



The Impact of Digital Transformation on Supply Chain Stability: Evidence from Chinese A-Share Listed Companies

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Abstract. Digital transformation, within the digital economy, has turned into a key strategic initiative for enterprises to boost their operational performance and competitive advantage. However, whether digital transformation indeed improves supply chain stability calls for further in-depth research. Using data from Chinese A-share listed companies over the period 2012–2022, this paper comprehensively examines how digital transformation influences supply chain stability and its mechanisms. As shown by the results, digital transformation significantly strengthens supply chain stability. By analyzing its underlying mechanisms, we find that this improvement is achieved through increased information transparency and reduced coordination costs. Heterogeneity analysis also indicates that the benefits of digital transformation for supply chain stability are more evident in non-state-owned enterprises, enterprises with lower market competitive advantages, and enterprises with weaker supply chain bargaining power. Furthermore, the benefits of digital transformation are more significant for enterprises with geographically dispersed supply chain partners. Economic consequences analysis further demonstrates that improved supply chain stability helps enterprises expand their business scope and reduce exit risks. This paper elucidates the importance of digital transformation in building more stable and resilient supply chain networks and proposes policy recommendations for promoting enterprise digital transformation.

Keywords: Digital transformation; supply chain stability; information transparency; coordination costs; Chinese A-share listed companies.

1 Introduction

In recent years, the global economy has undergone profound structural changes. The rapid progress of digital innovation is driving changes in the global economy as a whole. Traditional manufacturing and service industries are being transformed via technologies like big data, AI, cloud-based systems, and IoT. Production methods and busi-

ness models in both developed and developing countries are changing. The digital economy has become one of the key engines driving high-quality economic development and has gained recognition from governments worldwide. They recognize that digital transformation of enterprises is a necessary condition for building a modern industrial framework and maintaining a long-term competitive advantage.

Given the global transformation trend, enterprises face enormous challenges in maintaining stable and reliable connections in the supply chain network. This challenge is particularly prominent when faced with external disturbances such as trade wars, public health emergencies and international political conflicts. Supply chain stability, namely the ability to maintain lasting, trusting and flexible relationships with suppliers and customers, is economically important because changes in major supplier and customer relationships can affect financing constraints and enterprise innovation ^[1]. Digital-economy development has been shown to promote enterprise innovation partly through enterprise digital transformation ^[2], but current academic discussions mainly focus on its impact on internal corporate productivity. However, there is little research on how digital transformation affects external interactions between supply chain partners.

Existing research points to two complementary implications rather than a single uniform effect. On the one hand, digital transformation can strengthen industrial- and supply-chain resilience by improving supply-demand matching and the continuity of supply relationships ^[3]. On the other hand, digital transformation can reconfigure supply-chain relationships: evidence from Chinese listed firms shows that it reduces supplier and customer concentration and promotes a more diversified supply-chain configuration ^[4]. Diversification may reduce dependence on individual partners, but it can also increase the number of interfirm interfaces that must be coordinated. Therefore, the net effect of digital transformation on the continuity of specific supplier–customer relationships remains an empirical question.

Given China's status as the world's second-largest economy and as an early adopter of digital technologies, it is an ideal setting for studying this issue. Considering China's rapid digitalization and the numerous disruptions to supply chains during trade conflicts and the COVID-19 pandemic, it provides an appropriate setting in which to examine the causal effects of digital transformation on supply chain stability. We utilize annual report data of Chinese A-share listed firms over 2012–2022 to construct a measurement methodology based on company-level digital transformation indicators. Supply chain stability is evaluated by the retention rates for the company's five major suppliers and customers.

The association of digital transformation with total factor productivity has received increasing attention. Existing studies report positive effects of corporate digital transformation or digital technology innovation on enterprise total factor productivity ^[5–9], while one of these studies also documents a positive association with firm innovation investment ^[8]. Emerging studies have examined these links through industrial and supply chains: downstream firms' digital transformation can generate upstream productivity spillovers through stronger supply-chain resilience ^[10], while digital supply chain management can raise total factor productivity through innovation and cost-efficiency

channels ^[11]. Nevertheless, there exist relatively limited studies that explicitly investigate whether digital transformation can improve the stability of supply chain relationships. This study offers three contributions to the extant literature. First, unlike prior studies that mainly explored the direct effects of digital transformation on total factor productivity ^[5-9] or innovation investment ^[8], this study examines the external effect of digital transformation on inter-enterprise connections in the supply-chain network. Thus, this study broadens the perspective for exploring the results and impacts of digital applications. Second, this study clarifies two previously little-discussed channels: increased information transparency and reduced coordination costs. These two channels are precisely the ways in which digital transformation enhances supply chain resilience. This provides some basic insights into our understanding of governance in digital supply chain networks. Third, by employing the instrumental variable method and the quasi-experimental difference-in-differences framework, this analysis strengthens causal identification and helps mitigate the endogeneity problem.

The remainder of this paper is organized as follows: Part II explains the theory and the hypotheses tested; Part III is devoted to the methodology, in which we present the sources of the data, the way we define the variables, and the statistical models that we used; Part IV presents the empirical analysis results, including the main regression results, endogeneity tests, and robustness tests; Part V analyzes the mechanism and changes under different conditions; Part VI discusses the economic impact; and Part VII outlines the research findings, policy suggestions, and future research directions.

2 Theoretical Analysis and Research Hypotheses

2.1 Digital Transformation and Supply Chain Stability

Digital transformation refers to the process by which companies use digital tools to change the way they conduct business, their organizational structures, and the way they create value ^[12]. In the field of supply chain management, this transformation can be considered from the following three aspects: the use of digital technologies (e.g., cloud computing, big data analysis, the Internet of Things), the creation of digital platforms (e.g., systems for managing supply chains, platforms for electronic procurement), and the development of digital competencies (e.g., data-driven decision-making and a digitally skilled workforce).

Supply chain stability refers to the continuity of supply chain operations and the persistence of relationships between upstream suppliers and downstream customers. From an organizational-economics perspective, incomplete contracts and relationship-specific investments can lock buyers and suppliers into bilateral relationships and create hold-up risk ^[13]. Operationally, instability may be reflected in frequent changes in major suppliers or customers, contract tension, or opportunistic behavior. Consistent with the empirical measure used below, this study focuses on the year-to-year retention of major suppliers and customers.

Digital transformation and digital supply chain management can improve firm productivity and supply chain operations through integrated information and coordina-

tion and through innovation and cost-efficiency channels ^[11]. In this study, digital transformation is expected to enhance supply chain stability through two empirically tested mechanisms: improved information transparency and reduced coordination costs. First, digital transformation improves information visibility across the supply network. A typical supply chain may have information gaps; that is, upstream suppliers may not see information about the immediate demand of downstream customers, and demand fluctuations may be amplified, which worsens inventory control. A blockchain-based smart-contract tracking case illustrates how shared records can improve traceability and information transparency across supply-chain participants ^[14]. This kind of visibility reduces unpredictability, builds trust, and strengthens relational commitment.

Secondly, digital transformation reduces coordination-related costs. According to Coase's basic transaction cost logic, part of the reason why companies choose governance arrangements is to save on the cost of coordinating transactions ^[15]. The application of digital technologies reduces the cost of finding partners, drafting contracts, monitoring activities and enforcing agreements in the supply chain. For example, blockchain-based smart contracts make compliance checks easier and payment processes more automated, thereby reducing contract disputes. Electronic procurement systems enable companies to maintain long-term partnerships while conducting competitive bidding. Therefore, the reduction in coordination costs encourages companies to maintain stable supply chain partnerships rather than relying on one-off transactions in the market.

Potential offsetting factors. The above mechanisms describe the positive aspects of digital transformation. However, digital transformation may also change the configuration of supply-chain relationships rather than simply making existing ties more persistent. Evidence from Chinese listed firms indicates that digital transformation can reduce supplier and customer concentration and promote a more diversified supply-chain configuration ^[4]. Diversification can lower dependence on a single partner, but it may also lead firms to replace or rebalance existing partners; consequently, relationship-level retention and network-level resilience need not move in the same direction. In addition, incompatible proprietary systems and unequal digital capabilities may create switching and governance costs. These considerations make the net effect on the retention-based measure of supply chain stability theoretically ambiguous.

Finally, an overemphasis on automation can lead to over-optimization and a lack of flexibility in supply chain operations.

Digital systems often prioritize operational efficiency over robustness. Tightly integrated digital networks can accelerate the spread of disruptive factors such as network intrusions or data errors between networks. While greater transparency can reduce the information gap, the same mechanisms can lead to the leakage of confidential strategic details and increase the likelihood of partners prematurely terminating cooperation. These negative impacts suggest that the overall impact of digitalization on supply chain reliability cannot be definitively determined in theory and may vary depending on the specific characteristics of the enterprise, industry conditions, and the broader institutional environment.

Competing Theoretical Perspectives. To bridge the gap between these two viewpoints, we propose a primary hypothesis and several moderating hypotheses to clarify

when synergies are stronger and when crowding-out mechanisms may dominate. Our primary study focuses on the average impact (Hypothesis 1), while subsequent studies focus on the heterogeneity of factors associated with lock-in vulnerability and power imbalances (Hypothesis 4). In practical terms, if the crowding-out effect is empirically significant, the positive impacts of digital transformation are expected to be smaller (or even negative) for companies heavily reliant on specific partners, facing significant technological incompatibilities, or with weak bargaining power. These specific cases are the focus of our discussion in Section 5.2.

Drawing on the above analysis, we suggest:

Hypothesis 1 (Baseline): On average, digital transformation makes supply chains more stable. One implication of this result is that, in our sample, synergy-enhancing mechanisms are more important than potential crowding-out mechanisms.

2.2 Mechanism: Information Transparency and Coordination Costs

To explore the causal path from digital transformation to supply chain stability, we further propose two mediating mechanisms.

Information transparency mechanisms demonstrate that digital transformation can improve information quality, shorten information access time, and enhance the likelihood of information sharing among supply chain participants. Greater transparency helps reduce adverse selection and moral hazard issues because partners can better monitor each other's behavior and outcomes. For example, if manufacturers use IoT sensors and cloud dashboards, suppliers can track the consumption of production materials in real-time and adjust delivery schedules accordingly. This transparency reflects commitment and reliability, thereby reducing the likelihood of partnership termination.

Hypothesis 2: Digital transformation promotes supply chain stability by increasing information transparency.

Coordination cost mechanism. Digital technologies can reduce the coordination costs of interdependent tasks across organizational boundaries, including communication, negotiation, monitoring and execution. Related evidence on financial supply chain management shows that integrating financial and operational flows can improve inter-firm coordination and reduce transaction-related frictions (Wuttke et al., 2013) [16]. When coordination costs are reduced, long-term partnerships become more economical relative to repeated short-term contractual agreements; this can strengthen supply chain stability.

Hypothesis 3: Digital transformation promotes supply chain stability by reducing coordination costs.

2.3 Heterogeneous Effects

The effect of digital transformation on supply chain stability varies depending on the enterprise's attributes. First, ownership type is crucial. State-owned enterprises are usually more likely to obtain bank financing, government procurement opportunities and preferential policies, so they are less dependent on supply chain connections. Non-state-owned enterprises usually face more severe resource shortages, so they may gain more

advantages from the supply chain integration brought about by digital transformation. Second, the competitive position of an enterprise in the market determines its bargaining power. Enterprises with large market share and the ability to set prices can impose conditions on their supply chain partners, so they may have less need for digital governance structures. In contrast, firms with weaker resource or market advantages may rely more on digital transformation to reduce coordination costs and diversify their supplier and customer bases ^[4]. Third, bargaining power in the supply chain (measured by dependence on key suppliers or customers) determines the importance that enterprises attach to improving supply chain stability. Enterprises with weaker bargaining power (i.e., higher dependence) will face higher operational risks.

Fourth, physical separation between different locations also increases the problems associated with information gaps and coordination. Digital transformation can ease these kinds of problems by enabling virtual collaboration and real-time information sharing. Therefore, its role in increasing supply chain stability is more important for companies that have supply networks spread across wide geographic areas.

Based on the above analysis, we propose:

Hypothesis 4: The positive impact of digital transformation on supply chain stability is more significant for non-state-owned enterprises, enterprises with low market competitive advantage, enterprises with low supply chain bargaining power, and enterprises with geographically dispersed supply chains.

3 Research Design

3.1 Data Sources and Sample Selection

In our initial dataset, we included all companies listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange A-share markets between 2012 and 2022. We chose 2012 as the starting year because since the 18th National Congress of the Communist Party of China, which concluded at the end of 2012, China's policies related to the development of the digital economy have accelerated. Furthermore, we excluded companies in the financial and real estate sectors due to differences in regulatory provisions and capital structures. We also further excluded companies designated as ST (Special Treatment) and those with incomplete data. The final sample contains 28,547 company-year observations.

Data were provided as follows: (1) Company-specific financial and corporate governance information was obtained from the CSMAR database; (2) Digital transformation indicators were constructed through textual analysis of annual reports in the CNRDS database; (3) Supply chain information (i.e., the top five suppliers and customers) was obtained from the Wind database; and (4) Macroeconomic statistics were obtained from the EPS database. All continuous variables were Winsorized at the 1st and 99th percentiles to reduce the impact of extreme values.

3.2 Variable Measurement

Dependent variable: Supply chain stability (SC_Stable). Following the method of Jiang and Lu (2022) ^[1], supply chain stability is measured from the year-to-year retention of the five major suppliers and customers disclosed in annual reports. The specific steps are as follows: First, identify the five major suppliers and customers mentioned in the annual reports of each company. Then, calculate the ratio of the number of suppliers and customers retained in the current year to the number of suppliers and customers retained in the previous year. The value of this indicator ranges from 0 to 1, representing the level of supply chain stability. The higher the score, the more stable the supply chain. In order to improve the robustness of the results, we also constructed another weighted stability indicator based on the ratio of total purchase amount to total sales amount.

Independent variable: Digital transformation (hereinafter referred to as "digitalization"). We draw on the methods of Wu et al. ^[17] and Tao et al. ^[3] to construct digital transformation indicators through textual analysis of corporate annual reports. We compiled a digital transformation terminology library covering four areas: artificial intelligence (machine learning, computer vision, etc.), blockchain (distributed ledger, smart contracts, etc.), cloud computing (cloud storage, SaaS, etc.) and big data (data mining, prediction, etc.). We counted the number of times these terms appeared in the annual reports, performed logarithmic transformation, and then z-standardized to finally obtain the digitalization index.

We incorporated a range of firm-specific attributes that may affect the stability of a firm's supply chain: firm size (logarithm of total assets), leverage ratio (debt to total assets), profitability (return on assets, ROA), growth rate (sales growth rate), tangible asset ratio (fixed assets to total assets), cash flow ratio (operating cash flow to total assets), years since listing, ownership type (state-owned vs. non-state-owned), and industry concentration (measured using the Herfindahl-Hirschman Index). Additionally, we included year and firm fixed effects to control for unobserved time invariance and common time trends.

3.3 Empirical Model

To test hypothesis 1, we estimate the following baseline model:

$$SC_Stable_{it} = \alpha_0 + \beta_1 Digital_{it} + \gamma CVs_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where i and t represent the company and year, respectively. SC_Stable_{it} represents supply chain stability, $Digital_{it}$ represents the digital transformation index, CVs_{it} represents the control variable, μ_i and λ_t represent the fixed effects of the company and year, respectively, and ε_{it} represents the error term. To address potential serial correlation issues, we clustered the standard errors at the company level.

To test the potential mechanisms (see Hypotheses 2 and 3), we conducted a two-stage mediation analysis. In the first stage, we performed a regression analysis on one of the potential mediating variables (information transparency or coordination costs)

against the degree of digital transformation. In the second stage, we performed a regression analysis on supply chain stability against the digital transformation variable and the identified mediating variable. We used the Sobel test and the Bootstrap method to test the significance of the indirect paths.

4 Empirical Results

4.1 Baseline Regression

Table 1 reports the results of the baseline regression. In column (1), which only includes fixed effects for company and year, the coefficient for the digitalization variable is positive and significant (0.1245, $p < 0.01$). This coefficient remains positive and significant even after adding control variables in column (2) (0.0876, $p < 0.05$). Column (3) uses a different supply chain stability indicator, namely the weighted retention rate, with similar results (0.0923, $p < 0.05$). To rule out potential reverse causality, column (4) includes both concurrent and one-year lagged digitalization variables. The coefficients for the digitalization and one-year lagged digitalization variables are 0.0654 ($p < 0.10$) and 0.0872 ($p < 0.05$), respectively, both positive. These results collectively support Hypothesis 1, that digitalization has a significant positive impact on supply chain stability.

Table 1. Digital Transformation and Supply Chain Stability

Variable	(1) SC_Stable	(2) SC_Stable	(3) SC_Stable_W	(4) SC_Stable
Digital	0.1245*** (0.0382)	0.0876** (0.0341)	0.0923** (0.0405)	0.0654* (0.0387)
L.Digital				0.0872** (0.0369)
Control	No	Yes	Yes	Yes
Company FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	28,547	28,547	26,891	25,634
Adjust R ²	0.5124	0.5678	0.5432	0.5712

Notes: Standard errors are reported in parentheses.

***, **, and * denote significance at the 1%, 5%, and 10% levels.

4.2 Endogeneity Analysis

The potential reverse causality may stem from the fact that a stable supply chain can facilitate digital transformation. This paper addresses this issue and potential omission bias by employing instrumental variable (IV) estimation and quasi-natural experiments.

Drawing on Cai and Wu's use of historical communication infrastructure to address endogeneity in broadband development ^[18], we constructed a related time-varying instrumental variable by interacting per capita telephone density in 1984 with year indicators. Historical telephone density captures differences in the initial stock of communication infrastructure, while the year interaction allows its relevance to digital penetration to vary over time.

Justification for exclusionary constraints. Telephone penetration rates in 1984 pre-date the sample period and are relevant because early development of broadband infrastructure relied in part on traditional fixed-line telephone networks. To mitigate concerns that historical telephone penetration rates might represent regional sustainability, we controlled for the interaction between 1984 provincial GDP per capita and year-fixed effects. These controls help alleviate (but do not completely eliminate) concerns about exclusionary constraints.

The results of the first and second stages are reported as follows. The F-statistic for the first-stage regression was 34.72, where instrumental variables were used to predict digital transformation. This value also exceeds the Stock–Yogo critical value of 16.38 commonly reported for one endogenous regressor and one excluded instrument under the 10% maximal IV size criterion ^[19]. This mitigates, rather than mechanically eliminates, concerns about weak identification. The results of the second-stage estimation showed that the coefficient of digital transformation was still positive and significant (0.2143, $p < 0.05$). This result confirms the causal effect of digital transformation on supply chain stability. The estimated effect size is greater than the baseline OLS estimate of 0.0876. This suggests that ordinary least squares may introduce a downward bias, which may be due to measurement errors of variables or unobserved variables.

In addition to the instrumental variable strategy mentioned above, we also used the "Broadband China" policy as a quasi-natural experiment and estimated a difference-in-differences (DID) model. The policy began expanding broadband infrastructure in selected pilot cities in 2014 and 2015. Companies headquartered in pilot cities and involved in the implementation in those cities during and after the pilot year constituted the experimental group, while companies not located in pilot cities constituted the control group. The treatment variable in the difference-in-differences model is the interaction term "Treatment" $\times$ "Post".

4.3 Robustness Check

We performed several robustness tests to ensure the reliability of our findings. First, we excluded observations from the four provincial-level municipalities (Beijing, Shanghai, Tianjin, and Chongqing) to avoid the influence of regional development disparities. Second, we excluded data from the 2015 stock market turmoil and the 2020–2022 pandemic period. Third, we used propensity score matching to address and reduce sample selection bias. Fourth, we used a digital transformation surrogate indicator constructed based on patent classification and survey information. Fifth, we incorporated industry-year fixed effects to account for the impact of changes in different industries over time. The results of all these robustness checks are consistent with our main findings.

5 Mechanism Analysis and Heterogeneity

5.1 Mechanism Testing

Information transparency mechanism. We measure information transparency inversely using earnings opacity (the absolute value of discretionary accruals) and directly using the precision of analyst forecasts. As shown in Table 2, Column (1), digital transformation significantly lowers earnings opacity (the coefficient is -0.0421, $p < 0.01$). This reduction in opacity implies a substantial improvement in information transparency, as lower discretionary accruals indicate higher earnings quality. Column (2) shows a positive impact on the accuracy of analyst forecasts (the coefficient is 0.0387, $p < 0.05$). In the regressions that we run for supply chain stability and that include both digital transformation and the transparency indicators, the direct impact of digital transformation decreases, while the transparency measures remain statistically significant. This provides empirical evidence for the partial mediation effect stated in Hypothesis 2.

Coordination cost mechanism. Coordination costs are measured in two ways: the ratio of sales, general and administrative (SG&A) expenses to sales revenue, and inventory turnover days. Column (3) of Table 2 shows a significant negative correlation between digital transformation and the SG&A ratio (coefficient = -0.0234, $p < 0.05$). Column (4) also shows a significant reduction in inventory turnover days (coefficient = -5.672, $p < 0.01$), which implies higher operational coordination efficiency. Mediation analysis supports the mediating role of reduced coordination costs, explaining nearly 24% of the overall impact of digital transformation on supply chain stability, thus supporting Hypothesis 3.

Table 2. Mechanism Analysis

Variable	(1) Earnings Opacity	(2) Analyst accuracy	(3) Ratio of sales, ad- ministrative and management ex- penses	(4) Inventory days
Digital	-0.0421*** (0.0113)	0.0387** (0.0162)	-0.0234** (0.0098)	-5.672*** (1.823)
Control	Yes	Yes	Yes	Yes
Com- pany/Year FE	Yes	Yes	Yes	Yes
N	26,543	18,234	28,547	27,891
Adjust R ²	0.4231	0.3876	0.6123	0.4456

Notes: Standard errors are reported in parentheses.

***, **, and * denote significance at the 1%, 5%, and 10% levels.

5.2 Heterogeneity Analysis

Table 3 lists the results of the heterogeneity analysis. The coefficient for non-state-owned enterprises was 0.1245, significant at the 1% significance level. The coefficient for firms with lower market competitive advantage was 0.1534, significant at the 1% significance level. The coefficient for firms with lower supply chain bargaining power was 0.1789, significant at the 1% significance level. The coefficient for firms with geographically distant supply chains was 0.2012, significant at the 1% significance level; while the coefficient for firms with geographically close supply chains was 0.0456, not statistically significant.

Table 3. Heterogeneity Analysis

Subsample	Coefficient	N	Group Differences
State-owned	0.0321 (0.0456)	12,345	28.76***
Non-state-owned enterprises	0.1245*** (0.0389)	16,202	
High competitive advantage	0.0678* (0.0412)	14,287	15.43***
Low competitive advantage	0.1534*** (0.0478)	14,260	
High bargaining power	0.0543 (0.0432)	14,301	22.18***
Low bargaining power	0.1789*** (0.0512)	14,246	
Geographical proximity	0.0456 (0.0487)	13,892	31.25***
Remote geographical location	0.2012*** (0.0623)	14,655	

Notes: Standard errors are reported in parentheses.
***, **, and * denote significance at the 1%, 5%, and 10% levels.

6 Economic Consequences

Does improved supply chain stability resulting from digital transformation equate to improved firm performance, and can this improvement be quantified? This paper examines two key findings: the expansion of business boundaries and the probability of firms exiting industries. To rule out potential reverse causality—for example, firms expanding their operations might restructure their supply chains, thus impacting supply chain stability—we employ two approaches: (i) using supply chain stability lagged by one year as the primary explanatory variable; and (ii) estimating a two-stage least squares (2SLS) model where the impact of the "Broadband China" policy (measured by "Treatment" × "Post") serves as an instrumental variable for supply chain stability. Both approaches are used for estimation. This application of policy impact differs from the difference-in-differences (DID) analysis in Section 4.2: the DID analysis estimates the policy's impact on supply chain stability, while the 2SLS model uses the policy-induced changes in supply chain stability to estimate its economic consequences. All regressions incorporate firm and year fixed effects.

The natural log of the count of subsidiaries measures geographic expansion. The natural logarithm of the number of different four-digit industry codes within the company's business scope (Scope_Diversity) reflects product expansion. The core model estimates the relationship between these dependent variables and SC_Stable, controlling for all other factors.

Research findings. OLS estimates indicate that when SC_Stable increases by one standard deviation (approximately 0.31), the number of subsidiaries increases by 0.23 standard deviations, and business scope diversity increases by 0.18 standard deviations. However, inverse causality may bias these estimates.

We addressed potential reverse causality in two ways. First, we lagged the independent variable SC_Stable by one year (L.SC_Stable). The estimated coefficients for subsidiary and scope diversity remained statistically significant at the 5% significance level, but with smaller magnitudes of 0.124 and 0.093, respectively. This decay suggests that some of the effects captured by OLS may originate from contemporaneous feedback. Second, to enhance the identification effect, we estimated a two-stage least squares (2SLS) model. In the first phase, we used the interaction term Treatment $\times$ Post (reflecting the impact of the "Broadband China" policy) as a valid instrumental variable for SC_Stable. In the second phase, we used the fitted value of SC_Stable to estimate its impact on the two economic outcomes. The identification hypothesis was that, with control variables and fixed effects on firms and years, the policy impact affects these outcomes only through supply chain stability. The F-statistic for the first stage was 28.4, above the conventional threshold for weak instrumental variables. The second-stage estimates are larger than those of OLS and lagged OLS, with a subsidiary estimate of 0.317 and a range diversity estimate of 0.209; both are significant at the 1% significance level. This pattern could occur if there is an error in the measurement of SC_Stable, or if the estimates identify a local averaging effect on compliant subgroups. Overall, these findings reinforce the causal explanation that higher stability in the digital supply chain is more conducive to businesses expanding their operations.

Results. Supply chain stability (SC_Stable) is negatively correlated with exit risk. The OLS estimate of the SC_Stable coefficient is -0.0321, significant at the 5% significance level. Using lagged values of SC_Stable, the coefficient is -0.0278, significant at the 10% significance level. The coefficient obtained using the instrumental variable method (IV) is -0.0584 ($p < 0.05$). For the binary exit outcome, the instrumental variable method estimates that for every standard deviation change in SC_Stable, the probability of exit within two years decreases by 2.1 percentage points ($p < 0.05$). All these results remain consistent after incorporating firm-specific time trends into the analysis. This is consistent with the resource-based view: the more enduring the supply chain relationship, the more relationship capital is accumulated, enabling firms to survive in the market and reducing the risk of exiting under competitive pressure.

7 Conclusions and Policy Recommendations

7.1 Major Findings

This paper systematically examines how digital transformation influences supply chain stability. We used extensive data from Chinese listed companies. The main findings are as follows: (1) Digital transformation significantly improves supply chain stability. This result remains valid even after addressing potential endogeneity issues and using alternative model settings. (2) This improvement is achieved primarily through two channels: increased information transparency and reduced coordination costs. (3) The positive impact of digital transformation is more pronounced for non-state-owned enterprises, companies with weaker market competitiveness, companies with lower supply chain bargaining power, and companies whose supply chain partners are geographically distant. (4) The improved supply chain stability brought about by digital transformation enables companies to expand their business scope and reduces their probability of exiting the industry.

7.2 Policy Implications

First, policymakers must vigorously promote digital transformation as a means to enhance supply chain resilience. Financial support, such as tax breaks, grants, and more favorable loan terms, for adopting digital technologies in supply chain operations will accelerate this process. Second, priority should be given to building digital infrastructure such as high-speed internet access, cloud data centers, and unified technical standards to reduce collaboration costs between different companies. Third, assistance should focus on non-state-owned enterprises and companies with limited market power, as they will benefit the most from the stability brought about by digital transformation. Fourth, companies should view digital transformation not only as an improvement in internal efficiency but also as a commitment to strengthening relationships with external partners.

7.3 Study Limitations and Future Research Directions

There are several limitations in this study. First, the measurement of supply chain stability is based on information from the top five disclosed suppliers and customers, which may not fully reflect the structure of the supply chain. Other studies could utilize information such as administrative records or traceability systems within the supply chain to obtain information about the entire network. Second, this analysis treats stability as a static state; its dynamic characteristics, such as the system's ability to cope with disruptions and its recovery speed, warrant further investigation. Third, comparisons across different countries can reveal how different institutional frameworks shape the association between digital transformation and supply chain stability. Finally, the negative impacts of digital transformation, such as algorithm-facilitated collusion or power imbalances that may result from digital surveillance, should also be explored in depth.

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