impact of digital transformation on business resilience is heterogeneous for firms in different regions.

H4b: The impact of digital transformation on firm resilience is heterogeneous for firms with different factors of production.

H4c: The impact of digital transformation on firm resilience is heterogeneous for firms with different life cycles.

The research framework of this paper is shown as Figure 1:

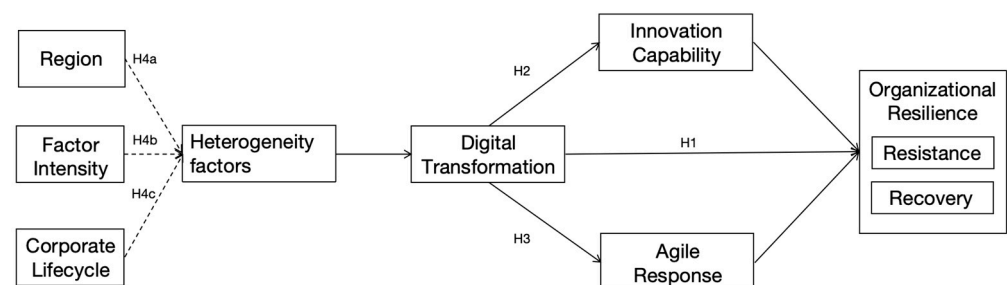


Figure 1. Mechanism framework diagram.

3. Research Design

3.1. Sample Selection and Data Sources

The study selects Chinese A-share listed companies from 2007 to 2023 as the research sample. Data on digital transformation are sourced from the annual reports of listed companies, patent data are obtained from the National Intellectual Property Administration, and other firm-level data come from the CSMAR database. Based on the raw data, the following processing steps are conducted: (1) excluding samples from the financial industry; (2) removing samples labeled as ST, *ST, suspended listing, delisted, or in the delisting consolidation period; (3) excluding samples with missing relevant data; and (4) applying a 1% winsorization for continuous variables at both ends. A total of 20,450 observations were obtained. Data were cleaned and analyzed using Stata 17.0 to generate statistical analysis findings. Table 1 presents the descriptive statistics of the key variables.

Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Resistance	20,450	−1.191	1.226	−9.283	9.146
Recovery	20,450	0.224	0.333	−0.225	2.536
Digital transformation	20,450	13.638	29.255	0	185
Innovation capability	20,450	4.634	4.545	0.03	29.33
Agile response	20,450	9.496	3.635	4	22
Ownership concentration	20,450	58.144	14.461	22.968	90.327
Listing age	20,450	2.209	0.68	1.099	3.497
Operational efficiency	20,450	0.637	0.384	0.105	2.408
Capital intensity	20,450	2.152	1.391	0.415	9.492
Financial leverage	20,450	0.405	0.187	0.062	0.883
Profitability	20,450	0.052	0.041	0	0.201
Market competition	20,450	0.19	0.162	0.041	0.934

3.2. Variable Definition

3.2.1. Dependent Variable: Organizational Resilience

Organizational resilience is a dynamic capability that enables an organization to respond to external shocks. It reflects both the system’s ability to resist disruptions when exposed to external disturbances [44] and its capacity to recover to its original state after being negatively impacted [45]. The prevailing approach to measuring organizational resilience often relies on single financial indicators, such as operating revenue, average stock returns, or return on sales [46]. However, this paper argues that using a single indicator to measure resilience may be overly specific and heterogeneous, potentially failing to accurately capture the true level of organizational resilience. Measuring resilience from multiple dimensions is more scientifically robust and better reflects the resilience of various aspects of an organization’s development. Accordingly, this paper conceptualizes organizational resilience as a two-dimensional construct comprising risk resistance capability and recovery capability [47,48].

For resistance capability, this study uses earnings per share (EPS) as the measurement indicator. EPS [49,50] is a core metric for evaluating a company’s profitability and financial stability, reflecting its ability to maintain normal operations under external shocks. From a financial perspective, higher EPS typically indicates that a company possesses sufficient internal resources to withstand potential risks, a resilience that is critical for sustaining long-term development. Therefore, EPS, as a quantitative measure of risk resistance capability, effectively captures a company’s immediate performance in responding to risks.

For recovery capability, this study uses the five-year growth rate of main business revenue as the measurement indicator, which comprehensively reflects a company’s long-term growth performance across multiple economic cycles [51]. The growth rate of main business revenue not only demonstrates a company’s adaptability to market fluctuations but also gauges its potential for resource integration and sustained expansion [52]. A higher growth rate indicates stronger operational resilience, enabling a company to recover swiftly and achieve stable growth. Additionally, this study employs return on equity (ROE) for robustness checks to rule out the influence of financial indicator selection on the results [53], thereby ensuring a comprehensive assessment of the multidimensional characteristics of organizational resilience.

3.2.2. Independent Variable: Digital Transformation

The existing literature measures corporate digital transformation using three main methods: text analysis, questionnaire surveys, and index construction. This study draws on the existing literature and methods [54], utilizing Python's web crawling functionality to collect text information related to digital technologies from the annual reports of listed companies to construct a data pool. Subsequently, 76 characteristic keywords of enterprise digital transformation are selected from five dimensions: artificial intelligence, big data, cloud computing, blockchain, and digital technology applications. Finally, based on the text data pool of the annual reports of listed companies, the keywords are matched, classified, and counted, providing the final word aggregation frequencies. These frequencies are normalized to form a comprehensive evaluation index of enterprise digital transformation.

3.2.3. Mediating Variables

Innovation capability reflects a company's ability to address uncertainties through the development of new products or services. Studies have shown that digital transformation enhances firms' adaptability and capacity for reconstruction during crises by promoting ambidextrous innovation (i.e., exploitative and explorative innovation) [55]. In this study, corporate innovation capability is measured by the ratio of R&D investment to operating revenue. This ratio serves as a key indicator of innovation capability, providing an objective assessment of a company's technological creativity and competitiveness.

Agile response refers to a company's ability to address external changes and achieve growth through rapid responses [56]. It enables firms navigate crises more flexibly by improving decision making speed and organizational coordination efficiency. In modern enterprises, especially listed companies, major decisions are typically made through board discussions. The frequency and quality of board meetings reflect management's ability to respond swiftly to market changes and serve as a reliable indicator of a firm's response to external shocks [57]. Furthermore, frequent decision making often signals an organization's heightened focus on and adaptability to dynamic environments. Accordingly, this study measures a firm's agile response by the number of board meetings held during the current period. A higher number of meetings indicates faster response speeds to external changes.

3.2.4. Control Variables

To better isolate the impact of the independent variable on organizational resilience, this study incorporates a series of control variables by drawing on the existing literature [58–60]. The selected control variables include ownership concentration, firm listing age, operational efficiency, capital intensity, profitability, financial leverage, and market competition intensity.

Ownership concentration refers to the proportion of a firm's equity held by its largest shareholders. High ownership concentration enhances the authority of controlling shareholders, enhancing decision making efficiency and consistency. Such centralized governance can enable firms to take swift actions during crises, thereby enhancing resilience. However, high ownership concentration may also lead to conflicts of interest between controlling and minority shareholders, triggering agency problems. Excessive control rights could increase the risk of internal corruption and financial misconduct, ultimately undermining the firm's long-term sustainability.

Listing age reflects a company's market experience and maturity. Companies with longer listing histories generally possess more stable financial structures and business strategies, as well as greater access to available resources. As a result, such companies are likely to demonstrate higher resilience.

Operational efficiency is measured by the company's asset turnover ratio, which directly reflects its ability to utilize resources and respond to market changes. Companies with higher asset turnover ratios typically maintain stronger liquidity, enabling them to better cope with changes in the external environment and reduce operational risks.

Capital intensity reflects the extent to which a company relies on capital investment in its production process. Capital-intensive firms typically invest heavily in fixed assets, making it more challenging for them to quickly adapt to external shocks [61].

Financial leverage measures the extent to which a company utilizes debt financing. High leverage can lead to greater financial risk, especially during economic downturns, which can significantly impact the company's resilience [62].

Profitability is a core indicator of a company's long-term sustainability. Firms with strong profitability generally have greater financial flexibility to cope with market changes. During crises, investors are also more likely to support companies with higher profitability.

Market competition represents the level of external pressure a company faces. A highly competitive environment may drive firms to continuously innovate and improve efficiency. However, excessive competition can erode profitability, thereby weakening the company's resilience.

3.3. Model Setting

3.3.1. Baseline Model

Based on the analysis in the previous sections, the baseline regression model in this study is specified as follows in Equation (1):

$$Y_{i,t} = \delta_0 + \delta_1 Digital_{i,t} + \delta_2 Control_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

In the equation, Y represents organizational resilience, including both the resistance ability to risks (*resistance*) and the recovery ability (*recovery*) of the company. *Digital* denotes digital transformation, *Control* represents the set of control variables, μ indicates industry fixed effects, λ represents time fixed effects, and ε is the random error term. The coefficient β is the focus of this study, indicating the direction and magnitude of the impact of digital transformation on organizational resilience.

3.3.2. Mediation Effect Model

To examine the role of corporate innovation capability and agile response in digital transformation-driven organizational resilience, this study builds the following mediation effect model based on Equation (1) [63]:

$$M_{i,t} = \alpha_0 + \alpha_1 Digital_{i,t} + \alpha_3 Control_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (2)$$

$$Y_{i,t} = \beta_0 + \beta_1 Digital_{i,t} + \beta_2 M_{i,t} + \beta_3 Control_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (3)$$

In Equations (2) and (3), M represents the mediator variables, which are corporate innovation capability and agile response. The meanings of other variables are consistent with those in Equation (1).

4. Empirical Results and Analysis

4.1. Baseline Regression Results

Table 2 reports the baseline regression results regarding the impact of digital transformation on organizational resilience. Column (1) and column (3) present the results that only include the core explanatory variables, while column (2) and column (4) present the results after incorporating control variables and accounting for time and industry fixed effects. The

results indicate that at the 1% significance level, the coefficient for digital transformation is significantly positive, suggesting that digital transformation exerts a beneficial effect on organizational resilience. Specifically, with regard to corporate risk resistance capability, the coefficients in column (1) and (3) are significantly positive at the 1% level, suggesting a positive correlation between digital transformation and the firm's ability to resist risks. For corporate recovery capability, the coefficients in column (2) and (4) are significantly positive at the 1% level, indicating that digital transformation significantly enhances the firm's recovery capability. These findings suggest that digital transformation significantly strengthens organizational resilience, thus supporting Hypothesis 1 (H1).

Table 2. Benchmark regression results.

Variables	(1) Resistance	(2) Resistance	(3) Recovery	(4) Recovery
Digital transformation	0.126 *** (3.593)	0.159 *** (6.593)	0.081 *** (7.938)	0.079 *** (8.103)
Ownership concentration		0.009 *** (20.081)		0.002 *** (10.116)
Listing age		−0.094 *** (−9.049)		−0.000 (−0.082)
Operational efficiency		0.044 * (1.737)		0.043 *** (3.727)
Capital intensity		−0.007 (−0.964)		−0.007 ** (−2.290)
Financial leverage		1.465 *** (34.272)		0.329 *** (20.134)
Profitability		22.416 *** (110.565)		1.463 *** (19.501)
Market competition		0.076 (1.187)		0.050 (1.499)
Constant	−1.209 *** (−125.319)	−3.345 *** (−62.860)	0.213 *** (81.057)	−0.159 *** (−5.868)
Observations	20,449	20,449	20,449	20,449
R-squared	0.067	0.584	0.043	0.109
YEAR	NO	YES	NO	YES
IND	NO	YES	NO	YES
Adjusted R-squared	0.0634	0.583	0.0391	0.105
F	12.91	1919	63.02	134.4

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2. Endogeneity Discussion

4.2.1. Instrumental Variable Approach

Given the potential bidirectional causal relationship between digital transformation and organizational resilience, endogeneity issues may arise. On the one hand, digital transformation can enhance a firm's ability to cope with external shocks, improving its flexibility and stability, and helping the firm recover more quickly from crises. On the other hand, firms with greater resilience generally exhibit stronger risk resistance capabilities, more abundant resource reserves, and more robust management systems, all of which enable them to better navigate the uncertainties associated with digital transformation.

To address potential endogeneity concerns, this study draws on the heteroscedasticity-based instrumental variable (IV) approach proposed by Lewbel, employing the cubic difference between a firm's digital transformation and the average digital transformation indicators classified by industry and province as the instrument [64].

Table 3 presents the two-stage regression results for the instrumental variables. The Kleibergen–Paap rk LM statistic is significant at the 1% level, rejecting the null hypothesis of instrument irrelevance, thereby validating the validity of the chosen instruments. According to Stock–Yogo, the Kleibergen–Paap Wald rk F statistic exceeds the critical value for a 1% bias, indicating that there is no issue with weak instruments. After addressing the endogeneity problem, the regression coefficients remain significant at the 1% level, validating the robustness of the baseline regression results.

Table 3. Instrumental variable two-stage regression results.

	(1)	(2)	(1)
Variables	Resistance	Recovery	Digital Transformation
Digital transformation	0.0725 ** (0.0334)	0.0325 *** (0.0097)	
IV1			0.6214 *** (0.0231)
Controls	YES	YES	YES
YEAR	YES	YES	YES
IND	YES	YES	YES
Observations	20,449	20,449	20,449
R-squared	0.554	0.071	0.694
Adjusted R-squared	0.552	0.0667	0.693
Kleibergen–Paap rk LM statistic	242.79 ***		
Kleibergen–Paap Wald rk F statistic	725.73 *** [16.38]		

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2.2. Propensity Score Matching (PSM)

There exist systematic differences between firms with varying degrees of digital transformation, and these differences may potentially affect the regression results. To mitigate these discrepancies, this study adopts propensity score matching (PSM), following the methodology proposed by Chen [41]. First, the degree of digital transformation is divided into two groups based on the median value of the digital transformation index for the year. Firms with a digital transformation degree higher than the industry’s annual median are assigned a value of 1, while those below the median are assigned a value of 0. Next, several characteristic variables, including ownership concentration, listing age, operational efficiency, capital intensity, financial leverage, profitability, and market competition, are selected. The nearest-neighbor matching method is then employed for a 1:2 matching ratio.

Table 4 presents the pre-matching and post-matching differences. After matching, the p -values for all characteristic variables become statistically insignificant. Additionally, except for the variable “listing age”, the absolute t -values significantly decrease after matching, indicating a satisfactory matching effect. Finally, the matching results are substituted into the model for regression analysis. The regression results for the post-matching sample are reported in Table 5, which are consistent with the earlier hypothesis testing results. Therefore, after considering potential endogeneity issues, the conclusions drawn from the previous analysis remain robust.

Table 4. PSM regression results.

	(1)	(2)
Variables	Resistance	Recovery
Digital transformation	0.002 *** (5.069)	0.001 *** (6.409)
Ownership concentration	0.009 *** (13.992)	0.002 *** (7.352)
Listing age	−0.101 *** (−7.147)	−0.012 * (−1.714)
Operational efficiency	0.007 (0.197)	0.018 (1.382)
Capital intensity	−0.013 (−1.296)	−0.013 *** (−3.886)
Financial leverage	1.533 *** (27.338)	0.345 *** (16.468)
Profitability	22.369 *** (78.085)	1.511 *** (14.447)
Market competition	−0.008 (−0.090)	−0.000 (−0.009)
_cons	−3.297 *** (−43.318)	−0.095 *** (−2.926)
N	16,152	16,152

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 5.** Difference checking before and after PSM matching.

Variables	Average Value			T_Test		
	Matching Status	High Digital	Control Group	Variable Bias	T_Value	p_Value
Ownership concentration	Pre-matching	58.127	58.162	−0.2	−0.17	0.866
	Post-matching	58.127	58.213	−0.6	−0.43	0.669
Listing age	Pre-matching	2.2218	2.1947	4.0	2.85	0.004 ***
	Post-matching	2.2218	2.2213	0.1	0.05	0.959
Operational efficiency	Pre-matching	0.6418	0.6321	2.5	1.80	0.072 *
	Post-matching	0.6418	0.6451	−0.9	−0.61	0.543
Capital intensity	Pre-matching	2.17	2.1334	2.6	1.88	0.060 *
	Post-matching	2.17	2.156	1.0	0.71	0.476
Financial leverage	Pre-matching	0.4026	0.4074	−2.5	−1.81	0.071 *
	Post-matching	0.4026	0.4032	−0.3	−0.24	0.810
Profitability	Pre-matching	0.0533	0.0506	6.6	4.71	0.000 ***
	Post-matching	0.0533	0.0533	0.1	0.10	0.923
Market competition	Pre-matching	0.1983	0.1806	11.0	7.80	0.000 ***
	Post-matching	0.1983	0.1991	−0.5	−0.32	0.752
N					16,152	16,152

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3. Robustness Test

4.3.1. Substitution of Independent Variables

Considering that different measurement methods for corporate digital transformation may influence the research results, this study draws on the work of Zhao Chenyu [65], conducting a text analysis of listed company annual reports. From four dimensions, digital technology applications, internet business models, smart manufacturing, and modern information systems, 99 digital-related keywords are selected for frequency analysis, forming an alternative variable for corporate digital transformation. The baseline regression

is then re-estimated using these new variables. The regression results are presented in columns (1) and (2) of Table 6, where the coefficient of digital transformation is significantly positive at the 1% confidence level.

Table 6. Robustness tests.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Resistance	Recovery	ROE	Resistance	Recovery	Resistance	Recovery
Digital transformation_sub	0.074 *** (6.649)	0.036 *** (7.854)					
Digital transformation			0.002 *** (2.997)			0.172 *** (6.534)	0.076 *** (7.047)
Digital transformation_lag				0.147 *** (5.878)	0.063 *** (6.221)		
Ownership concentration	0.009 *** (19.884)	0.002 *** (9.928)	−0.000 (−0.206)	0.010 *** (20.093)	0.002 *** (10.118)	0.009 *** (18.160)	0.002 *** (8.987)
Listing age	−0.093 *** (−8.976)	−0.000 (−0.013)	−0.001 ** (−2.477)	−0.094 *** (−9.081)	−0.001 (−0.104)	−0.103 *** (−9.051)	−0.004 (−0.717)
Operational efficiency	0.047 * (1.872)	0.045 *** (3.876)	0.008 *** (7.807)	0.045 * (1.784)	0.043 *** (3.744)	0.040 (1.443)	0.046 *** (3.632)
Capital intensity	−0.006 (−0.828)	−0.007 ** (−2.131)	0.002 *** (10.918)	−0.007 (−0.910)	−0.007 ** (−2.253)	−0.007 (−0.870)	−0.008 ** (−2.211)
Financial leverage	1.455 *** (33.970)	0.325 *** (19.740)	0.151 *** (80.529)	1.467 *** (34.306)	0.330 *** (20.166)	1.446 *** (30.594)	0.331 *** (18.435)
Profitability	22.406 *** (110.481)	1.459 *** (19.381)	1.784 *** (252.365)	22.431 *** (110.536)	1.468 *** (19.554)	22.364 *** (100.457)	1.447 *** (17.817)
Market competition	0.076 (1.179)	0.050 (1.493)	−0.000 (−0.056)	0.072 (1.116)	0.050 (1.479)	0.054 (0.819)	0.054 (1.616)
Constant	−3.352 *** (−62.824)	−0.163 *** (−6.000)	−0.068 *** (−36.988)	−3.343 *** (−62.777)	−0.157 *** (−5.780)	−3.301 *** (−57.271)	−0.148 *** (−4.977)
Observations	20,449	20,449	16,201	20,432	20,432	16,721	16,721
R-squared	0.585	0.109	0.904	0.584	0.108	0.584	0.109
YEAR	YES	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.583	0.105	0.903	0.582	0.104	0.582	0.104
F	1912	134.9	9307	1913	132.6	1580	117.3

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3.2. Substitution of Dependent Variable

Return on equity (ROE) is a comprehensive metric that reflects a company's profitability, financial health, and capacity to generate returns on equity. It simultaneously captures a firm's operational efficiency and risk profile. Previous studies on banking and corporate environments has shown a relationship between return on investment and resilience [66,67]. Therefore, in this study, return on equity (ROE) is used as an alternative variable for organizational resilience in the regression. The regression results are presented in column (3) of Table 6, where the results remain robust.

4.3.3. Lagging of Independent Variables by One Period

Considering that the impact of corporate digital transformation may exhibit time-lag effects, the core independent variables are lagged by one period before performing the

regression. As shown in columns (4) and (5) of Table 6, the results indicate that, at the 1% significance level, the coefficient estimates remain significantly positive.

4.3.4. Excluding Certain Samples

Changes in the external environment, often linked to the global economic climate, can not only influence corporate decisions regarding digital transformation but also affect overall organizational resilience. Failure to account for such factors may lead to biased regression results. The financial crisis of 2008, China's stock market crash in 2015, and the public health emergency in 2020 all had significant impacts on the economy and organizational resilience. By excluding data from these specific years and re-estimating the regression, we aim to minimize the influence of external shocks on the relationship between digital transformation and organizational resilience, thereby providing a more accurate assessment of the role of firm-specific factors in resilience. The results in columns (6) and (7) of Table 6 show that the conclusion that digital transformation significantly enhances organizational resilience remains unchanged.

5. Mechanism Analysis and Heterogeneity Test

5.1. Mediating Effect Analysis

Prior research has confirmed that digital transformation significantly enhances organizational resilience. This section further analyzes the pathways through which digital transformation impacts organizational resilience. Building on the previous literature review and theoretical analysis, the influence of digital transformation on organizational resilience primarily manifests in two dimensions. First, digital transformation provides technical support for innovation activities, thereby enhancing the firm's ability to respond to uncertainty and market competition through improved innovation capabilities. This, in turn, strengthens both risk resistance and recovery capacity. Second, digital transformation improves the efficiency of information acquisition and transmission, enabling companies to adjust strategies flexibly. By enhancing the efficiency of internal resource allocation and decision making quality, digital transformation helps organizations quickly adapt to market fluctuations and respond to crises, thus enhancing organizational resilience. To empirically test whether digital transformation enhances organizational resilience through these mechanisms, this study employs stepwise regression for mediating effect verification.

5.1.1. Innovation Capability

As shown in column (1) of Table 7, the coefficient of digital transformation is significantly positive, indicating that digital transformation helps companies engage in technological innovation and enhance innovation capability. Columns (2) to (3) examine the internal relationships between digital transformation, innovation capability, and organizational resilience. Regarding the company's risk resistance ability, the coefficients for both digital transformation and innovation capability are significantly positive. Based on the stepwise regression analysis, a partial mediating effect is observed, with the mediating effect ratio calculated at 5.86%. As for recovery ability, the coefficient for innovation capability in the third step is not significant. To verify whether a mediating effect exists, the study further employs the Bootstrap method for testing. The results show that the 95% confidence interval for the indirect effect does not include 0, with $p = 0.041$ ($p < 0.05$). The Bootstrap test confirms that the mediating effect of innovation capability is significant. Innovation capability helps transform digital transformation investments into actual competitive advantages, thus enhancing a company's risk resistance and recovery ability. On the one hand, digital technologies provide new tools for innovation activities, boosting technological capability and stimulating further innovation. This innovation capability increases the efficiency of

R&D investment and output, enabling the company to maintain a competitive edge in the face of market fluctuations and external shocks, thereby enhancing its risk resistance. On the other hand, innovation capability allows companies to adjust products and services more rapidly in response to changing market demands. By quickly launching innovative solutions, companies can shorten recovery cycles and seize new opportunities after crises, thereby enhancing organizational recovery capability. These results suggest that innovation capability plays a mediating role in the impact of digital transformation on organizational resilience, supporting H2.

Table 7. Mechanism test: innovation capability.

Variables	(1) Innovation Capability	(2) Resistance	(3) Recovery
Digital transformation	1.555 *** (9.233)	0.150 *** (6.175)	0.078 *** (7.877)
Innovation capability		0.006 *** (3.624)	0.000 (0.479)
Ownership concentration	−0.010 *** (−5.495)	0.010 *** (20.159)	0.002 *** (10.112)
Listing age	−0.618 *** (−14.540)	−0.090 *** (−8.638)	−0.000 (−0.047)
Operational efficiency	−0.956 *** (−9.923)	0.049 * (1.958)	0.043 *** (3.734)
Capital intensity	0.570 *** (13.322)	−0.010 (−1.400)	−0.007 ** (−2.374)
Financial leverage	−3.066 *** (−18.566)	1.483 *** (34.404)	0.330 *** (19.996)
Profitability	3.571 *** (5.210)	22.395 *** (110.435)	1.462 *** (19.439)
Market competition	−0.503 * (−1.857)	0.079 (1.231)	0.050 (1.503)
Constant	6.908 *** (30.379)	−3.385 *** (−61.991)	−0.161 *** (−5.805)
Observations	20,449	20,449	20,449
R-squared	0.462	0.585	0.109
YEAR	YES	YES	YES
IND	YES	YES	YES
Adjusted R-squared	0.460	0.583	0.105
F	315.9	1707	120.9

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.1.2. Agile Response

As shown in column (1) of Table 8, the coefficient for digital transformation is significantly positive, indicating that digital transformation enhances organizational agility. The regression results in columns (2) and (3) show that a partial mediating effect exists, with mediating effect ratios of 13.44% and 15%, respectively. This suggests that digital transformation enables firms to acquire real-time information, improve decision making efficiency, and enable facilitate the rapid capture of opportunities and problem-solving, thereby enhancing organizational resilience to a greater extent. These results suggest that agile response plays a mediating role in the impact of digital transformation on organizational resilience, supporting H3.

Table 8. Mechanism test: agile response.

	(1)	(2)	(3)
Variables	Agile Response	Resistance	Recovery
Digital transformation	1.182 *** (11.025)	0.137 *** (5.691)	0.067 *** (6.946)
Agile response		0.018 *** (10.435)	0.010 *** (14.010)
Ownership concentration	−0.002 (−0.833)	0.010 *** (20.216)	0.002 *** (10.220)
Listing age	0.001 (0.018)	−0.094 *** (−9.089)	−0.000 (−0.084)
Operational efficiency	−0.617 *** (−6.073)	0.055 ** (2.179)	0.049 *** (4.274)
Capital intensity	0.141 *** (4.824)	−0.010 (−1.307)	−0.008 *** (−2.791)
Financial leverage	5.904 *** (35.400)	1.358 *** (30.618)	0.271 *** (16.382)
Profitability	5.155 *** (7.754)	22.323 *** (110.111)	1.412 *** (18.801)
Market competition	0.005 (0.019)	0.076 (1.190)	0.050 (1.512)
Constant	6.859 *** (31.560)	−3.469 *** (−64.276)	−0.227 *** (−8.126)
Observations	20,449	20,449	20,449
R-squared	0.142	0.587	0.119
YEAR	YES	YES	YES
IND	YES	YES	YES
Adjusted R-squared	0.138	0.585	0.115
F	189.8	1739	144.4

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.2. Heterogeneity Test

5.2.1. Heterogeneity Test Based on Region

Digital transformation is more beneficial for enhancing organizational resilience in companies located in the eastern and central regions. As shown in Table 9, the positive effect of digital transformation on organizational resilience in the eastern and central regions passes the 1% significance test, while the effect on the western region is not significant. These results suggest that the impact of digital transformation on business resilience is heterogeneous for firms in different regions, supporting H4a.

Several factors may contribute to this: First, there are differences in regional economic development levels. The eastern region is economically developed, with well-established digital infrastructure; the central region has experienced a relatively fast pace of digitalization, allowing it to benefit from a catching-up advantage; the western region, however, remains economically underdeveloped with weak digital infrastructure. Second, there are differences in regional industrial structures. The eastern region primarily focuses on upgrading manufacturing and modern services, with a high degree of industrial digitalization; the central region is undergoing an industrial restructuring phase, and the diversification of industries has created various application scenarios for digital transformation; the western region is dominated by resource-based and labor-intensive industries, which have shorter industrial chains and limited innovation capabilities. These traditional industries are less adaptable to digital technologies, making it difficult for digital transformation to have a significant effect in the short term. Third, there are differences in regional policy support and market environments. The eastern region is a pioneer in implementing digitalization

policies, with the government supporting corporate digital transformation through tax incentives, special funding, and other measures. In recent years, the central region has gradually increased policy support for digital development, promoting corporate transformation through industrial parks, government subsidies, and other strategies. Although the western region also has strategic plans for digital development, the policy implementation is limited due to local financial constraints and weaker regional market demand. Fourth, there are differences in regional talent resources. The eastern region has numerous universities and research institutions, offering abundant and high-level digital talent to support corporate transformation. With the promotion of talent mobility policies, the central region has gradually attracted talent from the eastern regions, and local universities are training professionals who can adapt to digital development. However, the western region, due to its lower economic development, faces a shortage of digital talent and a significant outflow, which creates a large skills gap for enterprises pushing for digital transformation. The significant impact of digital transformation on enhancing organizational resilience in companies in the eastern and central regions can be attributed to several factors. The eastern region benefits from a well-established digital infrastructure, a high-value-added industrial structure, strong policy support, and abundant talent resources. The central region, by leveraging its latecomer advantage and policy support, has gradually realized its digital dividends. On the other hand, the western region faces challenges such as weak infrastructure, a single industrial structure, and a shortage of talent, which limit the effectiveness of digital transformation in improving organizational resilience.

Table 9. Heterogeneity test based on region.

Variables	(1) Eastern Region Resistance	(2) Recovery	(3) Central Region Resistance	(4) Recovery	(5) Western Region Resistance	(6) Recovery
Digital transformation	0.156 *** (5.964)	0.073 *** (6.965)	0.294 *** (3.728)	0.133 *** (4.252)	0.073 (0.556)	−0.021 (−0.410)
Ownership concentration	0.011 *** (18.717)	0.002 *** (6.389)	0.008 *** (6.454)	0.004 *** (6.335)	0.005 *** (3.988)	0.005 *** (5.284)
Listing age	−0.080 *** (−6.574)	−0.016 ** (−2.504)	−0.145 *** (−5.380)	0.028 * (1.957)	−0.086 *** (−2.848)	0.042 ** (2.475)
Operational efficiency	0.015 (0.516)	0.059 *** (4.103)	0.039 (0.686)	0.007 (0.271)	0.042 (0.529)	0.047 (1.360)
Capital intensity	−0.001 (−0.124)	−0.000 (−0.115)	−0.029 (−1.321)	−0.025 *** (−5.084)	−0.027 (−1.289)	−0.014 * (−1.887)
Financial leverage	1.519 *** (30.231)	0.352 *** (17.399)	1.187 *** (10.689)	0.253 *** (6.502)	1.537 *** (11.731)	0.386 *** (7.632)
Profitability	22.138 *** (92.661)	1.565 *** (17.699)	23.152 *** (45.263)	1.462 *** (6.737)	22.846 *** (37.449)	1.082 *** (5.774)
Market competition	0.135 * (1.841)	0.102 ** (2.468)	−0.160 (−0.950)	−0.108 * (−1.689)	−0.209 (−0.951)	−0.170 * (−1.848)
Constant	−3.431 *** (−55.063)	−0.138 *** (−4.286)	−2.992 *** (−21.166)	−0.200 *** (−2.996)	−3.158 *** (−19.481)	−0.308 *** (−3.388)
Observations	14,649	14,649	3362	3362	2429	2429
R-squared	0.588	0.122	0.610	0.156	0.623	0.183
YEAR	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.586	0.117	0.601	0.137	0.611	0.157
F	1393	103.2	292.8	25.46	210.5	17.86

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.2.2. Heterogeneity Test Based on Factor Intensity

This study classifies all sample industries, according to the 2012 industry classification standards of the China Securities Regulatory Commission, into three types based on the intensity of production factors: labor-intensive, capital-intensive, and technology-intensive [68]. The regression results in Table 10 reveal that the impact of digital transformation on organizational resilience varies across enterprises with different factor intensities. For a company's risk resistance capability, the coefficient for capital-intensive enterprises is significant at the 1% confidence level, while the impact of digital transformation on resilience is not significant for labor-intensive and technology-intensive enterprises. Regarding recovery capability, digital transformation has a positive effect on the resilience of labor-intensive enterprises, which passes the 1% significance test. The positive effect on the resilience of capital-intensive enterprises passes the 5% significance test, while for technology-intensive enterprises, the effect is not significant. These results suggest that the impact of digital transformation on firm resilience is heterogeneous for firms with different factors of production, supporting H4b.

Table 10. Heterogeneity test based on the factor intensity.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Labor-Intensive Resistance	Labor-Intensive Recovery	Capital-Intensive Resistance	Capital-Intensive Recovery	Technology-Intensive Resistance	Technology-Intensive Recovery
Digital transformation	0.104 (1.486)	0.224 *** (5.114)	0.126 *** (3.429)	0.023 ** (2.087)	0.149 (0.837)	0.097 (0.640)
Ownership concentration	0.012 *** (15.968)	0.003 *** (7.677)	0.007 *** (9.310)	0.002 *** (4.537)	0.001 (0.507)	0.003 * (1.893)
Listing age	−0.087 *** (−5.705)	0.012 (1.381)	−0.113 *** (−7.063)	−0.023 *** (−3.064)	−0.081 (−1.060)	0.010 (0.274)
Operational efficiency	−0.030 (−0.878)	0.079 *** (4.313)	0.110 *** (2.623)	−0.020 (−1.247)	0.214 ** (1.999)	−0.014 (−0.241)
Capital intensity	−0.011 (−0.942)	−0.006 (−1.381)	−0.013 (−1.134)	−0.008 (−1.414)	0.069 ** (2.403)	−0.013 (−1.094)
Financial leverage	1.350 *** (20.319)	0.273 *** (10.293)	1.624 *** (25.211)	0.418 *** (17.195)	1.269 *** (4.829)	0.127 (1.025)
Profitability	21.312 *** (75.183)	1.386 *** (11.477)	23.701 *** (71.578)	1.576 *** (14.686)	20.893 *** (11.164)	1.514 ** (2.292)
Market competition	−0.112 (−1.021)	0.037 (0.639)	0.166 (1.461)	−0.134 *** (−3.266)	−0.475 (−0.952)	0.012 (0.031)
Constant	−3.266 *** (−40.357)	−0.238 *** (−5.569)	−3.314 *** (−40.412)	−0.022 (−0.533)	−2.623 *** (−7.494)	−0.046 (−0.232)
Observations	8509	8509	9571	9571	351	351
R-squared	0.605	0.114	0.579	0.096	0.543	0.481
YEAR	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.601	0.105	0.576	0.0901	0.507	0.439
F	849.9	54.03	860.0	63.53	24.43	2.357

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The significant enhancement of resilience in capital-intensive enterprises due to digital transformation stems from its optimization of core asset management efficiency, effective mitigation of key risks, and strong support for the recovery process. Specifically, capital-intensive enterprises typically rely heavily on fixed assets (such as equipment, factories, and infrastructure) and capital investment. The efficiency of their operations and asset utilization is critical to organizational resilience. Automation technologies and intelligent management systems can significantly improve the efficiency of production processes.

Additionally, the Internet of Things (IoT) and big data analytics technologies can enhance predictive maintenance capabilities for equipment, reducing unplanned downtime, improving production continuity, and decreasing time costs and resource waste during the asset recovery process. In contrast, the primary risks faced by labor-intensive enterprises involve personnel management (such as worker turnover and rising labor costs) and external shocks (such as the impact of pandemics on labor availability). While digital transformation can alleviate these issues to some extent (e.g., through remote work and the automation of certain processes), its impact on enhancing organizational resilience is not as direct and significant as in capital-intensive enterprises. For technology-intensive enterprises, their core competitiveness lies in technological research and development (R&D) and innovation capability. However, the innovation cycle in these companies is generally longer, and market validation carries a high degree of uncertainty. As a result, the positive impact of digital transformation on resilience is less noticeable in these companies, as their focus on long-term technological development and uncertain market conditions may reduce the immediate benefits of digitalization.

5.2.3. Heterogeneity Test Based on the Corporate Lifecycle

In addition, the sample companies were categorized into growth stage, maturity stage, and decline stage for a group regression analysis [69]. This study uses a multivariable ranking method to classify enterprise life cycle stages. It calculates four variables: dividend payout ratio, revenue growth rate, capital expenditure ratio, and establishment year. Enterprises are grouped by these variables and classified into growth (0), maturity (1), or decline (2) stages using tertiles. Summing the classification scores across all variables determines the life cycle stage: 0–3 for growth, 4–6 for maturity, and 7–10 for decline. The empirical results, as shown in Table 11, reveal significant differences in the impact of digital transformation on organizational resilience at different stages of the corporate lifecycle. In terms of risk resistance ability, digital transformation has a significant positive impact at the 1% level for growth stage and maturity stage companies, while no significant effect is found for corporates in the decline stage. Regarding recovery ability, digital transformation significantly enhances resilience across all stages, with significance at the 1% level. These results suggest that the impact of digital transformation on firm resilience is heterogeneous for firms with different life cycles, supporting H4c.

Growth stage corporates are in a rapid expansion phase, experiencing high resource demands and facing significant uncertainty and competitive pressures. Digital transformation can significantly enhance organizational resilience by improving operational efficiency, promoting agile decision making, and reducing resource waste. Mature corporates, with slower growth, focus more on improving efficiency and controlling risks. Digital transformation can optimize resource allocation, explore new growth points, and strengthen the corporation's ability to resist external shocks. In contrast, corporates in the decline stage face constraints such as financial difficulties and talent loss, which limit their ability to support large-scale digital investments and, as a result, prevent the formation of systemic transformation outcomes. Digital transformation in these companies is often more of a short-term survival tactic, lacking the capacity for a comprehensive organizational restructuring at the strategic level. Therefore, its impact is more limited in depth and scope.

Therefore, the results of the heterogeneity analysis indicate that the impact of digital transformation on organizational resilience is constrained by factors such as the firm's location, factor intensity, and lifecycle stage, thus supporting the validation of hypothesis H4.

The results of all the hypotheses and their tests in this paper, including the results of the heterogeneity analysis, will be summarized below, as shown in Tables 12 and 13.

Table 11. Heterogeneity test based on the corporate lifecycle.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Growth Resistance	Recovery	Maturity Resistance	Recovery	Decline Resistance	Recovery
Digital transformation	0.199 *** (6.091)	0.075 *** (5.392)	0.119 *** (3.201)	0.064 *** (4.676)	0.150 (1.424)	0.077 *** (2.842)
Ownership concentration	0.009 *** (11.538)	0.002 *** (6.054)	0.010 *** (16.232)	0.003 *** (9.585)	0.010 *** (5.073)	0.002 *** (3.211)
Listing age	−0.195 *** (−10.919)	0.013 (1.317)	−0.001 (−0.089)	0.043 *** (6.035)	0.066 (1.476)	0.048 ** (2.335)
Operational efficiency	−0.024 (−0.643)	0.060 *** (3.052)	0.048 (1.305)	0.044 *** (2.898)	0.206 * (1.922)	−0.006 (−0.218)
Capital intensity	−0.031 *** (−2.675)	0.004 (0.745)	−0.008 (−0.785)	−0.015 *** (−4.253)	0.025 (1.072)	−0.023 *** (−2.626)
Financial leverage	1.549 *** (23.655)	0.382 *** (14.327)	1.332 *** (21.434)	0.191 *** (8.858)	1.083 *** (6.227)	0.057 (0.939)
Profitability	21.011 *** (70.081)	1.919 *** (15.007)	22.999 *** (77.431)	0.766 *** (8.474)	24.682 *** (24.446)	0.536 *** (2.597)
Market competition	0.047 (0.556)	0.002 (0.039)	0.124 (1.249)	0.010 (0.266)	−0.286 (−0.975)	0.066 (0.454)
Constant	−2.948 *** (−34.343)	−0.193 *** (−4.020)	−3.600 *** (−49.469)	−0.223 *** (−6.459)	−3.853 *** (−18.989)	−0.169 * (−1.922)
Observations	8560	8560	10,589	10,589	1291	1291
R-squared	0.584	0.145	0.589	0.100	0.620	0.141
YEAR	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.579	0.135	0.585	0.0923	0.597	0.0892
F	801.6	56.91	937.9	57.14	95.86	5.498

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 12.** Summary of assumptions.

Hypothesis	Hypothesis Content	Coefficients	p_Value	Conclusion
H1	Digital transformation- > Resistance	0.159	<0.01	support
	Digital transformation- > Recovery	0.079	<0.01	support
H2	Digital transformation- > Innovation capability	1.555	<0.01	support
H3	Digital transformation- > Agile response	1.182	<0.01	support

Table 13. Heterogeneity analysis results.

Hypothesis	Variables	Resistance	Conclusion	Recovery	Conclusion
H4a	Western	0.073	reject	−0.021	reject
	Central	0.294 ***	support	0.133 ***	support
	Eastern	0.156 ***	support	0.073 ***	support
H4b	Labor-Intensive	0.104	reject	0.224 ***	support
	Capital-Intensive	0.126 ***	support	0.023 **	support
	Technology-Intensive	0.149	reject	0.097	reject
H4c	Growth	0.199 ***	support	0.075 ***	support
	Mature	0.119 ***	support	0.064 ***	support
	Decline	0.150	reject	0.077 ***	support

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6. Conclusions and Discussion

6.1. Research Conclusions

Based on annual data from A-share listed companies between 2007 and 2023, this study conducted a series of empirical tests to assess the impact of digital transformation on organizational resilience. The key findings are as follows: First, digital transformation significantly improves organizational resilience, and this conclusion remains valid after a series of robustness tests. Second, digital transformation enhances organizational resilience by improving a company's innovation capability and agility. Third, heterogeneity tests indicate that the impact of digital transformation on enhancing resilience is more significant for companies in the eastern and central regions. The effect is also more pronounced for capital-intensive companies and those in the growth and maturity stages of their lifecycle.

6.2. Theoretical Contributions

First, this study expands the measurement framework of organizational resilience [4,41], constructing resilience indicators based on two dimensions: resistance capacity and recovery capacity. This approach provides a fresh perspective on resilience research. This multidimensional indicator system not only deepens the theoretical understanding of the concept of organizational resilience but also offers a more practical measurement tool for future research. It helps to more accurately reflect the dynamic performance of organizations in complex environments.

Second, it explores the mechanism of the relationship between digital transformation and enterprise resilience. Compared with the original static single perspective [5], this study focuses on how digital transformation affects enterprise resilience through the two key pathways of innovation capability and agile response, systematically analyzing these mechanisms. This contributes a more comprehensive theoretical framework for understanding the relationship between digital transformation and enterprise performance, offering new directions for future studies and expanding the applicability of digital transformation theory.

Finally, it promotes the exploration of the integration of the digital economy and corporate sustainability. While previous studies addressing the role of digital transformation on sustainable development have often been performed through green patent innovation [42] or human capital improvement [8], the findings of this study reveal the potential value of digital transformation in enhancing enterprise resilience and its role in high-quality economic development. By exploring the multifaceted facilitating role of digitalization on enterprise development, this paper further promotes the integration of digital economy and enterprise management theories, providing theoretical support for exploring the transformation and upgrading of digitally enabled traditional industries.

6.3. Practical Implications

First, enterprises should adopt digital transformation as a core strategy for enhancing resilience. Companies should place significant emphasis on the role of digital transformation in strengthening resilience, with particular focus on technological advancements and management innovation. For instance, optimizing resource allocation through digital management platforms can enhance a company's adaptability and responsiveness to environmental changes, thereby strengthening its survival and growth potential [25,32].

Second, the synergistic capability of innovation and agile response should be further developed. This study shows that innovation capability and agile response are important paths for digital transformation to enhance enterprise resilience. Studies have pointed out that increasing R&D investment and optimizing teamwork mechanisms are important ways to enhance innovation capability [70]. Similarly, establishing an efficient supply chain

network and data-driven decision-making system [6] can enhance agile response, enabling the effective integration of internal and external resources.

Third, companies should fully consider the differential performance of digital transformation. They should develop practical and feasible digital transformation strategies based on their own characteristics and industry environment, maximizing the role of digital transformation in enhancing resilience. Governments should formulate differentiated policies to support digital transformation [34]. For instance, the eastern and central regions should continue to improve digital infrastructure, while policies for capital-intensive industries and companies in the growth phase should prioritize specialized technical support or financial services. Furthermore, a favorable external business environment should be actively fostered, with strengthened intellectual property protection for digital technologies and data assets, a gradual relaxation of regulations, and the promotion of free market competition.

7. Research Limitations and Future Directions

The main limitations of this study include the following three aspects:

First, in terms of variable measurement, future research could explore corporate resilience from different perspectives, such as the long-term survival rate of enterprises. Additionally, compared to foreign stock markets, China's stock market is more strongly influenced by policies. Therefore, it is suggested that future research incorporate policy-related factors into the measurement indicators to more accurately address research issues under different contextual settings.

Second, in the mechanism analysis, this study focused on the roles of innovation capability and agile response. However, other potential mechanisms, such as the development of digital culture, organizational learning capabilities, or ecological synergy effects, still require further exploration. Subsequent research can expand to more dimensions to deepen the understanding of the pathways through which digitalization empowers organizations.

Third, regarding the research subject, future studies may consider the broader ecosystem in which companies operate. Specifically, it would be valuable to investigate whether the positive effects of digitalization on companies extend to the supply chain and industry chain, thereby enhancing the overall resilience and risk resistance of the entire supply chain and industry network.

Author Contributions: Conceptualization, J.Z. and H.L.; Data curation, J.Z.; Formal analysis, H.Z.; Funding acquisition, H.Z.; Methodology, J.Z.; Project administration, H.Z.; Software, J.Z. and H.L.; Supervision, H.Z.; Validation, J.Z. and H.L.; Writing—original draft, J.Z. and H.L.; Writing—review and editing, H.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Natural Science Foundation of China, grant number 71972175.

Data Availability Statement: The data presented in this study are openly available in CSMAR at <https://data.csmar.com> (accessed on 18 July 2024).

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Hamel, G.; Vlikangas, L. The quest for resilience. *Harv. Bus. Rev.* **2003**, *81*, 52. [PubMed]
2. Benner, M.J.; Waldfoegel, J. Changing the channel: Digitization and the rise of “middle tail” strategies. *Strateg. Manag. J.* **2023**, *44*, 264–287. [CrossRef]
3. Guo, B.; Feng, Y.; Lin, J. Digital inclusive finance and digital transformation of enterprises. *Financ. Res. Lett.* **2023**, *57*, 104270. [CrossRef]
4. Hejun, F.; Ningning, P. Digital transformation, agile responsiveness and corporate resilience. *Econ. Manag.* **2024**, *46*, 36–54.

5. Luo, L.; Zhang, L.; Wang, C. Digital transformation and corporate resilience—Evidence from Chinese A-share listed firms. *Reform Openness* **2024**, *96*, 64–79.
6. Wen, K.; Li, C. Digital transformation, supply chain concentration and supplier innovation. *Forum Stat. Inf.* **2024**, *39*, 107–128.
7. Scholz, R.W.; Czychos, R.; Parycek, P.; Lampoltshammer, T.J. Organizational vulnerability of digital threats: A first validation of an assessment method. *Eur. J. Oper. Res.* **2020**, *282*, 627–643. [[CrossRef](#)]
8. Xiao, T.; Sun, R.; Yuan, C. Firms' digital transformation, human capital restructuring and labour income share. *Manag. World* **2022**, *38*, 220–237.
9. Alexander, D.E. Resilience and disaster risk reduction: An etymological journey. *Nat. Hazards Earth Syst. Sci.* **2013**, *13*, 2707–2716. [[CrossRef](#)]
10. Limnios, E.A.M.; Mazzarol, T.; Ghadouani, A.; Schilizzi, S.G. The resilience architecture framework: Four organizational archetypes. *Eur. Manag. J.* **2014**, *32*, 2104–2116.
11. Bandura, A. Self-efficacy: Toward a unifying theory of behavioral change. *Psychol. Rev.* **1977**, *84*, 191–215. [[CrossRef](#)] [[PubMed](#)]
12. Sun, Y.; Mou, S.; Su, F.; Wang, Y. A single case study of organisational resilience formation mechanism under heterogeneous adversity events. *Nankai Manag. Rev.* **2024**, *3*, 1–28.
13. Zhai, X.; Zhu, C.J.; Zhang, M.M. Mapping promoting factors and mechanisms of resilience for performance improvement: The role of strategic human resource management systems and psychological empowerment. *Appl. Psychol.* **2023**, *72*, 915–936. [[CrossRef](#)]
14. Nikiforou, A.; Lioukas, S.; Chatzopoulou, E.C.; Voudouris, I. When there is a crisis, there is an opportunity? SMEs' capabilities for durability and opportunity confidence. *Int. J. Entrep. Behav. Res.* **2023**, *29*, 1053–1074. [[CrossRef](#)]
15. Lengnick-Hall, Cynthia, A.; Tammy, E.B.; Mark, L. Developing a capacity for organizational resilience through strategic human resource management. *Hum. Resour. Manag. Rev.* **2011**, *21*, 2243–2255. [[CrossRef](#)]
16. Boin, A.; Michel, J.; Van, E. The resilient organization. *Public Manag. Rev.* **2013**, *15*, 429–445. [[CrossRef](#)]
17. Barney, J.B. Firm Resources and Sustained Competitive Advantage. *J. Manag.* **1991**, *17*, 99–120. [[CrossRef](#)]
18. Grant, M.R. The resource-based theory of competitive advantage: Implications for strategy formulation. *Calif. Manag. Rev.* **1991**, *33*, 114–135. [[CrossRef](#)]
19. Gulati, R.; Nohria, N.; Zaheer, A. Strategic networks. *Strateg. Manag. J.* **2000**, *21*, 203–215. [[CrossRef](#)]
20. Volberda, H.W.; Morgan, R.E.; Reinmoeller, P.; Hitt, M.A.; Ireland, R.D.; Hoskisson, R.E. *Strategic Management: Competitiveness and Globalization (Concepts and Cases)*; Cengage Learning: Boston, MA, USA, 2011.
21. Dong, C. Digital Transformation Strategy of Local Newspaper Industry—Taking Hebei Province as an Example. *Journalism* **2008**, *6*, 19–21.
22. Yehu, Y.; Duanduan, W. Digital transformation of enterprises and supply chain resilience—A supply chain spillover perspective. *Syst. Eng. Theory Pract.* **2024**, 1–22.
23. Plekhanov, D.; Franke, H.; Netland, T.H. Digital transformation: A review and research agenda. *Eur. Manag. J.* **2023**, *41*, 821–844. [[CrossRef](#)]
24. Schilling, M.A. Toward a general modular systems theory and its application to interfirm product modularity. *Acad. Manag. Rev.* **2000**, *25*, 312–334. [[CrossRef](#)]
25. Ma, H.J.; Yue, L.; Su, Z.F.; Wang, Y.J. Artificial intelligence availability, value co-creation of smart manufacturing platforms and digital transformation performance of manufacturing firms. *China Ind. Econ.* **2024**, *06*, 155–173.
26. Martínez-Peláez, R.; Ochoa-Brust, A.; Rivera, S.; Félix, V.G.; Ostos, R.; Brito, H.; Mena, L.J. Role of digital transformation for achieving sustainability: Mediated role of stakeholders, key capabilities, and technology. *Sustainability* **2023**, *15*, 11221. [[CrossRef](#)]
27. Rodrigues, A.R.D.; Ferreira, F.A.; Teixeira, F.J.; Zopounidis, C. Artificial intelligence, digital transformation and cybersecurity in the banking sector: A multi-stakeholder cognition-driven framework. *Res. Int. Bus. Financ.* **2022**, *60*, 101616. [[CrossRef](#)]
28. Sjödin, D.; Parida, V.; Palmié, M.; Wincent, J. How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops. *J. Bus. Res.* **2021**, *134*, 574–587. [[CrossRef](#)]
29. Coutu, D.L. How resilience works. *Harv. Bus. Rev.* **2002**, *80*, 46–55.
30. Freeman, S.F.; Hirschhorn, L.; Maltz, M. Organization resilience and moral purpose: Sandler O'Neill and partners in the aftermath of 9/11/01. *Natl. Acad. Manag. Meet.* **2004**.
31. Xiao, P.; Wang, N.; Sun, Y.; Yin, S. The impact of digital transformation on firms' innovation performance and its segmentation dimensions. *Sci. Technol. Manag. Res.* **2024**, *44*, 177–187.
32. Zhou, D.; Wan, Y. Can digital transformation effectively promote firms' cross-regional innovation? --A perspective on innovation of off-site subsidiaries. *Nankai Manag. Rev.* **2024**, 1–29.
33. Tsiapa, M.; Batsiolas, I. Firm Resilience in Regions of Eastern Europe During the Period 2007–2011. *Post-Communist Econ.* **2019**, *31*, 19–35. [[CrossRef](#)]
34. Wang, W.; Han, X. Strategic technological innovation of enterprises and the level of industrial autonomy and control. *China Ind. Econ.* **2024**, 43–60.

35. APEC. *Digital Economy Action Plan*. Singapore: APEC Secretariat; APEC: Singapore, 2020.
36. Mikalef, P.; Krogstie, J.; Pappas, I.O.; Pavlou, P. Exploring the Relationship between Big Data Analytics Capability and Competitive Performance: The Mediating Roles of Dynamic and Operational Capabilities. *Inf. Manag.* **2020**, *57*, 103–169. [\[CrossRef\]](#)
37. Mendrofa, S.A.; Vittorio, R.; Hulu, F.; Aina, Q.; Saling, S. Fostering Organizational Resilience through Agile Leadership: A Comparative Study Analysis. *Glob. Int. J. Innov. Res.* **2024**, *2*, 974–983. [\[CrossRef\]](#)
38. Li, C.; Wang, Y. Digital transformation and enterprise resilience: Enabling or burdening? *PLoS ONE* **2024**, *19*, e0305615. [\[CrossRef\]](#)
39. Peneder, M. Industrial structure and aggregate growth. *Struct. Change Econ. Dyn.* **2003**, *14*, 427–448. [\[CrossRef\]](#)
40. Porter, M.E.; Heppelmann, J.E. How smart, connected products are transforming companies. *Harv. Bus. Rev.* **2015**, *93*, 96–114.
41. Chen, H.; Guo, T.M.; Zhang, Y.; Guo, Q.Y. The impact of internal control on organisational resilience of manufacturing firms: A firm life cycle perspective. *Nankai Manag. Rev.* **2024**, *28*, 1–28.
42. Zhang, H.; Wu, J.; Mei, Y.; Hong, X. Exploring the relationship between digital transformation and green innovation: The mediating role of financing modes. *J. Environ. Manag.* **2024**, *356*, 120558. [\[CrossRef\]](#)
43. Lozić, J.; Čiković, K.F. The impact of digital transformation on the business efficiency of the New York Times. *UTMS J. Econ.* **2021**, *12*, 225–239.
44. Bellini, N.; Grillo, F.; Lazzeri, G.; Pasquinelli, C. Tourism and regional economic resilience from a policy perspective: Lessons from smart specialization strategies in Europe. In *The Role of Art and Culture for Regional and Urban Resilience*; Routledge: London, UK, 2019; pp. 140–154.
45. Martin, R.; Sunley, P. On the notion of regional economic resilience: Conceptualization and explanation. *J. Econ. Geogr.* **2015**, *15*, 11–42. [\[CrossRef\]](#)
46. Fahlenbrach, R.; Rageth, K.; Stulz, R.M. How Valuable is Financial Flexibility When Revenue Stops? Evidence from the COVID-19 Crisis. *Rev. Financ. Stud.* **2021**, *34*, 5474–5521. [\[CrossRef\]](#)
47. Desjardine, M.; Bansal, P.; Yang, Y. Bouncing back: Building resilience through social and environmental practices in the context of the 2008 global financial crisis. *J. Manag.* **2019**, *45*, 1434–1460. [\[CrossRef\]](#)
48. Buyl, T.; Boone, C.; Wade, J.B. CEO narcissism, risk-taking, and resilience: An empirical analysis in U.S. commercial banks. *J. Manag.* **2019**, *45*, 1372–1400. [\[CrossRef\]](#)
49. Hu, H.; Song, X.; Dou, B. The value of digitisation during a crisis: Evidence from firm resilience. *Financ. Trade Econ.* **2022**, *43*, 134–148.
50. Yue, Y.; Gu, M. An empirical study on the impact of intelligent transformation on the performance of manufacturing enterprises. *J. Cent. Univ. Financ. Econ.* **2023**, 114–128.
51. Buallay, A.; Allam, H.; Qasim, Z. Corporate governance and firm performance: Evidence from Saudi Arabia. *Australasian Accounting. Bus. Financ. J.* **2017**, *11*, 78–98.
52. Azila-Gbettor, E.M.; Honyenuga, B.Q.; Berent-Braun, M.M.; Kil, A. Structural aspects of corporate governance and family firm performance: A systematic review. *J. Fam. Bus. Manag.* **2018**, *8*, 306–330. [\[CrossRef\]](#)
53. Arun, R.; Patnayakuni, R.; Patnayakuni, N. Technology investment and business performance. *Commun. ACM* **1997**, *40*, 89–97.
54. Jiang, K.; Du, X.; Chen, Z. Firms' digitalization and stock price crash risk. *Int. Rev. Financ. Anal.* **2022**, *82*, 102196. [\[CrossRef\]](#)
55. Bouwman, H.; Nikou, S.; De Reuver, M. Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs? *Telecommun. Policy* **2019**, *43*, 101828. [\[CrossRef\]](#)
56. Lu, Y.; Ramamurthy, K. Understanding the Link between Information Technology Capability and Organizational Agility: An Empirical Examination. *MIS Q.* **2011**, *35*, 931–954. [\[CrossRef\]](#)
57. Ahammad, M.F.; Glaister, K.W.; Gomes, E. Strategic Agility and Human Resource Management. *Hum. Resour. Manag. Rev.* **2020**, *30*, 100700. [\[CrossRef\]](#)
58. Cheng, S.; Hua, X.; Wang, Q. Corporate culture and firm resilience in China: Evidence from the Sino-US trade war. *Pac. Basin Financ. J.* **2023**, *79*, 102039. [\[CrossRef\]](#)
59. Xia, Y.; Qiao, Z.; Xie, G. Corporate resilience to the COVID-19 pandemic: The role of digital finance. *Pac.-Basin Financ. J.* **2022**, *74*, 101791. [\[CrossRef\]](#)
60. Yang, J.; Peng, Q.; Ge, Z. The customer contagion effect of digital transformation: A supplier innovation perspective. *China Ind. Econ.* **2022**, *8*, 156–174.
61. Gittell, J.H.; Cameron, K.; Lim, S.; Rivas, V. Relationships, layoffs, and organizational resilience. *J. Appl. Behav. Sci.* **2006**, *42*, 300–329. [\[CrossRef\]](#)
62. Wu, T.-H.; Pei, J.L.T.; Mei-Chen, L.; Chia-Chi, C. Corporate ownership and firm performance: A mediating role of innovation efficiency. *Econ. Innov. New Technol.* **2020**, *31*, 292–319. [\[CrossRef\]](#)
63. Wen, Z.; Ye, B. Mediated effects analysis: Methodology and model development. *Adv. Psychol. Sci.* **2014**, *46*, 731–745. [\[CrossRef\]](#)
64. Lewbel, A. Constructing Instruments for Regressions With Measurement Error When No Additional Data Are Available, with An Application to Patents and R&D. *Econometrica* **1997**, *65*, 1201–1213.

65. Zhao, C.; Wang, W.; Li, X. How digital transformation affects total factor productivity of enterprises. *Financ. Trade Econ.* **2021**, *42*, 114–129.
66. Caparusso, J.; Lewrick, U.; Tarashev, N.A. *Profitability, Valuation and Resilience of Global Banks: A Tight Link*; Bank for International Settlements, Monetary and Economic Department: Basel, Switzerland, 2023.
67. Markman, G.M.; Venzin, M. Resilience: Lessons from banks that have braved the economic crisis—And from those that have not. *Int. Bus. Rev.* **2014**, *23*, 1096–1107. [[CrossRef](#)]
68. Wei, W.; Zhang, W.L.; Wen, J.; Wang, J.S. TFP recovery in Chinese cities: The role of factor intensity and industrial agglomeration. *Econ. Model.* **2020**, *91*, 534–549. [[CrossRef](#)]
69. Dickinson, V. Cash flow patterns as a proxy for firm life cycle. *Account. Rev.* **2011**, *86*, 1969–1994. [[CrossRef](#)]
70. Li, X. Patent infringement litigation, executive team risk appetite and corporate innovation. *Econ. Innov. New Technol.* **2024**, *1*–24. [[CrossRef](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.