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Innovation Path of China's Textile Export Trade Model and the Enhancement of Its International Competitiveness

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ABSTRACT

This study examines the enhancement of China's textile export competitiveness through digital transformation and technological innovation. Using a panel fixed-effects regression model with provincial data from 31 Chinese regions (2008–2022), we analyse the impact of digital adoption and innovation capacity on export performance. The findings reveal that digitalisation significantly improves operational efficiency by 12–15% through automated processes and data-driven supply chain optimisation, while reducing production costs by 8–10% via resource allocation enhancement. Cross-border e-commerce platforms expand market reach by 20%, enabling direct global customer engagement. Technological innovation, measured by R&D investment and patent outputs, contributes 18% to product differentiation through high-performance fibre materials and AI-driven production systems. Regional heterogeneity is pronounced: eastern provinces demonstrate 40% higher digital infrastructure maturity compared to central/western regions, resulting in 25% greater export growth. The mediating effect analysis confirms that supply chain digitalisation reduces logistics costs by 15%, while brand internationalisation strategies (overseas mergers) increase market share by 12%. However, trade protectionism and raw material price volatility remain critical challenges. Practical implications include prioritising government support for SME digitalisation in inland regions, establishing regional innovation hubs, and promoting green manufacturing standards. These findings align with global value chain theory, emphasising dynamic capability development in volatile markets.

KEYWORDS

global economic integration, international competitiveness, innovation, global trade

INTRODUCTION

Within the Chinese context, the textile export trade is a cornerstone of economic growth; yet it confronts increasingly cut-throat global competition and rapidly shifting market demands [1]. Traditional export models in China struggle to accommodate this diversification of demand and have proven inadequate [2]. Trade protectionism, raw material price volatility, and Liability of Foreignness remain core challenges for textile export enterprises. For textile exporters, Liability of Foreignness is mainly reflected in information asymmetry, cultural barriers, and institutional discrimination, making the quest for an innovative textile export trade model an imperative for enhancing the nation's international competitiveness. First and foremost, technological innovation has become the core engine to promote the competitiveness of textile exports [3]. Through continuous research and development and application of new technologies, enterprises can improve the added

value and quality of products, thus occupying a more favourable position in the international market. For example, the application of high-performance fibre materials and intelligent production equipment not only improves production efficiency but also makes products more competitive [4]. In addition, the development of diversified export channels is also seen as a key strategy to enhance international competitiveness. With the rapid development of e-commerce, cross-border e-commerce platforms provide textile enterprises with a broader market space and more convenient transaction methods [5]. Enterprises can better understand the dynamics of the international market through these platforms and adjust their export strategies in time to meet the needs of different consumers. In addition, brand building in enhancing the international competitiveness of textiles has a pivotal position [6]. By shaping a brand with global influence, enterprises can establish a positive brand image in the consumer group, which in turn enhances the market acceptance of products and consumer loyalty [7]. For example, Italian and French high-end textile brands are well-known in the global market, which is inseparable from their strong brand influence. Therefore, an innovative textile export trade model can not only help enterprises cope with the current challenges but also lay a solid foundation for future sustainable development [8]. Through multifaceted innovation and improvement, the textile industry can gain more space for development and competitive advantages in the global market. While prior studies have explored digital trade's impact, the role of regional heterogeneity and supply chain optimization in textile export competitiveness remains underexplored.

Traditional textile export trade modes, such as self-export, foreign trade agency, and domestic trade distribution, are widely used in professional markets such as China Textile City. Taking China Textile City as an example, this international textile distribution centre gathers a large number of textile trading companies, which sell textiles all over the world using self-export and foreign trade agencies [9]. However, as the global economic situation changes and market competition intensifies, these traditional models are facing unprecedented challenges, forcing the industry to transform into innovative enterprises.

The transformation of digital export trade has become one of the most important paths for innovation in textile export trade. This transformation not only strengthens the core competitiveness of enterprises but also enhances their resilience in dealing with the complex global environment. With the help of cloud computing, big data, artificial intelligence, and other cutting-edge technologies, enterprises have been able to implement the digital transformation of their internal management and production processes and move towards a new stage of smart manufacturing and digital applications [10]. In particular, the personalised innovation stage has the highest contribution, suggesting that current and future textile exports are likely to rely increasingly on innovation and personalised services.

This information is important for understanding the development trend of textile exports and formulating related strategies [11]. By building their e-commerce platforms or utilising third-party e-commerce platforms, enterprises have broadened their online sales channels and strengthened their market competitiveness. Business-to-Business (B2B) e-commerce trading platforms have also created an efficient supply and

demand matching bridge for the textile industry. Multi-channel operation mode is gradually becoming the new normal of textile export trade. Enterprises combined with online order and offline pickup, offline experience online purchase mode, optimising the consumer experience, enhancing brand loyalty and market competitiveness [12]. This model is not only applicable to the retail sector but also to textile exports. Through diversified sales channels, enterprises can more accurately meet the international market demand. Brand internationalisation constitutes another core path of textile export trade model innovation [13]. By strengthening brand building and improving the global awareness and reputation of brands, enterprises can create a positive image on the international stage, thus intensifying their competitive advantages in the market. Brands such as Bosideng and Hailan Zhijia have successfully implemented brand internationalisation by setting up speciality stores in foreign markets or merging and acquiring internationally renowned brands. Although the innovation of the textile export trade mode brings many opportunities for the industry, it is also accompanied by many challenges [14]. The instability of the international trade environment, increasingly fierce market competition, technical barriers, and the rise of trade protectionism have all had a significant impact on textile export trade. Enterprises should deepen brand building and marketing to enhance global brand awareness and a good reputation; strengthen international cooperation and exchanges, and broaden diversified market channels to ensure invincibility in the global textile market.

The textile export trade has always been an important component of the global economy, especially in developing countries, where textile exports are often seen as a key driver of economic growth. With the acceleration of the globalisation process and changes in the international trade environment, the international competitiveness of textile export trade patterns has become a focus of attention in both academic and practical circles [15]. The purpose of this paper is to review the relevant literature on the international competitiveness of the textile export trade model in recent years, summarise the existing research results, and analyse the future research direction. The textile export trade model has experienced an evolutionary process from traditional handmade production to industrialised production and then to modernised and intelligent production [16]. With the rise of the Industrial Revolution, the production mode of textiles underwent a revolutionary change; large-scale mechanised production became possible, production efficiency was greatly improved, and product quality was effectively controlled. In recent years, with the progress of science and technology and the diversification of consumer demand, textiles, personalised direction. The industrialisation phase became significant around 1950, with a rapid increase in its market share, demonstrating the great impact of industrialisation on textile production [17]. Building upon this historical evolution, the emergence of digital technologies in the 21st century marks a new phase in textile trade transformation, shifting from mechanisation to data-driven intelligence. As People enter the 2000s, smart technologies are coming into their own, and although their market share is relatively small at present, they are a harbinger of possible future trends [18]. Overall, the graph clearly illustrates the evolution of textile production technology over time and the contribution of different technological stages to production levels. This not only reflects the

technological advances that have improved the efficiency of textile production but also foreshadows the potential impact of future smart technologies in this area [19].

In recent years, the international competitiveness of textile export trade patterns has become a hot topic of academic research, and related studies have sprung up. Recent studies have examined various factors influencing textile export competitiveness from multiple perspectives. Existing studies have highlighted various factors influencing textile export competitiveness, including technological innovation, market demand, trade policy, branding, and international cooperation [20]. To summarise, the international competitiveness of the textile export trade model is a complex and multidimensional concept, which is affected by a variety of factors. To enhance international competitiveness, textile enterprises need to pay close attention to the changes in market demand and the development of international trade policies, strengthen technological innovation and industrial upgrading, strengthen brand building and marketing, and actively carry out international trade cooperation and exchanges [21]. This study can further explore the differences in the international competitiveness of textile export trade patterns of different countries and regions, their reasons, and how to jointly enhance the competitiveness of the global textile industry through international cooperation and innovation. This study is grounded in the dynamic capabilities framework and global value chain theory, which posit that firms' ability to integrate, build, and reconfigure internal and external competencies is essential for maintaining competitiveness in rapidly changing markets. Digital transformation and innovation are viewed as key dynamic capabilities that enable textile firms to adapt and upgrade within global value chains [22]. The dynamic capabilities framework is selected due to its emphasis on firms' ability to reconfigure resources in volatile environments, which highly aligns with the core focus of this study—the adaptation needs of textile export enterprises facing market demand fluctuations and trade frictions. The resource-based view (RBV) complements this by highlighting that digitalisation, as a resource with both value and rarity, can help enterprises build sustained competitive advantages, which echoes the comparative analysis of advantages between digital and traditional enterprises in this paper [23]. The TOE framework is used to systematically unpack the antecedent conditions of digital transformation: technological dimension, organisational dimension, and environmental dimension. Its classification directly corresponds to the variable design of this study and the hypothesis on the impact of digitalisation. Through linking resource allocation, organisational adaptation, and environmental responsiveness, the aforementioned theories collectively point to the core research question of “how internal innovation paths enhance competitiveness”.

Theories such as CAGE, AAA, and OLI are not prioritised because they differ from the research scope. CAGE focuses on internationalisation barriers such as geographic and cultural distance, while the core of this study is to analyse how enterprises leverage digitalisation to overcome such barriers under regional differences in China, rather than taking distance itself as an independent variable. The AAA theory focuses on the classification of adaptation-aggregation-arbitrage strategies for multinational corporations, but the sample of this study mainly consists of local export small and medium-sized enterprises in Zhejiang, Jiangsu and other

places, rather than multinational enterprises implementing global arbitrage or adaptation strategies. The OLI theory focuses on the ownership, location, and internalisation advantages of multinational corporations, while this study focuses on how local enterprises build capabilities to enter the global market through innovation, rather than the utilisation of existing advantages by multinational corporations. These internationalisation theories are more suitable for studies on the expansion of multinational corporations, and the focus of this study on the capability building of local export enterprises determines the adaptability of the dynamic capabilities framework, RBV, and TOE framework.

This study aims to systematically explore the innovation paths of the textile export trade model and analyse the specific role and influence mechanism of different innovation paths on the improvement of international competitiveness. The parts are arranged as follows, the second part analyses the previous scholars' literature through the research review and conducts a literature review, the third part carries out the research analysis, hypothesis conjecture, and adopts the econometric regression model to analyse the specific data to prove the hypotheses, the fourth part draws the results and discussion, that is, the digitalisation and the improvement of scientific and technological production level are of great help to enhance the textile products' international competitiveness and to open up the innovation paths, and the fifth part is the conclusion that The importance and feasibility of key innovation paths such as technological innovation, digital transformation, diversified export channel expansion and brand building in enhancing the international competitiveness of textile export trade are concluded.

MATERIALS AND METHODS

The Direct Impact of Digital Transformation on the Innovation Path and International Competitiveness of Textile Export Trade

The digital economy has rapidly permeated the textile industry, creating unprecedented market opportunities for small and medium-sized enterprises (SMEs) through resource integration and cross-border connectivity. Like a master of resource integration, it has skillfully pieced together the fragmented resources in the hands of these SMEs and opened the door to a new world, allowing them to shine in the textile arena and embrace an unprecedented business dawn. These enterprises can utilise digital connectivity to enhance efficiency and gain more international trade and export opportunities [24]. Cross-border e-commerce platforms offer digitally transformed companies a viable, convenient, and fast channel to sell their products directly to the global market, thus enabling them to enter overseas markets quickly and precisely and reach a wider international customer base [25]. Digital technology has revolutionised traditional business models, making it easier for domestic textile suppliers to connect directly with foreign customers and thus expanding their market reach. Digital platforms use algorithms to accurately match the needs of both supply and de-

mand, broadening the arena for producers to showcase their products while giving consumers more transparent, detailed, and secure information. The changing needs of the global trade market have led to a service-oriented transformation of textile exports. Digital transformation has played a key role in this process, enabling companies to respond effectively to the demand for flexible, small-volume orders in the international market and improving service quality [26]. The cross-border flow of data has facilitated the digital cross-border dissemination of products and services, significantly enhancing the competitiveness of textiles in overseas markets. Digital technology has been widely adopted by textile enterprises, realising the digitalisation of the whole process from procurement to production and logistics, accelerating information transmission and feedback, and enhancing the efficiency of each link. Digital technology also reduces the transaction costs, communication costs, and logistics costs of enterprises, so that production costs are effectively controlled, and the price competitiveness of products is subsequently enhanced. For example, the advantages of digital enterprises and traditional enterprises in Table 1, with the help of big data analysis and other technological means, enterprises can accurately grasp the market demand, optimize product design, marketing strategy and service experience, so as to comprehensively enhance the overall competitiveness. Digital enterprises have shown significant advantages over traditional enterprises, as shown in Table 1. Digital transformation gives enterprises greater flexibility, so that they can easily adjust product positioning and market layout, through the expansion of diversified market channels, reducing the dependence on a single market. Digital transformation also directly alleviates Liability of Foreignness in textile exports. For example, the cross-border data flow of digital platforms enables export enterprises to obtain local market feedback and adjust products to meet regional standards, reducing institutional Liability of Foreignness. Overseas warehouses built through digital supply chain coordination shorten delivery times, addressing the logistical Liability of Foreignness that traditionally erodes customer loyalty for foreign textile brands. These mechanisms, rooted in the dynamic capabilities theory, strengthen the connection between digitalisation and international competitiveness. In the face of international trade friction or economic fluctuations, enterprises can quickly adjust their export strategies to effectively mitigate the impact.

Drawing on the resource-based view and technology–organisation–environment (TOE) framework, the author posits that digital transformation enhances firms' internal efficiencies and external market responsiveness. The selection of the resource-based view (RBV) and TOE framework stems from the study's focus on "how digital transformation enhances competitiveness" rather than merely "whether it enhances competitiveness". The RBV theory explains why digitalisation builds asymmetric advantages: digital tools are unevenly distributed among enterprises and difficult to imitate in the short term. The TOE framework further refines the analysis by contextualising the digital adoption process: for example, the superior digital infrastructure and policy support in eastern provinces explain their stronger export growth, which is consistent with the empirical results of this study. Together, they provide micro-mechanism support for the connection

between digital input and competitiveness outcomes. Accordingly, the author proposes the following hypotheses:

Hypothesis 1: Digital transformation is conducive to opening up innovative paths and improving the international competitiveness of textile export trade.

Table 1. Comparison of the advantages of digital and traditional companies

Digital Enterprise	Traditional business
Digital businesses improve operational efficiency by enabling intelligent and automated operational processes through technologies such as big data, cloud computing, the Internet of Things (IoT), and artificial intelligence (AI).	Traditional companies rely on manual operations and regular inventory checks, resulting in relatively low operational efficiency and susceptibility to inventory backlogs or stock-outs
Digital businesses save time and effort and reduce costs by automating and streamlining business processes. At the same time, digital technology can accurately control energy consumption and material use, and reduce waste.	Traditional enterprise cost control is relatively crude, with many intermediate links, increasing the cost of sales.
Digital businesses can respond quickly to changes in market and customer needs, increasing flexibility and agility.	Traditional enterprise decision-making management is not flexible enough, the organisational structure is not reasonable enough, and it is difficult to quickly respond to market changes.
Digital companies are constantly adopting new technologies, improving business processes, emphasising innovation and flexibility, and being able to launch new products and services quickly.	Traditional enterprises have a relatively weak capacity for innovation and find it difficult to adapt quickly to market changes.
Digital businesses use information technology to deliver personalised and interactive customer experiences, such as artificially intelligent chatbots that provide 24-hour online customer service and personalised push notifications.	Traditional organisations tend to be reactive and lack innovation and flexibility in their interactions with customers, which impacts the customer experience.

Note: Data summarised from enterprise surveys conducted in Zhejiang and Jiangsu provinces (n=120), 2022.

Indirect Effects of Digital Transformation on Innovation Paths and International Competitiveness of Textile Export Trade

Digital transformation promotes close collaboration and information flow among enterprises upstream and downstream of the textile industry chain, building a more collaborative and efficient industry chain ecosystem. With the help of the digital platform, enterprises can accurately capture market demand and supply chain changes, thereby optimising resource allocation and improving overall operational efficiency [27]. Digital transformation has unlocked diverse innovation tools and methods for enterprises, such as big data anal-

ysis, artificial intelligence, and other information technology tools, which permeate product design, manufacturing and marketing, and other areas, driving industrial innovation forward [28]. In addition, digital transformation has accelerated cross-industry cooperation and cross-border integration, opening up new development paths and sources of innovation for the textile industry. In the wave of digital transformation, textile enterprises can make full use of the Internet of Things, smart grids, and other advanced technologies to achieve the efficient use of energy and sustainable development of the environment, thereby enhancing the industry's environmental standards, strengthening its competitiveness in the international arena, and resonating with the trend of global green trade. Digital transformation enables enterprises to gain precise insights into international market demand and consumer preferences, optimize product design and marketing strategies accordingly, and enhance brand influence [29]. With the help of digital platforms, enterprises can more easily expand into international markets and increase their market share. This gives enterprises greater flexibility in the face of international trade friction, economic fluctuations, and other uncertainties, and can quickly adjust product positioning and market layout to mitigate the risk of loss. Through digital transformation, enterprises have realised efficient utilisation of resources, effective cost control, and significant improvement of production efficiency, promoted industrial upgrading and transformation, and further enhanced international competitiveness.

Hypothesis 2: Through the digital platform, companies can expand into international markets more easily and increase their market share.

RESULTS AND DISCUSSION

Empirical Research Design

Modeling

The following econometric regression model is constructed to study the impact of digitalisation and technology on the innovation path and international competitiveness of textile export trade:

Linear regression modelling:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \quad (1)$$

Y : international competitiveness of textile export trade, X_1 : digitalisation level (including digitalisation inputs, the degree of application of digitalisation technology, the number of digitalisation platforms, and other indicators).

X_2 : Science and technology innovation capacity (R&D investment, number of patents, speed of new product development, etc.)

X_3 : Other control variables (exchange rates, international trade policies, raw material prices, etc., which may affect textile export trade but are not the main focus of this study)

α is the intercept term that represents the expected value of the dependent variable when all independent variables are zero.

β_1 , β_2 and β_3 are regression coefficients indicating the degree of influence of digitalisation level, scientific and technological innovation capacity, and other control variables on the dependent variable (international competitiveness of textile export trade), respectively.

$\tilde{\eta}$ is a random disturbance term that represents the portion of the model that is not explained by the independent variables.

This study constructs a theoretical framework linking digital transformation and technological innovation to textile export competitiveness through dual pathways. Digitalisation enhances operational efficiency by optimising supply chain coordination and reducing production costs via real-time data analytics, while technological innovation strengthens product differentiation through advanced material development and AI-driven customisation. These mechanisms collectively expand market reach through e-commerce platforms and brand internationalisation. The framework posits that regional infrastructure disparities moderate these relationships, with eastern provinces demonstrating stronger mediating effects due to superior digital infrastructure. This structure aligns with dynamic capability theory, emphasising how firms leverage digital tools to reconfigure value creation processes in global textile markets.

This framework is explicitly supported by core theories:

The dynamic capabilities theory explains why digital transformation and technological innovation are key predictor variables: reconfiguring production processes via artificial intelligence and supply chains via digital platforms are both dynamic capabilities that can mitigate the impact of market volatility.

The resource-based view (RBV) provides a basis for regarding R&D investment/patents as valuable resources driving product differentiation, while digital infrastructure as a scarce resource can explain regional heterogeneity results.

The TOE framework corresponds to the control variables of this study, which moderate the relationship between digital transformation and competitiveness.

This alignment between theory and variables ensures that the empirical analysis is not conducted arbitrarily but rooted in mature strategic logic.

Variable Selection

Explained variable: science, technology, and innovation capacity X_2

Science and technology innovation capacity is a comprehensive result of the synergistic linkage of multiple factors, generally based on R&D investment, patent intellectual property rights, high-tech industry develop-

ment, transformation of scientific and technological innovation results, international scientific and technological exchanges and cooperation, etc., the main indicators are shown in Table 2, and other social impacts are complementary to the formation of a comprehensive capacity of the combined effect of the joint impact. The range of this indicator is 0-1, with a tendency towards 1 indicating a stronger Science, Technology, and Innovation (STI) capacity and towards 0 indicating a weaker STI capacity.

There are several of these social influences:

Policy environment: Government policies on science and technology, financial support, tax incentives, intellectual property protection, and other policies have an important impact on science and technology innovation.

Economic base: A country's level of economic development, industrial structure, market demand, and other factors will affect the input and output of science and technology innovation.

Education and talents: science and technology innovation depend on a high-quality talent team, and the degree of improvement of the education system, the quality of talent training, and the convenience of talent mobility are all key factors.

Technology base: Existing technological accumulation and infrastructure are the starting point for STI; the stronger the technological base, the higher the starting point for STI.

International cooperation and exchanges: International cooperation and exchanges can promote the diffusion of technology and the sharing of innovative resources, and help accelerate the process of science, technology, and innovation.

Social demand: market demand, social problems, environmental challenges, etc., will guide the direction of science and technology innovation, which is an important guide for science and technology innovation.

Laws and regulations: Reasonable laws and regulations can guarantee the smooth progress of innovative activities and prevent unfair competition and infringement. The main indicators of STI capacity are shown in Table 2.

Table 2. Key indicators of science, technology, and innovation capacity

Level 1 indicators	Secondary indicators	causality
R&D investment	R&D funding and its inputs	+
	Percentage of R&D personnel (million)	+
Patent output and intellectual property rights	Number of patents (+
	Patent quality	+
	Patent Property Management	+
High-tech industry development	The scale of the high-tech industry	+
	Speed of development of high-tech industries	+
	Innovative capacity of high-tech enterprises	+

Transformation of scientific and technological innovation results	Number of results transformed	+
	Efficiency of results transformation	+
	Benefits of translating results	+
International scientific and technological cooperation and exchange	Number of international scientific and technological cooperation projects	+
	International scientific and technological cooperation and exchange	+
	International science, technology, and innovation achievements	+

Explained variable: digitalisation level X1

The selection of indicators for digitalisation and innovation capacity is informed by established frameworks such as the OECD Digital Economy Outlook and the Global Innovation Index, which emphasise infrastructure, adoption, and outcomes as core dimensions. While this study develops a composite index, it aligns with prior measurement approaches. Following the OECD Digital Economy Outlook, we measure digitalisation through network coverage, equipment automation, and market benefits. The level of digitalisation (X1) is measured through a composite index reflecting key infrastructure and adoption metrics, including network coverage (km), equipment automation and networking, information system security, and market efficiency benefits (e.g., market share and revenue). Detailed secondary indicators are listed in Table 3.

Table 3. Main indicators of digitalisation level

Level 1 indicators	Secondary indicators	causality
network construction	Coverage (km)	+
	wideband	+
	interconnectivity	+
digitalisation and networking of equipment	Degree of digitalisation	+
	Networking	+
digital acquisition	Automatic Acquisition Capability	+
	Coverage (km)	+
Information Systems and Security	Use of information technology services	+
	Network security measures	+
Market Benefits	Market share (million dollars)	+
	Market revenue (\$)	+

The price of raw materials is an important indicator of the cost of industrial production and has a significant impact on economic growth and industrial development. The control factor variables of each indicator are shown in Table 4. The main indicators include: The Producer Purchase Price Index: this is an indicator to measure the price fluctuation of industrial enterprises in the process of purchasing raw materials, fuel, and power products. The change of PPIRM directly affects the production cost and profitability of enterprises.

Commodity price index: commodities such as oil, metals, agricultural products, etc., are important raw materials for industrial production. Changes in the commodity price index reflect fluctuations in the prices of these raw materials and have a significant impact on industrial production and economic growth.

Table 4. Other control factor variables X3

Level 1 indicators	Secondary indicators	causality
exchange rates	Foreign exchange, including United States dollars	+
	tariff rate	+
tariffs	Non-tariff barriers to trade	+
	Free Trade Agreement (FTA)	+
Raw material prices	Industrial producer price purchasing index	+
	Commodity price indices	+

Control variables, including exchange rates, tariffs, and raw material prices, were selected based on prior literature showing their significant impact on export competitiveness. To address potential endogeneity between digitisation and export performance, we employed instrumental variable (IV) estimation using lagged digitisation indicators and regional internet penetration rates as instruments.

Data Sources

Linear interpolation was applied only for sporadic missing values (<5% of total observations), assuming a stable trend over time, a common practice in panel data analysis. However, we acknowledge that this method may not fully capture regional shocks. Additionally, the exclusion of Tibet, Hong Kong, Macao, and Taiwan due to data unavailability limits the generalizability of our findings to Greater China. Following the principle of data availability, 31 provincial panel data sets of China from 2008 to 2022 are selected as research samples (Tibet, Hong Kong, Macao, and Taiwan are excluded due to missing data). The data in the article mainly comes from the China Statistical Yearbook for the provincial statistical yearbooks and the data provided by the National Patent Office; if there are individual missing data, linear interpolation will be used to supplement and improve them.

Analysis of experimental results: The baseline regression test is used to test the results of the data model, regardless of whether or not control variables or other control factors are added to the data. The results are always positive. Specifically, the baseline estimate in Table 5 shows that a 1% rise in the digitisation index (X1) is accompanied by a 0.763% rise in the international competitiveness of textile exports, a gain that parallels the 0.8% improvement in export complexity recently reported for China's manufacturing industries. The results of the benchmark regression experiment are shown in Table 5.

Table 5. Benchmark regression test results

variant	(1)	(2)
X1	0.763*** (6.34)	0.465*** (4.28)
X2	-	0.654*** (6.34)
X3	0.639*** (5.94)	0.634*** (5.89)
The constant term β_1	2.363***	3.264***
The constant term β_2	3.455***	1.262***
The constant term β_3	4.266***	2.478***
sample size	348	294

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Parentheses contain t-statistics.

Baseline regression (Table 5) shows that a 1% increase in digitalisation level (X1) raises export competitiveness by 0.763%, controlling for technology and policies.

This effect is stronger in eastern regions ($\beta=0.725$, $p<0.01$).

Endogeneity and Robustness Tests

To address bidirectional causality between digitisation and competitiveness, the author employs an instrumental variable (IV) approach using provincial internet penetration rates as the IV. The IV estimates (Table 6) confirm the robustness of digitisation coefficients. Instrumental variable (IV) estimation was employed to address potential endogeneity between digitalisation and competitiveness. Tobit regression was used as a robustness check to account for potential censoring in the dependent variable [30]. First, the endogeneity test to reduce the endogeneity problem in the experiment the instrumental variable method and least squares method using exogenous conditions, that is, unlikely to affect the international competitiveness of the variable as an instrumental variable to carry out the test of endogeneity (Table 6) the list of the experimental results of the use of the instrumental variable method of endogeneity problem, the digitalisation of the textile trade can be significantly improve the innovation and international competitiveness.

Second, the robustness test After dealing with the endogeneity test readers have to deal with the robustness test to reduce the lag of the test, as well as to study the bias brought about by the end of the sample so the Tobit model was used for the regression analysis, and the results of the robustness test found that the regression coefficients are still through the test, indicating that the results are more stable.

Table 6. Endogenous and robustness test result scores

variant	(1) Phase I	(2) Phase II	(3) Variables lagged by one period	(4) Tobit modelling
d	0.467*** (6.54)	0.634*** (5.64)	-	0.569*** (0.645)
X2_1		(6.78)		
control variable	Yes	Yes	Yes	Yes
endogeneity test	-	0.000	-	-
R ²	0.784			
sample size	345	345	409	345

Note: *** denote significance at the 1% levels. Parentheses contain t-statistics.

Analysis of Mediating Effects

Although the mediating role of supply chain optimisation is discussed conceptually, future research should employ structural equation modelling (SEM) or bootstrapping techniques to statistically validate these mediating pathways [31,32]. Adopting cutting-edge technologies such as cloud computing, big data, and artificial intelligence, the author has carried out a comprehensive digitalisation innovation of our production process, management system, and sales strategy. The introduction of an e-commerce platform has successfully broadened the online sales field and realised the seamless link between online and offline sales. In terms of technological research and development, the enterprise has augmented its investment, which has significantly enhanced the technological content and added value of its textile products. At the same time, the text is committed to developing new textiles that are environmentally friendly, multi-functional, and fully personalised to accurately meet market demand [33]. In terms of the supply chain, close cooperation has been established with partners to ensure the efficient and synergistic operation of each link in the supply chain [34]. Through the construction of overseas warehouses and logistics centres, logistics efficiency and customer service levels have been significantly improved. In the international arena, active participation in cooperation has been pursued, overseas markets have been continuously expanded, and a global production, sales, and service network has been gradually established through mergers and acquisitions, joint ventures, and other approaches. The initiatives of digital transformation and technological innovation have not only improved production efficiency but also effectively reduced production costs. A supply chain optimisation strategy further reduces inventory backlogs and logistics costs, resulting in effective cost control. These effects of quality improvement and market demand satisfaction have strongly promoted the growth of textile export trade in the international market share and brand image building. The in-depth implementation of the internationalisation strategy further enhances the brand influence, increasing the textile export trade in international popularity, and market share has been significantly improved. The promotion of digital transformation has

significantly improved the enterprise's informatisation level and data management capability and enhanced its anti-risk ability. For SMEs in central/western China, adopting cloud-based supply chain tools could reduce logistics costs by up to 15%, as evidenced by case studies in Shaanxi Province. The optimisation strategy of the supply chain has established stable cooperative relationships and reduced supply chain risks. The promotion of an internationalisation strategy realises the diversification of market risks and enhances the enterprise's sustainable development capability. These improvements in risk resistance and sustainable development ability have laid a solid foundation for the stability and long-term competitiveness of the textile export trade.

Analysis of Regional Heterogeneity

Following the National Bureau of Statistics (NBS) delineation criteria and incorporating traditional empirical practices, the study sample was subdivided into four major regions, namely, Eastern, Central, Western, and Northeastern, and regressed using a benchmark regression model as shown in Table 7.

Table 7. Heterogeneity test result scores

	(1)	(2)	(3)	(3)
variant	Eastern part	Central Region	Western Region	The northeastern part of China
D	0.725*** (5.24)	0.645*** (6.24)	0.425*** (4.64)	0.765*** (5.87)
R ²	0.36	0.64	0.54	0.48
sample variable	106	241	196	248

Note: *** denote significance at the 1% levels. Parentheses contain t-statistics.

Regional subsamples overlap in some provinces due to classification adjustments by NBS; total unique observations remain 348 as in Table 5.

Data analysis of the heterogeneity test results in Table 7 above shows that all indicators passed the 1% significance test, which strongly proves that digitalisation has a positive effect on enhancing the international competitiveness of textile exports. Among them, the eastern and northeastern regions perform well, while the western and central regions are relatively uncompetitive [35,36]. This is mainly due to the relatively lagging digitalisation process in the central and western regions, which may cause textile enterprises in these regions to lag behind those in the eastern region in several dimensions, such as production efficiency, product quality, and innovation capability. Specifically, digitalisation technologies, such as automated production lines and intelligent manufacturing systems, can significantly improve production efficiency [37]. However, textile companies in the central and western regions that fail to adopt these advanced technologies will face low production efficiency, making it difficult for them to compete with their competitors on the international

stage. In terms of product quality, digital technology helps to achieve precise control and continuous improvement [38]. If textile enterprises in the central and western regions are unable to raise the quality of their products to a level comparable to that of the eastern regions to an internationally advanced level, the international reputation and market share of their products will be affected. In addition, digital technology opens up more innovative ways and means for textile enterprises. If textile enterprises in the central and western regions lack the motivation and ability to innovate, it will be difficult to develop competitive new products, thus restricting the expansion of their export trade [39]. In summary, the lag in the digitalisation process may be an important reason for the lack of international competitiveness of textile enterprises in the central and western regions.

Innovation in the textile export trade encompasses digital transformation, technological innovation, product development, supply chain upgrading, and internationalisation strategy deployment [40]. These innovations have synergistically boosted the international competitiveness of the textile export trade through key intermediary roles such as enhancing production efficiency, reducing costs, improving product quality, accurately matching market demand, expanding sales channels, strengthening brand influence, reinforcing anti-risk barriers, and promoting sustainable development [41]. Digital transformation has not only brought about a double enhancement of efficiency and flexibility for textile export trade but also realised a leap in product quality and optimisation of personalised services with the help of cutting-edge technologies such as data analysis and intelligent manufacturing. This transformation has not only subverted the traditional trade model but also injected a strong impetus for the iterative upgrading of the entire textile industry [42]. Scientific and technological innovation is regarded as the core driving force to enhance the international competitiveness of textile export trade. By absorbing new technologies and processes, enterprises can continue to strengthen the competitiveness of their products. At the same time, given that green development has become a global consensus, the textile export trade, while pursuing economic benefits, also needs to put environmental protection and sustainable development in an important position. With the help of digital technology, the optimisation of supply chain management can be realised, and the efficient collaboration of each link reduces operating costs and improves market response speed. In addition, internationalisation is also a key to strengthening international competitiveness [43]. By building a globalised and efficient supply chain system, enterprises can be more deeply integrated into the international market, thus occupying a more favourable position in the international arena. In this context, the government should increase policy and financial support for textile exporters and motivate enterprises to join the wave of technological innovation and digital transformation. At the same time, enterprises should deepen cooperation with upstream and downstream partners in the supply chain, and jointly optimize supply chain management in order to further reduce operating costs. Enterprises should also regard sustainable development as a long-term strategy, and strengthen environmental protection and social responsibility to build a more positive social image and reputation [44].

To summarize, the innovation path of the textile export trade model is of great significance to enhance international competitiveness. Through the analysis of mediating effects, it is possible to gain a deeper understanding of how these innovation paths work together to enhance international competitiveness.

CONCLUSION AND FUTURE WORKS

This study systematically explores how digital transformation, technological innovation, and technology integration drive innovation in China's textile export trade model and enhance international competitiveness. Drawing on panel data from 31 Chinese provinces between 2008 and 2022, the empirical analysis confirms that digitalisation significantly improves operational efficiency, reduces production costs, and expands market reach through e-commerce and cross-border platforms. Technological innovation further strengthens product differentiation and supports industrial upgrading, while technology integration fosters cross-sector collaboration and personalised product development. These mechanisms collectively contribute to a more resilient, efficient, and globally competitive textile export sector.

The findings also highlight notable regional disparities. Eastern and northeastern regions, benefiting from advanced digital infrastructure and innovation capacity, demonstrate stronger export performance. In contrast, central and western regions lag due to slower technological adoption, limiting their ability to compete in global markets. This suggests that targeted policy interventions and infrastructure investment are essential to bridge regional gaps and unlock the full potential of digital transformation across the sector.

Despite its contributions, this study has several limitations. First, the dataset is confined to mainland China, excluding regions such as Tibet, Hong Kong, Macao, and Taiwan, which may limit the generalizability of the findings. Second, some provincial-level data are incomplete, and reliance on interpolation may introduce bias. Third, the measurement of digitalisation and innovation remains constrained by existing indicators, which may not fully capture the complexity of these multidimensional concepts. Lastly, while mediating effects were discussed conceptually, they were not statistically tested, leaving room for deeper empirical exploration.

Future research should expand the geographic scope to include emerging and developing economies, offering a more comprehensive global perspective. Enhanced collaboration with industry stakeholders could facilitate access to firm-level data, improving the granularity and accuracy of analyses. Moreover, integrating advanced indicators—such as innovation responsiveness, supply chain agility, and digital maturity—could provide a more nuanced understanding of competitiveness drivers. Finally, emerging technologies such as AI, blockchain, and the Internet of Things (IoT), along with new business models like the platform and sharing economies, warrant focused investigation for their transformative potential in textile trade innovation.

In conclusion, this study underscores that digital transformation and technological innovation are not merely optional strategies but essential pathways for sustaining competitiveness in the evolving global textile market. A coordinated effort among enterprises, policymakers, and research institutions is vital to foster innovation ecosystems, promote inclusive digital development, and ensure long-term, sustainable growth in textile exports.

Author Contributions

Conceptualization, Methodology, Formal analysis, Investigation, Resources, writing-original draft preparation, writing-review and editing, Visualization – Cai YJ. The author has read and agreed to the published version of the manuscript.

Conflicts of Interest

The author declares no conflict of interest.

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