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Research on the Impact of Digital Consumption on the Upgrading of Industrial Structure

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Abstract: Digital consumption has become a vital engine of economic growth in the digital economy era and a key support for boosting the domestic circulation. It is practically significant for unlocking new consumption potential, advancing the digital-real economic integration of enterprises, and driving industrial structure upgrading. Using provincial-level data from 2015 to 2024, this paper constructs an indicator system of digital consumption, empirically tests the direct effect of digital consumption on industrial structure upgrading through a two-way FE model, and further verifies its indirect role in advancing industrial structural upgrading via the channel of technological innovation by adopting the mediating effect approach. The results confirm that digital consumption not only directly boosts industrial structural upgrading, but also drives the overall industrial optimization and the secondary industry's internal structural upgrading through technological innovation spillovers. Accordingly, we should unlock digital consumption potential, deepen its connotation, and enhance technological innovation capacity to fully leverage its role in releasing consumption demand, expanding domestic demand, and propelling economic growth and industrial upgrading.

Keywords: Digital Consumption; Industrial Structure Upgrading; Manufacturing Upgrading; Service Industry Upgrading

1. Introduction

In 2025, the improvement of China's core digital economy industries accounted for 10.5% of the gross domestic product (GDP). The integration of digital and physical elements has become the key to promoting high-quality economic development. By the end of June 2025, the number of netizens in China had reached 1.123 billion, with an internet penetration rate of 79.7%; the number of online shopping users reached 976 million, accounting for 86.9% of the total netizens. Digital consumption has shown a vigorous development trend of full-domain penetration, scale expansion and format innovation, driving the continuous quality and efficiency improvement of related industries such as live-streaming e-commerce, instant retail and smart services. Against this backdrop, improving the long-term mechanism for expanding consumption, reasonably increasing public consumption, and promoting digital consumption have become the guarantees for cultivating new types of consumption and unleashing consumption potential. Consumption is the basic engine of economic growth. Taking data as the factor, platform as the carrier and scenario as the starting point, new digital consumption has continuously reshaped the production, circulation and consumption chains, and has become an important support for smoothing the domestic great cycle, stimulating the momentum of industrial upgrading and promoting the new vitality of economic development.

At the same time, with the popularization of digital technology and the wide application of the Internet, traditional industries have gradually accelerated the pace of structural adjustment and upgrading in the face of the new trend of digital consumption. Digital consumption has promoted the in-depth integration of the real economy and the virtual economy, prompting various industries to innovate and optimize in products, services, production and supply chains. "Efforts should be made to expand domestic demand and enhance the fundamental role of consumption in the economy."

Digital consumption is an important force for expanding domestic demand and promoting industrial transformation, and its role is reflected in two aspects. First, consumption is the starting point of economic activities. The digital

consumption model brings an increase in the quantity of consumption and more diverse consumption demands, which drives the development of enterprise production and enhances enterprise vitality; on the other hand, consumption is also the end point of economic interaction. The content of digital consumption guides the transformation and upgrading of the industrial structure and optimizes the economic development structure. Digital consumption is becoming a key driving force for promoting the optimization and upgrading of the industrial structure. It is not only an innovation in the consumption field, but also an important engine for the in-depth adjustment of the entire social industrial chain and economic structure. Therefore, this paper explores the impact of digital consumption on industrial structure upgrading and explore its impact on the upgrading of industrial structure from both theoretical and empirical perspectives.

2. Literature Review

2.1 The Connotation of Digital Consumption

With the continuous advancement of consumption upgrading, new consumption driven by digital technology has gradually become a hot topic of concern from all sectors of society. Digital consumption refers to the purchase, use and consumption behaviors of goods and services by consumers through digital technologies and Internet platforms with the help of intelligent devices. It covers various forms from traditional online shopping to virtual service consumption, emphasizing the acquisition and experience of goods or services through digital tools and platforms [1]. The main difference between digital consumption and traditional consumption models lies in its high dependence on digital technologies and network platforms. Consumers can complete online shopping and service acquisition anytime and anywhere through devices such as smartphones and computers. This transformation has greatly improved the convenience and flexibility of consumption, enabling consumers to shop according to their personal needs at any time and place, no longer restricted by the business hours, transportation or geographical location of traditional stores. The precision recommendation system of digital platforms can not only push relevant products based on consumers' hobbies, but also provide customized shopping experiences, such as customized goods, personalized designs and customized services, and at the same time provide guiding suggestions for enterprise production. This convenient online consumption model has brought closer and real-time connections between consumers and manufacturers, which is more conducive to consumers' demand adjustment and enterprises' supply adjustment [2].

On the other hand, digital consumption is not equivalent to e-commerce and online transactions, nor is it limited to the onlineization of consumption models. In digital consumption, the demand for virtual goods and services is gradually rising. Subsequently, as the Internet continued to develop, more and more digital content, such as digital music, videos, e-books, and in-game virtual items, has become an important part of people's daily consumption. The virtualization of digital consumption has not only changed consumers' consumption choices, but also expanded the space for industrial development. For example, the rise of online music and video platforms has made people no longer rely on physical records or CDs, but subscribe to and consume content through streaming platforms; props, equipment and skins in virtual games have also become consumption objects for players, and their consumption scale is expanding year by year. This form of virtual consumption not only meets consumers' needs, but also promotes the rapid development of emerging industries such as cultural and creative industries and entertainment industries [3].

2.2 Research Status of Digital Consumption Promoting Industrial Structure Upgrading

From the current research, studies related to digital consumption are still in the theoretical exploration stage, and there are few literatures on the empirical application of digital consumption. Only Ru and Deng [4] explored the impact of digital consumption on economic growth by analyzing the quasi-natural experiment of China's national information consumption pilot. In terms of the research on digital consumption promoting industrial structure upgrading, a small number of scholars have discussed the theoretical mechanism of digital consumption promoting industrial structure upgrading: Deng [5] pointed out that the mechanism of digital consumption driving industrial upgrading is mainly through two

aspects: demand pull and technology diffusion; He and Pang [6] analyzed the path of digital consumption promoting industrial upgrading from the perspective of theoretical mechanism, and they believed that digital consumption promotes the high-end and globalization of the industrial chain by promoting technological innovation and intelligent development of the service industry. Scholars all agree that the technological innovation effect of digital consumption is an important factor driving industrial structure upgrading. In addition, Pang and Hua [7] innovatively proposed the measurement indicators and methods of digital consumption from the perspective of digital consumption.

In addition, Han [3] explored the new connotation of digital consumption in the digital economy. Pang and Hua [7] believed that digital consumption not only promotes changes in consumption models, but also strengthens the interaction between consumers and producers, which is conducive to the rapid transformation of industries. On the whole, digital consumption has provided an important driving force for industrial structure upgrading by promoting the application of information technology and the transformation of consumption methods, but there are still many challenges such as difficult technology landing, large regional differences, and insufficient policy support. Therefore, how to overcome these obstacles to enable digital consumption to more widely promote the transformation of industrial structure is still an important topic in current research and policy formulation. As an important part of new consumption, the measurement method of new consumption also provides a reference for the construction of indicators in this paper [8].

In addition, some scholars have conducted research on other applications of digital consumption, exploring and analyzing the specific development strategies of industries such as medical care, fitness, and education in the digital consumption environment. For example, Liu and Nie [9] proposed suggestions such as narrowing the consumption level gap, promoting the quality improvement of health products and services, promoting the resonance of diverse formats, and accelerating the digital transformation of the health industry to cultivate healthy digital consumption. Foreign scholars mainly focus on consumer behavior to study the changes in digital consumption models and structures, and believe that there is a clear relationship between the changes in technology and real economic demand and the changes in consumption models and structures; digital technology platforms play an important role in sustainable development, promoting the development of new consumption and production models.

2.3 Theoretical Mechanism of Digital Consumption Affecting Industrial Structure

Digital consumption has become a major force driving industrial structure upgrading. This paper analyzes its dual impact: the direct effect of expanding consumer demand and the indirect effect of stimulating corporate technological innovation [10]. On the one hand, rising demand from digital consumption directly promotes the emergence of new industries and industrial optimization. On the other hand, digital consumption creates new products and business models, encouraging firms to increase R&D investment, which further upgrades industrial structure. Since the direct mechanism has been discussed earlier, this part focuses on the theoretical channel of technological innovation.

It is through promoting technology popularization, raising industrial efficiency, spawning new industries, and optimizing industrial chains that digital consumption upgrades industrial structure by driving technological innovation. Digital consumption has promoted the popularization and application of new technologies and the digital transformation of traditional industries [11]. With the increase in consumers' demand for digital products and services, enterprises have begun to increase investment in information technology and adopt advanced digital technologies to improve production efficiency and service quality. With the application of advanced technologies such as the Internet, artificial intelligence, and big data, digital consumption has not only changed the way consumers demand, but also triggered technological innovation and industrial transformation in a wide range of fields. By promoting technological innovation, digital consumption improves industrial efficiency, spawns emerging industries and promotes the optimization of industrial chains, providing a strong driving force for the upgrading of industrial structure. The increase in consumption demand brought by digital consumption is an

important factor promoting the optimization and adjustment of industrial structure. With the rapid development of information technology and the popularization of the Internet, consumers' consumption patterns and demands have undergone profound changes, and digital consumption has become a new engine driving economic development. Consumers' demand for digital products and services is growing day by day, prompting manufacturers to increase technological innovation to improve production efficiency and the research and development of new products [12]. Secondly, digital consumption has promoted the rise of emerging industries and the extension of industrial chains. With the rise of digital consumption, emerging industries such as online education, digital entertainment, and the sharing economy have developed rapidly, spawning a large number of new market demands and innovative technologies. These emerging industries not only provide new development directions for traditional industries, but also promote the deepening of related industrial chains.

3. Research Design

3.1 Data Sources

All relevant data used in this paper are from the National Bureau of Statistics of China. In view of the lack of some key data in the subsequent years, this paper selects panel data of 30 provinces in China from 2015 to 2024 based on the availability of original data and the phased characteristics of the economy and society, focusing on studying the direct impact of digital consumption on industrial structure upgrading and the indirect impact on the internal upgrading of industrial structure through technological progress.

3.2 Construction of Econometric Model

First, the following two-way FE model is constructed to test the impact of digital consumption on industrial structure upgrading:

$$y_{i,t} = a_0 + \beta_1 x_{i,t} + \text{control}_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

i stands for provinces, t stands for time, and $y_{i,t}$ represents the level of industrial structure in region i in year t. This paper measures the explained variable from three dimensions, namely the overall upgrading of industrial structure and the internal upgrading of the secondary and tertiary industries. $x_{i,t}$ denotes the digital consumption index of province i in year t, $\text{control}_{i,t}$ stands for a set of control variables, μ_i represents the fixed effect of each province, γ_t represents the time fixed effect, and $\varepsilon_{i,t}$ represents the random disturbance term. Robust standard errors are used in the subsequent regressions.

3.3 Variable Setting

3.3.1 Explained variable

The explained variable in this paper is in this paper takes industrial structure upgrading as the explained variable, measured by three dimensions: overall industrial structure upgrading, and the internal upgrading of the secondary and tertiary industries. Existing literature mostly focuses on the overall quality improvement of the industrial system. Specifically, the overall upgrading reflects the sequential evolution of the industrial structure from low to high levels, following the logical trajectory of economic development. According to Clark's Law, the academic circle generally defines the improvement of the overall quality of the industrial structure as the increase in the proportion of non-agricultural industries. Referring to the research method of Lan Qingxin et al. [13], certain weights are assigned to the three industries in turn, and the industrial structure upgrading index is obtained by weighted calculation, which approximately represents the improvement of the overall industrial quality. The specific calculation formula is as follows:

$$y_{i,t} = \sum_{m=1}^{3} l_{i,t,m} m \quad (2)$$

On the basis of the overall transformation and upgrading of the industrial structure towards the secondary and tertiary industries, it is more important to study the internal structural changes of the secondary and tertiary industries. For example, digital consumption brings more types of emerging service industries, and their proportion indirectly reflects the internal structural changes of the tertiary industry. Therefore, referring to the practice of Wang [14], this paper uses the proportion of the financial industry, real estate industry, transportation, storage and postal services in the tertiary industry to measure the internal structural changes of the tertiary industry. At the same

time, the proportion of the manufacturing industry in the secondary industry is used to measure the internal structural changes of the secondary industry.

3.3.2 Explanatory variable

This paper selects digital consumption as the core explanatory variable, and constructs an indicator system from two aspects: digital consumption level and digital consumption potential, and uses the entropy method to calculate the comprehensive digital consumption index [15].

The main feature that distinguishes digital consumption from traditional consumption is the online consumption model. Due to data availability, it is difficult to measure it directly. Therefore, this paper measures the digital consumption level from four aspects closely related to online consumption: software business, telecommunications business, e-commerce sales and express delivery volume. The equipment support for digital consumption is measured by three indicators: the number of enterprise websites, mobile Internet users, and enterprises engaged in e-commerce transactions, which jointly reflect the development potential of digital consumption [16]. The entropy method is then adopted to objectively determine the weight of the above seven indicators, so as to construct a comprehensive index of digital consumption.

The detailed selection of indicators is presented in Table 1:

Table 1. The Digital Consumption Indicator System

Digital Consumption Level	E-commerce Sales (100 million yuan)
	Express Delivery Volume (10,000 pieces)
	Total Telecommunications Business Volume (100 million yuan)
	Software Business Revenue (10,000 yuan)
Digital Consumption Potential	Number of Enterprise Websites (unit)
	Internet Penetration Rate (%)
	Number of Enterprises with E-commerce Transaction Activities (unit)

3.3.3 Control variables

To alleviate the endogeneity caused by omitted variables and ensure the robustness of empirical results, this study introduces a set of control variables that may influence industrial structure upgrading with reference to previous studies. Descriptive statistics of the main variables are presented in Table 2:

Table 2. Descriptive Statistics

Variable Name	N	mean	sd	min	max
Overall Upgrading of Industrial Structure	300	2.413	0.118	2.132	2.835
Internal Upgrading of Secondary Industry	300	0.805	0.743	0.516	0.934
Internal Upgrading of Tertiary Industry	300	0.360	0.038	0.281.	0.502
Digital Consumption	300	0.111	0.131	0.000	0.833
Urbanization Process	300	0.61	0.11	0.38	0.90
Government Intervention	300	0.26	0.11	0.11	0.75
Foreign Investment Level	300	0.098	0.475	0.005	5
Infrastructure Level	300	17.077	5.037	4.110	28
Human Capital Level	300	0.022	0.006	0.008	0.436

4. Empirical Analysis

4.1 Benchmark Regression

Benchmark regression results are reported in Table 3. Digital consumption has a significantly positive effect on industrial structure upgrading. The coefficients are 0.096, 0.095 and 0.082 for overall industrial upgrading, secondary industry upgrading and tertiary industry upgrading, respectively. This suggests that digital consumption significantly promotes the overall optimization and internal upgrading of China's industrial structure.

From the perspective of control variables, the results of infrastructure construction vary greatly among the three models, and it has a significant positive effect only on the upgrading of the tertiary industry structure. The reason is that the tertiary industry is highly dependent on infrastructure, and the tertiary industry is concentrated in areas with high infrastructure levels. However, the changes in the secondary industry structure are affected by a variety of factors, such as capital investment, labor quality, technological progress, and government policies. In the model of the overall upgrading of the industrial structure, the impact is also not

significant due to the influence of the secondary industry. If these factors have a more prominent impact on the secondary industry, the impact of infrastructure may be masked, leading to an insignificant relationship between the two.

Table 3. Benchmark Regression Results

VARIABLES	(1)	(2)	(3)
	Y1	Y2	Y3
Digital Consumption	0.096*** (2.76)	0.095*** (4.10)	0.082*** (5.27)
Urbanization Process	0.233** (2.27)	0.212*** (2.63)	-0.102 (-0.96)
Government Intervention	0.303*** (4.66)	0.211*** (3.77)	0.040 (0.58)
Foreign Investment Level	0.010*** (4.62)	0.001 (0.36)	-0.002* (-1.95)
Infrastructure Level	0.596 (0.08)	-4.061 (-0.65)	22.404** (2.03)
Human Capital Level	2.425* (1.94)	4.075*** (3.74)	-0.379 (-0.39)
Constant	3.350*** (6.94)	-0.245 (-0.87)	-0.553* (-1.94)
Observations	300	300	300
R-squared	0.980	0.969	0.893
Provincial FE	YES	YES	YES
Time FE	YES	YES	YES

In addition, the producer services in the tertiary industry are not closely related to government expenditure, education level and urban-rural population structure, which may be the reason why the urbanization level, government intervention and human capital level in column (3) are not significant. The relationship between foreign direct investment and industrial structure upgrading is relatively complex, showing three different results in the three models. Referring to the explanation of Yuan [12], the reason may be that in order to meet the performance assessment standards of GDP, local governments stimulate regional economic development through large-scale investment introduction. The industrial parks with highly similar industrial structures have low actual utilization efficiency, which is likely to cause over-competition and overcapacity problems, and the promotion effect on industrial structure upgrading is very limited.

4.2 Mediating Effect

Following the two-step approach developed by Jiang [17], Table 4 presents the regression results of the mediating effect of technological innovation. The results show that technological innovation plays a significant mediating role in the process of digital consumption affecting the overall industrial structure upgrading and the internal upgrading of the secondary industry, whereas the mediating effect is not significant for the tertiary industry. As shown in Model (1), digital consumption exerts a positive and significant effect on technological innovation, indicating that the expansion of digital consumption effectively stimulates regional innovation activities.

Table 4. Mediating Effect Results

VARIABLES	(1)	(2)	(3)	(4)
		Y1	Y2	Y3
Digital Consumption	0.008*** (11.27)	0.096*** (2.76)	0.095*** (4.10)	0.082*** (5.27)
Control Variables	YES	YES	YES	YES
Constant	0.019*** (7.77)	3.350*** (6.94)	-0.245 (-0.87)	-0.553* (-1.94)
Observations	300	300	300	300
R-squared	0.974	0.980	0.969	0.893
Sobel		6.301***	2.869***	-0.499
bootstrap		0.245***	0.099***	-.009
Provincial FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

The significantly positive coefficients of digital consumption in columns (2) and (3) further verify the mediating role of technological innovation. That is, digital consumption promotes industrial structure upgrading partly by enhancing technological innovation. The insignificant mediating effect in the tertiary industry may be attributed to the long cycle required for technological innovation to improve efficiency, reduce costs, and upgrade service quality, thus leading to a lagged impact on industrial evolution.

4.3 Robustness Test

To verify the robustness of the baseline results, this paper replaces the industrial value-added share with employment share to re-measure industrial structure upgrading, and re-estimates the model using panel regression. The results are reported in Table 5. After changing the measurement of the explained variable, digital consumption still presents a significantly positive effect on industrial structure upgrading, which is consistent with previous findings and confirms the robustness of our conclusions.

Table 5. Robustness Test Results

VARIABLES	(1)	(2)	(3)
	Y1	Y2	Y3
Digital Consumption	0.390*** (5.50)	0.182*** (3.59)	0.151*** (5.20)
Control Variables	YES	YES	YES

Constant	2.553*** (17.40)	0.360*** (2.99)	0.502*** (9.10)
Observations	300	300	300
R-squared	0.840	0.934	0.937
Provincial FE	YES	YES	YES
Time FE	YES	YES	YES

4.4 Endogeneity Treatment

Potential endogeneity may exist between digital consumption and industrial structure upgrading, mainly due to their two-way causality. On the one hand, digital consumption drives industrial transformation and upgrading. On the other hand, advanced industrial structure brings more diversified products, stimulates consumption demand, and in turn boosts digital consumption.

Against this background, this study adopts the instrumental variable method to address the endogeneity issue. Referring to the research of Cai Haiya and Xu Yingzhi, considering that the geographical location of provinces may be a variable associated with the degree of digital development, with reference to the common practice in previous studies, the reciprocal of the distance (100 kilometers) from each province to coastal ports is used as a measure of geographical location. Considering the time variability of variables, the product of this indicator and per capita disposable income (yuan) is calculated and then taken the logarithm as the final instrumental variable.

This paper selects one instrumental variable, so there is no over-identification problem. The same instrumental variable is used to conduct instrumental variable treatment on the three models in the benchmark regression respectively, and the results of IV estimation are shown in Table 6. Since the same instrumental variable is used, the results of the first-stage regression are the same. Columns (2)-(4) are the second-stage regression of the three explained variables respectively. The C-Dwald F statistic exceeds the critical value at the 10% level of the Stock-Yogo test, so the null hypothesis of weak instrumental variables is rejected. This demonstrates that the instrumental variable employed in this study is exogenous and sufficiently strong.

Table 6. Endogeneity Treatment

VARIABLES	(1)	(2)	(3)	(4)
	First	Y1	Y2	Y3
Digital Consumption		0.402*** (3.70)	0.541*** (4.98)	0.478*** (4.93)
Instrumental Variable	0.486*** (5.01)			
Control Variables	YES	YES	YES	YES
Observations	300	300	300	300
C-DwaldF		60.984		
Stock-yogo10%		16.38		
Provincial FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

The estimated coefficients of the core explanatory variable (digital consumption) are all significantly positive, which is consistent with the previous research conclusions, indicating that the estimated results are robust.

5. Conclusions and Recommendations

Using provincial-level data from 2015 to 2024, this paper constructs a digital consumption index and three variables for measuring industrial structure upgrading. The two-way FE model is used to empirically test the significant positive effect of digital consumption on the three types of industrial structure upgrading. The study finds that digital consumption does promote industrial structure upgrading. Subsequently, the two-step method of mediating effect is used to further verify the indirect effect of digital consumption on industrial structure upgrading through technological innovation. Furthermore, robustness and endogeneity treatments are conducted on the model, and the conclusions consistent with the benchmark regression are obtained, which proves the rationality and robustness of the research.

The specific research conclusions are as follows: Digital consumption affects industrial structure upgrading through the direct impact of consumption demand and the indirect impact of technological innovation. The direct impact of consumption demand significantly promotes the overall upgrading of industrial structure and the internal upgrading of the secondary and tertiary industries, while the indirect impact of technological innovation is not obvious only on the internal upgrading of the tertiary industry structure.

Digital consumption has become an important driving force for promoting industrial structure upgrading, especially in the tertiary industry, where digitalization has brought unprecedented opportunities and the emergence of more diversified producer services and living services. To further promote the role of digital consumption in driving industrial structure upgrading, combined with the conclusions drawn in this paper, the following recommendations for China's digital consumption are put forward:

First, unleash the potential of digital consumption and tap into its driving role. The construction of digital infrastructure is crucial, especially strengthening the construction of 5G networks, optical fiber broadband and data centers, so that more enterprises and consumers can enjoy the convenience brought by digital consumption. At the same time, promote the digital transformation of traditional industries, especially manufacturing and agriculture, and improve productivity and service quality with the help of technologies such as intelligent production and supply chain management, thereby optimizing the industrial structure. In addition, rural areas have a huge potential consumption scale. While promoting the construction of digital infrastructure, it is more important to improve farmers' digital literacy, thereby increasing the demand for digital consumption in quantity and promoting economic development.

Second, further deepen the connotation of digital consumption. The connotation of digital consumption not only includes changes in consumer behavior, but also involves profound changes in the industrial chain. Digital consumption has promoted the digital upgrading of the entire industrial chain, including the supply chain, production chain and service chain, breaking the limitations of traditional industrial models and business models. This transformation has prompted enterprises to re-evaluate their relationship with consumers, and realize services such as precision marketing, personalized customization and real-time feedback through technologies such as big data, artificial intelligence and the Internet of Things, improving industrial efficiency and consumer satisfaction. Therefore, an important direction to deepen the connotation of digital consumption is to study how digital technologies can be deeply integrated with traditional industries to promote industrial upgrading and innovation.

Finally, we should enhance digital technology innovation and talent development. Innovative consumption models, including social e-commerce, live-streaming e-commerce and virtual reality shopping, have diversified consumer demand and accelerated industrial digital transformation. In addition, the rapid development of digital consumption is inseparable from technological innovation and talent training. Therefore, strengthening the training of digital talents, promoting universities and vocational training institutions to set up relevant courses, and cultivating technical talents in fields such as big data and artificial intelligence can provide strong human support for industrial structure upgrading.

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