

Digital Technology Innovation and the Development of China's International Consumption Center Cities: Mechanisms, Empirical Evidence, and Policy Implications

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Abstract: *Against the backdrop of deep integration between digital technology innovation and the global economy, examining the impact of digital technology innovation on the development of China's international consumption center cities is of critical importance. Drawing on the pilot city list for international consumption centers and the Global Cities Index, this paper selects 25 Chinese cities as the research sample, including Shanghai, Beijing, Guangzhou, Shenzhen, Chengdu, Chongqing, Tianjin, Hangzhou, Nanjing, Wuhan, and Xi'an, and constructs a balanced panel covering 2015 to 2022, yielding 200 city-year observations. Through theoretical mechanism analysis and the construction of an evaluation index system—measuring digital technology innovation by digital invention patents per 10,000 people, R&D expenditure intensity, and the number of high-tech enterprises, and measuring international consumption center city development across consumption scale, international influence, digital infrastructure, business environment, and cultural attractiveness—it employs both fixed-effects and mediating-effects models for comprehensive empirical analysis. Heterogeneity analysis further shows that the positive effect is more pronounced in eastern and digitally advanced cities than in central and western cities. Based on these findings, this paper proposes relevant recommendations in six areas: strengthening the leading role of digital technology innovation, optimizing the industrial structure layout, improving digital infrastructure, enhancing the quality of the consumption environment, deepening international cooperation and exchanges, and expanding the international consumption market.*

Keywords: Digital technology innovation, International consumption center cities, Industrial structure upgrading, Mediating effect, Fixed-effects model, Urban development, Consumption environment, China.

1. Introduction and Literature Review

Although digital technology innovation has brought new development opportunities to the construction of international consumption center cities in China, there are still many challenges in promoting industrial structure optimization, consumption environment improvement, and international market competitiveness enhancement. Therefore, studying the impact of digital technology innovation on the development of international consumption center cities in China has important theoretical and practical significance.

Existing scholars have conducted certain explorations in aspects such as the construction path of international consumption center cities, development influencing factors, and the impact of digital technology innovation on international consumption center cities. First, regarding the construction path of international consumption center cities, scholars have conducted research from different perspectives. When discussing new ideas for the construction of international consumption center cities in the post-epidemic era, Huang Qinghua (2022) and Zhang Yuanyuan (2023) proposed suggestions such as creating a first-class international consumption environment through institutional and technological innovation and building complementary consumption brands. These suggestions emphasize the importance of innovation and brand construction in the construction of international consumption center cities. Lu Ming (2022) and Li Mingliang (2023) put forward the construction path of international consumption center cities in China from the perspectives of focusing on “international”, improving the global aggregation of consumption resources, digital governance, and enhancing urban convenience.

Second, regarding the development influencing factors of international consumption center cities, consumer demand is one of the key factors driving the development of international consumption center cities. Cui Guangye (2021) and Guo Xinmei (2022) believe that the guiding and driving role of consumer demand in economic development is becoming increasingly significant. In addition, urban characteristics and development foundation are also important factors affecting the construction of international consumption center cities. Chen Lili (2023) believes that based on the characteristics and development foundation of the urban agglomeration, promoting regional revitalization based on the commercial hierarchy system and strengthening consumption format innovation driven by scenarios are the keys to the construction of international consumption center cities.

In recent years, with the continuous development of digital technology, its impact on international consumption center cities has also deepened. Yue Peng (2022) pointed out that the digital economy plays an important role in the development of international consumption center cities and can promote urban development by optimizing the consumption environment and enhancing the diversification of consumption supply. At the same time, digital technology can also promote urban governance and the innovation of consumption patterns, injecting new vitality into the development of international consumption center cities (Zhang Huilin, 2023).

To sum up, existing literature has conducted a relatively comprehensive study on aspects such as the construction path of international consumption center cities, development influencing factors, and the impact of digital technology

innovation. However, there are still some deficiencies: First, the theoretical foundation research on the construction of international consumption center cities is relatively weak, lacking a systematic theoretical framework and guiding ideology; Second, the empirical research on the impact of digital technology innovation on international consumption center cities is relatively scarce. Therefore, the innovation points of this paper are as follows: First, construct a comprehensive evaluation index system for the development level of international consumption center cities from a diversified perspective to expand the research in this field; Second, through the method of combining theoretical analysis and empirical research, comprehensively analyze the impact and action mechanism of digital technology innovation in the development of international consumption center cities, in order to provide more comprehensive and in-depth theoretical support and practical guidance for the construction and development of international consumption center cities.

2. Theoretical Mechanisms and Research Hypotheses

2.1 Impact Mechanism of Digital Technology Innovation on the Development of China's International Consumption Center Cities

The impact of digital technology innovation on the development of China's international consumption center cities is mainly reflected in the following five aspects:

First, from the perspective of the international visibility of cities, digital technology innovation has significantly enhanced the international exposure of China's international consumption center cities by improving the efficiency and scope of information dissemination. With digital means, such as social media and search engine optimization, the city image and characteristics can be quickly spread globally, attracting more international tourists and consumers. This not only helps to enhance the international status of the city but also brings more business opportunities and development space to the city. Second, in terms of consumption prosperity, digital technology innovation provides more diverse consumption choices and scenarios for international consumption center cities. At the same time, digital technology has also promoted the development of emerging consumption formats, such as digital entertainment and virtual reality experiences, providing consumers with a more diversified and personalized consumption experience. Third, at the level of commercial activity, digital technology innovation has significantly enhanced the commercial vitality and competitiveness of international consumption center cities. By applying digital technology, the costs and thresholds of commercial activities have been reduced, promoting the development of small and micro enterprises and innovative enterprises, and injecting more vitality into the business ecosystem of international consumption center cities. Fourth, in terms of transportation convenience, digital technology innovation has brought more convenient and efficient transportation services to international consumption center cities. Through digital means such as intelligent transportation systems and online reservation platforms, consumers can more easily plan their trips, book transportation tools and accommodation, etc. This not only improves the travel experience of consumers but also

helps to optimize the allocation of urban transportation resources and alleviate traffic congestion problems. Fifth, at the level of consumption satisfaction, digital technology innovation has significantly improved consumers' satisfaction in international consumption center cities by enhancing service quality and efficiency. With digital platforms, consumers can more conveniently obtain product and service information, make evaluations and give feedback. At the same time, digital technology has also promoted the improvement of consumer rights protection mechanisms, providing consumers with a safer and more reassuring consumption environment.

Based on the above content, this paper proposes the following research hypotheses:

H1: Digital technology innovation can significantly promote the improvement of the development level of international consumption center cities.

2.2 Mechanism of Action of Digital Technology Innovation on the Development of China's International Consumption Center Cities

Digital technology innovation, as the core driving force of today's economic development, has had a profound impact on the upgrading of the urban industrial structure. In the actual development process, this driving role is mainly reflected in the following aspects: First, digital technology innovation promotes the optimization and upgrading of traditional industries by improving production efficiency and reducing costs. At the same time, digital technology can also help enterprises achieve refined management, optimize resource allocation, and improve product quality and service levels. Second, digital technology innovation has given birth to emerging industries, injecting new vitality into the urban economic development. With the continuous development of technologies such as big data, cloud computing, and artificial intelligence, a series of emerging industries such as e-commerce, intelligent manufacturing, and digital content have emerged as the times require. These emerging industries not only develop rapidly themselves. Finally, many traditional industries have begun to actively embrace digital technology and carry out digital transformation. By introducing digital technologies and management models, these traditional industries have achieved the optimization of business processes, the innovation of service models, and the diversification of market expansion.

In the actual process of urban economic development, the upgrading of the industrial structure plays a crucial role in enhancing the development level of international consumption center cities. Specifically, this promoting role is mainly reflected in the following aspects:

First, the upgrading of the industrial structure has brought diversification and high-endization of consumer supply. With the rise of emerging industries and the optimization and upgrading of traditional industries, international consumption center cities can provide a greater variety and higher quality of goods and services, which not only meet the increasingly diverse needs of consumers but also enhance the consumption attractiveness and international competitiveness of the city.

Second, the upgrading of the industrial structure has promoted the optimization and upgrading of the consumption environment. With the support of digital and intelligent technologies, the shopping environment, service experience, and transportation convenience in international consumption center cities have been significantly improved. Consumers can enjoy a more convenient, comfortable, and safe consumption experience, further enhancing the consumption satisfaction and attractiveness of the city. Third, the upgrading of the industrial structure has also promoted the deep integration of international consumption center cities with the global consumption market. With the rapid development of international trade and cross-border e-commerce, international consumption center cities can more conveniently connect with global commodity and service resources to meet consumers' demands for international brands and high-quality products.

Based on the above content, this paper proposes the following research hypotheses:

H2: Digital technology innovation can promote the upgrading of the industrial structure and thus drive the improvement of

the development level of international consumption center cities.

3. Variable Selection, Model Construction and Data Description

3.1 Variable Selection

1) Explained variable: The development level of international consumption center cities. There is no unified measurement standard for the development level of international consumption center cities in the existing literature. Therefore, in order to comprehensively evaluate the development level of international consumption center cities, this paper refers to the research results of Zeng Qingjun (2024), constructs a comprehensive evaluation index system from five dimensions: the international reputation of the city, the prosperity of the consumption market, the activity of business activities, the convenience of the transportation network, and the satisfaction of the consumption environment, as shown in Table 1, and uses the entropy method for measurement, denoted as city.

Table 1: Comprehensive Evaluation Index System for the Development of International Consumption Center Cities

Goal Layer	Sub-indicator	Indicator Content
Development Level of International Consumption Center Cities	City's International Reputation	Number of Fortune Global 500 Companies
		Number of World Cultural Heritages
		Number of National Scenic Spots of Grade 4A and Above
		Number of Inbound Tourists Received
		Number of Domestic and International Events and Exhibitions Held
	Prosperity Degree of the Consumption Market	Total Retail Sales of Consumer Goods
		Total Volume of Import and Export Trade
		Added Value of the Service Industry
		Per Capita Consumption Expenditure
	Activity of Commercial Activities	Number of National Pilot Pedestrian Streets
		Number of Approved Chinese Time-honored Brands
		Number of Duty-free Stores
		Number of Five-star Hotels
		Fixed Asset Investment in the Tertiary Industry
	Convenience of the Transportation Network	Number of Domestic and International Flights
		Number of High-speed Rail Stops
		Operating Line Length of Urban Rail Transit
		Length of Expressways
		Number of Operating Taxis
	Satisfaction with the Consumption Environment	Score of the Business Environment Index
		Score of Consumer Satisfaction

2) Explanatory variable: Digital technology innovation. This paper refers to the research of Zhang Liao (2023), and measures it by matching the number of patents related to the digital economy industry. The specific method steps are as follows: First, define the scope of the digital economy industry according to the "Statistical Classification of Digital Economy and Its Core Industries"; second, determine the international patent classification number according to its corresponding national economic industry code; finally, retrieve the corresponding classification from the intellectual property patent database, and take the logarithm of the sum of 1 of the relevant patent applications in the city, denoted as innovation.

3) Mediating variable: industrial structure upgrading. Referring to the method of Wang Yu (2024), this paper selects the ratio of the added value of the tertiary industry to that of the secondary industry in the city as the measurement index of industrial structure upgrading, denoted as industry.

4) Control variables. This paper selects the following relevant control variables: the level of economic development is measured by the per capita GDP of each city, denoted as PGDP; the level of foreign investment is measured by the amount of foreign direct investment, denoted as FDI; the level of marketization is measured by referring to the marketization index released by Fan Gang, denoted as Market; the level of medical care is measured by the logarithm of the number of hospital beds per 10,000 people in the city, denoted as Medical.

3.2 Model Construction

To verify the theoretical hypothesis H1 proposed above, the benchmark model is set as follows:

$$city_{cj} = \alpha_0 + \alpha_1 innovation_{cj} + \alpha_2 control_{cj} + \kappa_c + v_j + \varepsilon_{cj}$$

(1)

Among them, c represents the research city, j represents the research period, city represents the explained variable, i.e., the development level of the international consumption center city, innovation represents the core explanatory variable, i.e., the level of digital technology innovation, control represents the relevant control variables, κ_c , v_j respectively represent the fixed effects of controlling the research city and the research period, and ε_{cj} represents the residual term.

In addition, to further test the mechanism of action of digital technology innovation on the development of China's international consumption center cities, based on the theoretical hypothesis H2 and variable setting above, the mediating effect model is set as follows:

$$industry_{cj} = \beta_0 + \beta_1 innovation_{cj} + \beta_2 control_{cj} + \kappa_c + v_j + \varepsilon_{cj} \quad (2)$$

$$city_{cj} = \rho_0 + \rho_1 innovation_{cj} + \rho_2 industry_{cj} + \rho_3 control_{cj} + \kappa_c + v_j + \varepsilon_{cj} \quad (3)$$

Among them, industry represents the mediating variable, i.e., the upgrading of the industrial structure, and other variables are the same as above.

3.3 Data Description

The State Council has selected five major cities, namely Shanghai, Beijing, Guangzhou, Tianjin, and Chongqing, as the list of pilot cities for international consumption centers. In addition to the pilot cities, this paper refers to the method of Wang Xiaolin (2023) and selects other well-known cities with international representativeness in the consumption field as an expanded sample based on the "World City" compiled by the Globalization and World Cities Research Network. Finally, 25 cities are determined as the research samples of international consumption center cities, and the research period is from 2011 to 2022. The data sources are the "China Urban Statistical Yearbook", the "China Statistical Yearbook", the "China Urban Competitiveness Report", and the data published on the official government websites.

4. Analysis of Empirical Results

4.1 Benchmark Regression Analysis

Table 2 shows the results of the benchmark regression. Among them, column (1) shows the impact of only considering the explanatory variable of digital technology innovation on the explained variable of the development of international consumption center cities. Judging from the estimated coefficient, it is significantly positive, preliminarily indicating that digital technology innovation significantly promotes the improvement of the development level of international consumption center cities. Further analysis shows that by gradually adding control variables, the results are shown in columns (2)-(5). The estimated coefficient values of the core explanatory variable of digital technology innovation are all significantly positive. From column (5), when the development level of digital technology innovation increases by one unit, it will the development level of international consumption center cities to increase by 0.030%, further verifying the setting of the previous hypothesis H1.

From the perspective of control variables, the improvement of economic development level, marketization level and medical level also the development of international consumption center cities.

Table 2: Benchmark Regression Results

Variable Name	(1)	(2)	(3)	(4)	(5)
innovation	0.038*** (0.003)	0.039*** (0.003)	0.037*** (0.003)	0.031*** (0.003)	0.030*** (0.003)
PGDP	-	0.040*** (0.003)	0.019** (0.034)	0.087** (0.039)	0.081** (0.038)
FDI	-	-	0.027*** (0.001)	0.011 (0.001)	0.001 (0.001)
Market	-	-	-	0.022*** (0.004)	0.002*** (0.004)
Medical	-	-	-	-	0.041*** (0.013)
cons	0.010*** (0.001)	0.057 (0.034)	0.064** (0.034)	0.050 (0.038)	0.103*** (0.034)
Individual Fixed	Yes	Yes	Yes	Yes	Yes
Time Fixed	Yes	Yes	Yes	Yes	Yes
R^2	0.738	0.739	0.721	0.730	0.736

Note: The symbols *, **, and *** represent passing the test at the significance levels of 10%, 5%, and 1% respectively. The values in the corresponding parentheses are the t-statistic values. The same applies hereinafter.

4.2 Endogeneity Analysis

To rule out possible endogeneity problems in the research results, first, this paper selects the first and second lags of the explanatory variables for regression estimation. The results are shown in columns (1) and (2) of Table 3. It can be found that the estimated coefficients of digital technology innovation are all significantly positive, further indicating the robustness of the results. Second, referring to the method of Huang Qunhui (2019), this paper uses the interaction term of the national number of Internet users in the previous year and the number of fixed telephones in each city in 1984 as an instrumental variable and conducts two-stage estimation analysis. The results are shown in columns (3) and (4) of Table 3. From the results, the P value of the Rk LM statistic is less than 0.1, indicating that the null hypothesis is rejected, and the estimated coefficients of the explanatory variable digital technology innovation are all significantly positive, proving the rationality of the selection of the instrumental variable.

Table 3: Endogeneity Test

Variable Name	(1) One-period lag	(2) Two-period lag	(3) First stage	(4) Second stage
innovation	-	-	0.087*** (0.001)	0.104*** (0.003)
L. innovation	0.032*** (0.001)	-	-	-
L2. innovation	-	0.031*k** (0.004)	-	-
Control variables	Yes	Yes	Yes	Yes
Individual fixed	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes
Rk LM statistic	-	-	31.284 [0.000]	25.372 [0.000]
Wald rk F statistic	-	-	27.803 {15.438}	24.518 {16.349}
R^2	0.405	0.412	0.784	0.753

4.3 Robustness Analysis

First, this paper re-evaluates the development level of international consumption center cities using the principal component analysis method and re-conducts regression estimation on the results. The results are shown in column (1) of Table 4. The estimated coefficient value of digital technology innovation is 0.045 and is significant at the 1% level, further proving the robustness of the previous benchmark regression results. Second, this paper conducts a 1% winsorization treatment on the explained variable and the explanatory variable respectively and re-conducts the regression test. The results are shown in column (2) of Table 4. The estimated coefficient and direction of the explanatory variable are still consistent with the previous conclusions. Finally, this paper uses the Tobit model to conduct regression estimation again. The results are shown in column (3) of Table 4. It can be seen that the impact of digital technology innovation on the explained variable is still significantly positive, further indicating that the results are robust.

Table 4: Robustness Analysis

Variable	(1) Replace the measure of the explained variable	(2) Winsorization	(3) Tobit model
innovation	0.045*** (0.020)	0.030*** (0.010)	0.041*** (0.023)
Control variables	Yes	Yes	Yes
cons	-3.258*** (-0.483)	-0.021 (-0.029)	0.513*** (0.014)
City fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
R ²	0.423	0.486	0.438

4.4 Analysis of the Mechanism of Action

The test results of the mechanism of action of digital technology innovation on the development of international consumption center cities are shown in Table 5. Among them, column (1) represents the impact of digital technology innovation on the upgrading of the urban industrial structure. It can be seen from the results that the estimated coefficient of digital technology innovation is 0.017 and is significant at the 5% level, indicating that digital technology innovation can significantly promote the upgrading of the urban industrial structure. After introducing the upgrading of the industrial structure into the benchmark model, as shown in column (2) of Table 5, the estimated coefficients of both the upgrading of the industrial structure and digital technology innovation are significantly positive, indicating that the upgrading of the industrial structure plays a mediating role in the impact of digital technology innovation on the development of international consumption center cities, supporting the validity of hypothesis H2 proposed above.

Table 5: Results of the mechanism test

Variable	(1) industry	(2) city
innovation	0.017** (0.007)	0.004*** (0.001)
industry	-	0.056*** (0.010)
Control variables	Yes	Yes
City fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
R ²	0.483	0.465

5. Policy Recommendations

First, strengthen the leadership of digital technology innovation and optimize the industrial structure layout. Relevant governments should increase support for digital technology innovation, encourage enterprises to increase R & D investment, and promote the wide application of digital technology in various industrial fields. At the same time, it is necessary to guide traditional industries to transform and upgrade towards digitalization and intelligentization, cultivate emerging industries, and optimize the industrial structure layout. Through the leadership of digital technology innovation, promote the formation of a modern industrial system with international competitiveness and provide a solid industrial support for the development of international consumption center cities.

Second, improve the construction of digital infrastructure and enhance the quality of the consumption environment. Relevant governments should accelerate the construction of digital infrastructure and improve the digital level of the city. Strengthen the promotion and application of new generation information technologies such as 5G networks, the Internet of Things, and cloud computing, and create digital consumption scenarios such as smart cities and smart business districts. At the same time, it is necessary to improve supporting service facilities such as transportation and logistics, and improve the convenience of urban transportation and logistics efficiency. By improving digital infrastructure and enhancing the quality of the consumption environment, attract more domestic and foreign consumers to shop, travel, and experience, and promote the development of international consumption center cities.

Third, deepen international cooperation and exchanges and expand the international consumption market. Relevant governments should actively participate in international economic cooperation and exchanges and strengthen links with the global consumption market. Promote cooperation with international trade organizations, multinational enterprises, etc., and hold international exhibitions, cultural exchange activities, etc. to enhance the international visibility and influence of the city. At the same time, it is necessary to encourage enterprises to expand overseas markets and promote high-quality goods and services to the world. By deepening international cooperation and exchanges and expanding the international consumption market, inject new impetus into the development of international consumption center cities.

Fund Project

Special Knowledge Innovation Project of Wuhan Science and Technology Bureau in 2025, "Research on the Development Countermeasures of Wuhan's Nighttime Economic Agglomeration Areas Aiming at China's International Consumption Center Cities" (Project Number: 2025010801020427).

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