doi: 10.36689/uhk/hed/2024-01-023 HED Hradec Economic Days

Digital Economy Drives the Transformation and Upgrading of Western Service Industry

Kai LI, Rong KANG and Chao YANG*

School of Economics and Management, Northwest University, Xi'an, China; 499413655@qq.com; kangrong@nwu.edu.cn; yc19980417@163.com

* Corresponding author: yc19980417@163.com

Abstract: This article discusses the important role of Internet popularization and the development of digital inclusive finance in promoting the transformation and upgrading of the western service industry, and conducts a theoretical review from the perspective of digital economic development. At the same time, by measuring the degree of upgrading of the service industry structure in each province in the west, this article finds that regions with a higher level of comprehensive economic development have a higher degree of transformation and upgrading of the service industry. The difference in the degree of upgrading of the service industry in the western region mainly comes from provinces. This article conducts a panel data model analysis on the data of 12 western provinces from 2016 to 2020 to explore the impact of the development level of the digital economy on the transformation and upgrading of the service industry. The research results show that the improvement of the development level of the digital economy can optimize the industrial structure of the service industry and promote the transformation and upgrading of the service industry in the western region.

Keywords: digital economy; industrial structure; Gini coefficient; service industry

JEL Classification: L80

1. Introduction

The report of the 20th National Congress of the Communist Party of China pointed out that high-quality development is the primary task of comprehensively building a modern socialist country. To accelerate the construction of a new development pattern and strive to promote high-quality development, it is necessary to promote the upgrading of the industrial structure and accelerate the development of the modern service industry. The efficient development of the service industry is one of the keys to achieving high-quality economic development, and promoting the transformation and upgrading of the service industry is key measures to achieve this goal. With the continuous development and update of digital technology, the digital economy, as a new economic form, plays an important role in the development of the modern service industry and the allocation of service resources. Digital technology also plays an important role in promoting the transformation and upgrading of the service industry. Under the requirements of implementing the strategy of expanding domestic demand and deepening the supply-side structural reform, the main driving force

for the transformation and upgrading of the service industry now comes from "service digitalization" and "digital servitization".

Under the development pattern of the service industry driven by digital technology, the technological revolution with a new generation of digital universal technology as the core has the advantage of transcending geographical characteristics and reshaping the geographical pattern, thus providing opportunities for the development of the service industry in the underdeveloped western region. For the western region, relying on digital economic development with digital technology as the core is an important means to achieve an advanced development of the service industry structure. The digital economy drives the transformation and upgrading of the western service industry, which plays a vital role in improving the development level and efficiency of the western service industry, promoting high-quality economic development in the western region, and helping the western region catch up and surpass.

Domestic and foreign scholars generally believe that the digital economy, as a new endogenous factor driving the transformation and upgrading of the service industry, has had a positive effect. Kaplinsky and Morris (2012) found that under the guidance of national policies, the accelerated transfer, diffusion and absorption of information technology can promote the development of the modern service industry. According to research by Wang (2013), digital technology innovation is becoming increasingly active, and at the same time, the competitive landscape of knowledge and technology-intensive service industries is also undergoing changes. In this case, the key to the transformation and upgrading of the service industry is to properly handle the deep integration of traditional service industries and information technology, and to cultivate emerging service industries. According to Zhang (2015), in the current economic development, the relative lag of the modern service industry is an existing problem. This situation can be alleviated by promoting the deep integration of information technology and the service industry and relying on information technology to transform the traditional service industry. Pisano (2015) pointed out that with the major breakthroughs in mobile Internet technology, the economic model based on the Internet platform can achieve instantaneous and accurate matching of traditional service supply and demand, improve the level of personalization and customization of services, and promote the development efficiency of the service industry. Dong (2015) took the integrated development of the Internet and traditional service industries as an entry point and believed that information technology is driving a new round of changes in the service industry and becoming an important point of new economic growth. Zeng and Gao (2016) believe that Internet technological innovation is changing the global industrial structure, giving rise to new service business models, improving the quality of service consumption, improving the efficiency of service supply, and promoting the transformation and upgrading of the service industry.

To sum up, although domestic and foreign scholars have begun to pay attention to the positive role of information technology in promoting the transformation and upgrading of the service industry and believe that it is an important means to break through the "bottleneck" of the development of the service industry, it is still difficult to promote the transformation and upgrading of the service industry in the development of the digital economy. There is still a big

lack of theoretical mechanism and empirical research. In addition, because the development level of the service industry in the western region is lower than that in the eastern region, there are relatively few specific studies on the transformation and upgrading of the service industry in the western region. This article explores its impact on the transformation and upgrading of the western service industry from the two perspectives of Internet popularization "dividends" and digital inclusive finance brought about by the development of the digital economy, based on prefecture-level city data from 2016 to 2020. Due to the complexity and variability of the internal structure of the service industry, there are inconsistent views on the classification of the service industry, and then the definitions and connotations of the internal industrial structure upgrade of the service industry are also diverse. When studying the relationship between the industrial structure and productivity of the service industry, Baumol (1967) pointed out that there are traditional sectors and high-end sectors within the service sector. He believes that only when production factors flow to advanced high-end sectors can the transformation and upgrading of the service industry be realized, thereby promoting the improvement of service industry productivity. The connotation of defining the upgrading of the service industry structure is the expansion of the proportion of the high-end service sector, and the degree of advanced service structure is defined as including information transmission, computer services and software industries, finance, leasing and business services, scientific research, technology. The proportion of employees in the service and geological exploration industries has increased.

2. Theoretical Analysis of the Promotion Mechanism and Effects of Digital Economy on the Transformation and Upgrading of the Service Industry in the Western Region

The development of the digital economy has changed people's production and lifestyle today. Among them, the popularization of the Internet and the development of digital inclusive finance brought about by the development of the digital economy have played an important role in the transformation and upgrading of the service industry.

2.1. Internet Popularization and Transformation and Upgrading of the Service Industry

With the development of the digital economy, digital technology has accelerated its comprehensive penetration and integration into the service industry. As a low-cost infrastructure for processing information, the new element of the Internet not only implants new genes into the traditional service industry, making it flourish; it has also spawned many new service industries. With the rapid development of the digital economy, the Internet has become an indispensable and important production factor in the service industry, which has had a comprehensive impact and promoted the upgrading of the industrial structure of the service industry. In this context, the Internet, as a service tool, combines with the demand side and supply side of the traditional service industry to promote the transformation and upgrading of the traditional service industry into the modern service industry.

First, the popularization of the Internet promotes the transformation and upgrading of the service industry from the perspective of supply and demand mechanisms. With the popularization of the Internet, the sharing economy, as a newly developed model, has

facilitated the supply and demand of the service industry. The role of the Internet economy in the service industry is not only reflected in technology, but also in that it changes the way of collaboration and communication within the service industry and enhances trust and cooperation between organizations. This change provides a new interpretation framework for the supply mechanism of the service industry, makes the division of labor and collaboration in the service industry more efficient and flexible, and creates better conditions for the transformation and upgrading of the service industry. Wong et al. (2015) believe that the popularization of the Internet is conducive to broadening service consumption channels and increasing opportunities for service supply mechanisms; with the popularization of Internet technology on the demand side, the sharing economy has become a new business model, through timely collection, sorting, transmission and analysis of services Data in the marketing and consumption process accurately reflect the rules of service consumption activities and service innovation needs. These data elements provide an important information basis for promoting the transformation and upgrading of the service industry. Therefore, the popularity of the Internet has become the main engine driving the rapid growth of service consumption in the Internet era. Therefore, we can conclude that the increase in Internet penetration included in the development of the digital economy enables the use of mobile Internet technology platforms in terms of service supply and demand to achieve timely matching and coordination of service supply and demand, improve service supply efficiency, and promote service transformation and upgrading.

Second, the popularization of the Internet has reduced the transaction costs of service supply and demand, helping the service industry to transform and upgrade. A typical feature of service consumption is that the service provider and the consumer are very close in time and space, which means that before consumption, the consumer is usually at an information disadvantage. Information asymmetry may cause consumers to make adverse choices, which will affect the healthy operation of the market and even cause bad money to drive out good money. The popularization of the Internet can largely overcome the information asymmetry problem that exists in the service consumption process. Adda and Saad (2014) believes that the Internet model has changed the environment and norms of traditional business competition, providing an opportunity to cultivate new business rules for service consumption. In addition, Wang (2015) pointed out that the development of China's modern service industry requires the help of "Internet +" and sharing economic platforms, and the development and popularization of the Internet provide strong technical support for the innovation of new service business models. The popularization of the Internet under the development of digital economy has created a good trading environment for the transformation and upgrading of the service industry.

2.2. The Impact of Digital Inclusive Finance on the Transformation and Upgrading of the Service Industry

Digital inclusive finance is a new type of financial service based on the combination of Internet digital technology and finance. Through its innovative functions and wide range of service objects, it makes up for the shortcomings of traditional financial services and meets

the needs of broad social groups for financial services. It also Promoted the transformation and upgrading of the service industry.

First, digital inclusive finance reduces the financing costs of service industry companies and promotes the upgrading of the service industry structure. High-end manufacturing is generally a knowledge-intensive industry, so it requires greater financial support than labor-intensive industries, and therefore has higher financing needs. The impact of digital inclusive finance on the structural upgrading of the service industry can be realized through two channels: direct and indirect. On the direct path, digital inclusive finance is more convenient than traditional financing channels and can reduce corporate financing costs, thereby promoting the transformation and upgrading of the service industry; on the indirect path, digital inclusive finance can alleviate financing difficulties in the manufacturing industry and promote local The upgrading of the manufacturing industry will create demand for high-end service industries and further promote the upgrading of the service industry. In addition, digital inclusive finance has different impacts on different levels of service industries. For non-high-end service industries, they can cope with unfavorable factors such as increased costs by raising product prices, while high-end service industries are more sensitive to increased costs. It may cause the industry to shrink and hinder the transformation and upgrading process of the service industry. Therefore, digital inclusive finance promotes the transformation and upgrading of the service industry by easing the financing difficulties of modern service companies.

Second, digital inclusive finance can promote the transformation and upgrading of the service industry by improving the service factor market. The development of digital inclusive finance can reduce the "pickiness" of financial services for various industries in the service industry through inclusive financial services, ensure "equal treatment", especially provide convenient financial services for small and medium-sized service enterprises, and reduce the capital factor Problems such as structural imbalance in the service industry caused by distorted allocation. Digital inclusive finance relies on the support of digital technology. Its rise has given rise to the rapid development of Internet information technology and financial technology, promoted the improvement of relevant scientific and technological talents, improved the quality of production factors, optimized the allocation of resources, and also promoted It has promoted the digital transformation of service-oriented enterprises, thereby promoting the upgrading and development of the service industry.

To sum up, this article believes that the development process of the digital economy, the popularization of the Internet and the development of digital inclusive finance will promote the upgrading of the service industry structure in terms of service industry supply and demand, transaction costs, financing and resource allocation.

3. Pre-judgment and Difference Analysis of the Transformation and Upgrading of the Service Industry in the Three Western Regions

3.1. Descriptive Analysis of the Upgrading of Service Industry Structure in Western Provinces

It is generally believed that the increase in the proportion of producer services and high-end services in the service industry will help alleviate Baumol's "cost disease" and realize the

optimization and upgrading of the internal structure of the service industry (Eichengreen & Gupta, 2013). Therefore, drawing on the estimation ideas of Yu and Pan (2019) and Wang et al. (2020), this paper uses the proportions of producer services and high-end services in the total number of employees in the service industry to describe the structure of the service industry. Among them, the producer services mainly include transportation, warehousing and postal services, information transmission, computer services and software, finance, leasing and commercial services, scientific research, technical services and geological exploration. Considering the existence of some traditional service industries in the transportation, warehousing and postal industries, this paper defines the high-end service industry as the other four industries in the producer service industry in addition to the transportation, warehousing and postal services.

By measuring the advanced level of the service industry structure in the western region from 2016 to 2020, the results are shown in Table 1.

Table 1. Advanced index of service industry structure in western provinces

	2016	2017	2018	2019	2020
Inner Mongolia Autonomous Region	0.1626	0.1652	0.1757	0.2002	0.2213
Guangxi Zhuang Autonomous Region	0.1597	0.1582	0.1644	0.1635	0.1632
Chongqing	0.1866	0.1772	0.1694	0.1806	0.2124
Sichuan Province	0.2111	0.2072	0.2131	0.2089	0.2079
Guizhou Province	0.1371	0.1393	0.1430	0.1573	0.1725
Yunnan Province	0.1508	0.1557	0.1552	0.1668	0.1790
Tibet Autonomous Region	0.1328	0.1104	0.0994	0.1507	0.1842
Shaanxi Province	0.2056	0.2030	0.2081	0.2221	0.2341
Gansu province	0.1444	0.1630	0.1349	0.1536	0.1721
Qinghai Province	0.1989	0.1879	0.1791	0.1970	0.2105
Ningxia Hui Autonomous Region	0.1938	0.1783	0.1685	0.1947	0.2176
Xinjiang Uygur Autonomous Region	0.1675	0.1754	0.1685	0.1678	0.1736

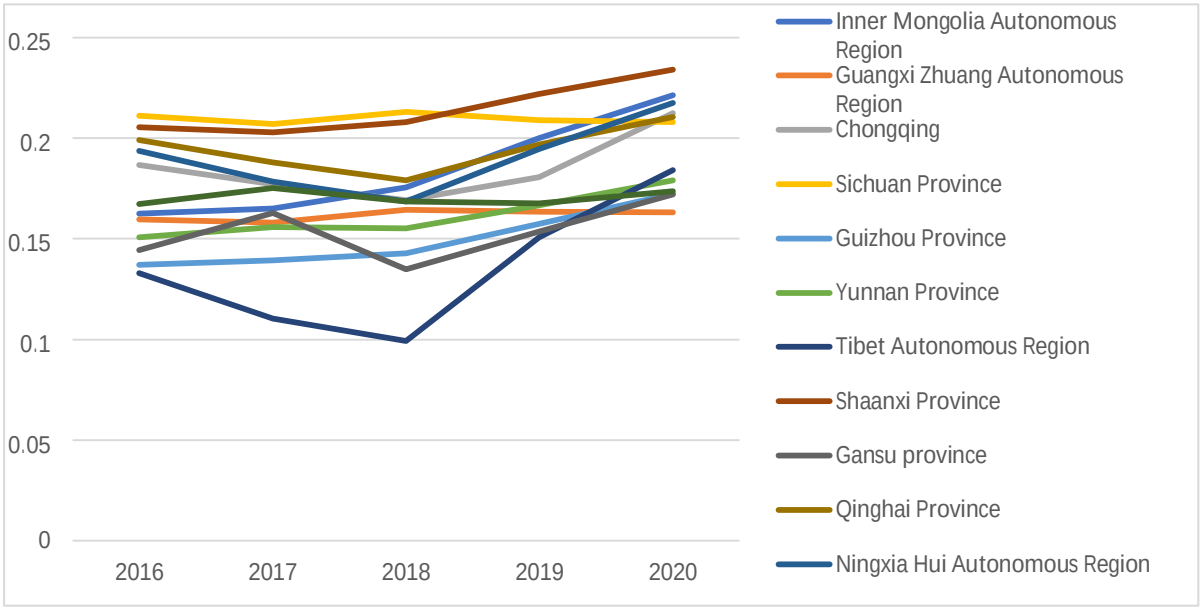

Figure 1. Changes in the upgrading of the service industry structure in western provinces in years 2016-2020 (vertical axis = the industrial structure advanced index)

In order to more clearly observe the changes in the degree of advanced service industry structure in various western provinces, Figure 1.

As shown in Figure 1, the overall level of service industry structure in various western provinces tends to be advanced, and the index of advanced service industry structure has increased. The Tibet Autonomous Region showed a trend of first declining and then rising during the sample investigation period, and overall, the service industry structure advanced index increased by 38.7% in 2020 compared with 2016, making it the region with the largest increase in the west; Shaanxi Province and Sichuan Province the average service industry structure upgrading index is at the forefront of the western provinces. The reason is that these provinces have better economic development in the western region, so talents, capital and other factors flow to these provinces, especially Xi'an and Chengdu, which are the economic pillars of the western region. In "bridgehead" cities, the modern service industry has advantages over other regions in terms of factor supply and service consumption, which has accelerated the transformation and upgrading of the service industry in these regions. At the same time, Shaanxi Province and Sichuan Province have a relatively high level of digital economic development. Based on the above analysis, it can also be seen that they have a promoting effect on the upgrading of the service industry structure. The average value of the advanced industrial structure index in Guizhou Province is 0.14984, ranking second from the bottom, only higher than the Tibet Autonomous Region. According to the "China Digital Economy Development White Paper (2020)" released by the China Academy of Information and Communications Technology, Guizhou Province's digital economy grew at a growth rate of 22.1% in 2019, ranking first in the country for five consecutive years. Its digital economy has developed rapidly, but its level of advanced service industry structure is low. The reason is that the traditional service industry in Guizhou Province has developed relatively slowly, and the ability to combine digital technology with the service industry still has great potential. That is, the level of "service digitalization" needs to be improved, which has led to Guizhou Province's The service industry structure is not sufficiently advanced.

3.2. Decomposition of Dagum Gini Coefficient of Service Industry Structure Upgrading Index in Western Provinces

In the previous section, we compared the gaps and changes in the upgrading of service industry structures in various western provinces. This section explores where the differences come from. This article reveals the regional differences and sources of the transformation and upgrading of the service industry in western provinces based on the Gini coefficient proposed by Dagum (1997). The coefficient is divided into intra-regional contribution G_w, inter-regional contribution G_{nb} and hyper-variable density contribution G_t, and the relationship between the three is $G = G_w + G_{nb} + G_t$. The specific method is as follows:

$$G = \frac{\sum_{j=1}^{k}\sum_{h=1}^{k}\sum_{i=1}^{n_j}\sum_{r=1}^{n_h}|y_{ji} - y_{hr}|}{2n^2\mu} \quad (1)$$

Among them, *G* represents the overall Gini coefficient; *k* is the number of provinces; *n* is the total number of cities in the west; in this article *n* is 95; and $n_j(n_h)$ is the number of cities

in the j(h) province; $y_{ji}(y_{hr})$ is the j(h) province Internal urban service industry structure upgrading index; μit is the average value of all urban service industry structure upgrading indexes. Before decomposing the Dagum Gini coefficient, it is necessary to sort the average values of the service industry structure premium index in each province from small to large.

$$\bar{y}_1 \le \bar{y}_2 \le \cdots \le \bar{y}_j \le \cdots \le \bar{y}_k \tag{2}$$

$$G_{jj} = \frac{1}{2\mu n_j^2}\sum_{i=1}^{n_j}\sum_{r=1}^{n_j}\left|y_{ji} - y_{ir}\right| \tag{3}$$

$$G_{jh} = \frac{\sum_{i=1}^{n_h}\sum_{r=1}^{n_h}\left|y_{ji} - y_{hr}\right|}{n_j n_h(\mu_j - \mu_h)} \tag{4}$$

The above formulas respectively represent the Gini coefficient of the j province G_{jj} and the inter-regional Gini coefficient of provinces *j* and *h*. $\bar{y}_j$ and $\bar{y}_h$ represent the service industry structure upgrading index of province *j* and province *h* respectively; n_j and represent the number of cities included in province n_h j and province *h* respectively. Furthermore, the overall Gini coefficient is decomposed into intra-regional Gini coefficient, inter-regional Gini coefficient and hypervariable density, as shown in the formula:

$$G = G_w + G_{nb} + G_t$$

The following formulas describe the calculation methods of intra-regional Gini coefficient, inter-regional Gini coefficient and hypervariable density respectively:

$$G_w = \sum_{j=1}^{k} G_{jj}P_jS_j \tag{5}$$

$$G_{nb} = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(p_j s_h + p_h s_j)D_{jh} \tag{6}$$

$$G_t = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(p_j s_h + p_h s_j)(1 - D_{jh}) \tag{7}$$

in, $p_i = \frac{n_j}{n}, s_j = (n_j\bar{y}_i)/(n\bar{y})$. Moreover, $\sum p_j = \sum s_j = \sum_{j=1}^{k}\sum_{h=1}^{k} p_j s_h = 1$。 D_h it represents the relative impact of the degree of service industry upgrading between the j and h regions , and the calculation formula is :

$$D_{jh} = \frac{(d_{jh} - p_{jh})}{(d_{ih} - p_{jh})} \tag{8}$$

In the following formula, d_{jh} and p_{jh} respectively represent the mathematical expectation of the sum of all sample values in provinces $y_{ji} > y_{hr}$j and h and the average of the sum of all sample values in provinces j $y_{ji} < y_{hr}$ and h. The calculation formulas for both are as follows. Among them, F_j、F_h represent the cumulative distribution function of *j* and *h* regions respectively.

$$d_{jh} = \int_0^{\infty} dF_j(y) \int_0^{y} (y - x) dF_h(x) \quad (9)$$

$$p_{jh} = \int_0^{\infty} dF_h(y) \int_0^{y} (y - x) dF_j(x) \quad (10)$$

3.3. Analysis of Differences in the Upgrading of the Service Industry Structure in Western Provinces

Overall difference analysis

Based on the Gini coefficient mentioned above, the degree of urban service industry upgrading in 12 western provinces from 2016 to 2020 was calculated. Since Chongqing is one of the four major municipalities in China, the Gini coefficient cannot be calculated, so it was eliminated. According to the data in Table 2, the average Gini coefficient of the overall advanced service industry structure in western provinces during the investigation period was 0.2353, showing an overall fluctuating trend.

Table 2. Advanced index of service industry structure in western provinces

	2016	2017	2018	2019	2020
overall	0.2262	0.2464	0.2424	0.2151	0.2462
Yunnan Province	0.1891	0.2156	0.2317	0.1993	0.2031
Xinjiang Uygur Autonomous Region	0.2970	0.3116	0.3003	0.2563	0.2323
Shaanxi Province	0.1981	0.1981	0.1891	0.1895	0.2368
Sichuan Province	0.1661	0.1642	0.1512	0.1354	0.2071
Tibet Autonomous Region	0.5056	0.6276	0.5748	0.3991	0.4534
Inner Mongolia Autonomous Region	0.1178	0.1171	0.1412	0.1646	0.1885
Qinghai Province	0.1840	0.1625	0.1287	0.1891	0.2317
Ningxia Hui Autonomous Region	0.1848	0.1568	0.1424	0.1675	0.2342
Gansu province	0.2507	0.2835	0.2450	0.2415	0.2665
Guangxi Zhuang Autonomous Region	0.1636	0.1737	0.1931	0.1590	0.1551
Guizhou Province	0.1388	0.1392	0.1332	0.0824	0.0702

Analysis of intra-regional differences

As can be seen from Table 2, the level of intra-regional differences in the 12 provinces in western China shows a differentiated evolution trend. During the inspection period, the highest annual mean value of difference within the region was in the Tibet Autonomous Region, reaching 0.5121; followed by the Xinjiang Uygur Autonomous Region (0.2795), Gansu Province (0.2574), Yunnan Province (0.2078), Shaanxi Province (0.2023), and Qinghai Province (0.1792), Ningxia Hui Autonomous Region (0.1771), Guangxi Zhuang Autonomous Region (0.1689), Sichuan Province (0.1648), Inner Mongolia Autonomous Region (0.1458), Guizhou Province has the lowest annual mean value of intra-regional difference, only 0.1128. The general Gini coefficient within the western provinces shows a trend of " one super and many strong", that is, the difference value within the Tibet Autonomous Region from 2015 to 2021 far exceeds that of other provinces, and the difference values of the remaining 11 provinces during the investigation period are all the same. The difference is not big and shows a state of fluctuation. Among them, Xinjiang Uygur Autonomous Region, Guangxi Zhuang Autonomous Region and Guizhou Province generally show a downward trend, indicating that

the degree of advanced service industry structure among the cities in the province is relatively average and the differences gradually become smaller; the differences within the remaining provinces All have expanded more or less. Taking a closer look at the data, we found that the widening gap in the degree of advanced service industry structure between central cities in some provinces and other cities in the province has caused an increase in the Gini coefficient value within the province. The reason is, Cities with strong "siphon" effects such as Xi'an and Chengdu attract talents and funds, resulting in uneven urban development, which in turn leads to a large gap between the levels of modern service industries.

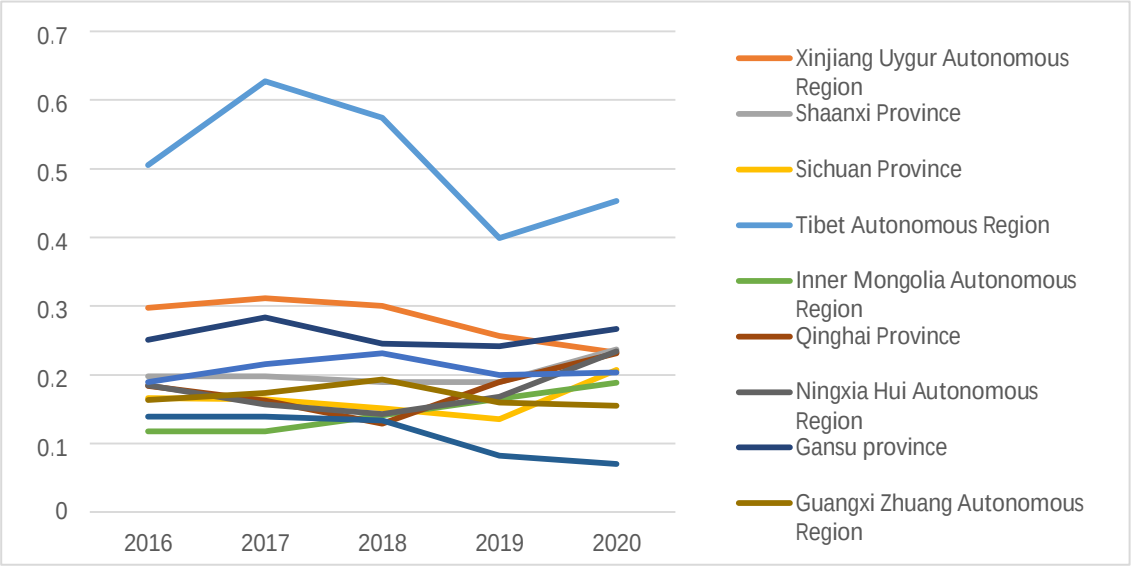

Figure 2. Changes in intra-provincial differences in the advanced service industry structure in western provinces. The horizontal axis in the figure is the year, and the vertical axis is the Gini coefficient.

Provincial difference contribution rate

Table 3 shows the overall sources of differences in the degree of advanced service industry structure in 12 provinces in China. It can be seen that the differential contribution rate of hypervariable density is the highest, with an average annual contribution rate of 48.1% during the investigation period; followed by the inter-regional contribution rate, with an annual average value of 42.418%; the contribution rate within a region is the smallest, with an annual average value of 9.242%. Obviously, the most important sources of overall differences in the upgrading of the service industry structure in western provinces are hypervariable density and inter-regional differences. It shows that narrowing the gap in the transformation and upgrading development of the service industry among the western provinces should focus on resolving inter-regional differences, and the modern service industry in the western provinces should develop collaboratively.

Table 3. Differential contributions to the upgrading of service industry structure in western provinces

years	2016	2017	2018	2019	2020
Within the area	9.42%	8.97%	8.78%	9.17%	9.87%
interregional	40.81%	40.25%	48.32%	43.18%	39.53%
hypervariable density	49.77%	50.78%	42.9%	47.65%	49.4%

4. Empirical Research on Digital Economy Driving the Transformation and Upgrading of Service Industry in Western China

4.1. Research Design

Data source

The data used in this article come from the China Urban Statistical Yearbook and the Western Region Provincial Statistical Yearbook. The time span is from 2016 to 2020. The research scope includes 12 provinces in the Western Region, covering 95 prefecture-level cities. To ensure the reliability of the data, the original data were processed and standardized, and interpolation was used to fill in some missing values. Additionally, winsorization was performed to avoid outliers or extreme values from adversely affecting the results.

Variable description

Interpreted variable. The degree of upgrading of the service industry structure *upgrade*. This article considers using the development level of the high-end service industry to measure the structural upgrading of the service industry. When selecting indicators, this article refers to the research methods of Yu and Pan (2019) and uses the proportion of high-end service industry employees as the research indicator to reflect the degree of sophistication of the service industry structure.

Explanatory variables. Digital economy *Dige*. There is currently a lack of comprehensive measurement research on the development level of the digital economy. The focus of this study is to explore the impact of Internet popularization and digital inclusive finance on the transformation and upgrading of the service industry. To this end, we draw lessons from the measurement core of Zhao (Zhao et al., 2020) and others, and combine the index construction ideas of digital financial inclusion to measure Internet development at the city level. Specifically, four indicators are used to measure the level of Internet development: Internet penetration rate, related employees, related output, and mobile phone penetration rate. Data for these indicators can be obtained from the China Urban Statistical Yearbook. In addition, in order to measure the development level of digital finance, this article uses the China Digital Financial Inclusion Index. By standardizing and reducing dimensionality of the above indicators, the digital economy development index *Dige* was obtained.

Control variables.

- The level of economic development *agdp*. The level of economic development in a region often affects the industrial structure of the local service industry. The per capita consumption levels in different regions often lead to different consumption structures. In turn, the consumption structure of the region affects the changes in the industrial structure of the service industry. This article chooses the logarithm of per capita GDP (yuan) of prefecture-level cities as an indicator of the level of people's economic development.
- Urbanization level *urban*. Different regions have different urbanization levels that will have an impact on the transformation and upgrading of the service industry. The difference in consumption between urban and non-urban populations affects the degree of transformation and upgrading of the local service industry. Therefore, the proportion

of the urban population to the total population of the city is selected. (%) as an indicator of this variable.

- City *size scale*. The size of a city has an impact on the transformation and upgrading of the service industry. A larger city has a larger market in terms of service supply and demand. At the same time, economies of scale can also help improve the production efficiency of the service industry and promote the transformation and upgrading of the service industry. Therefore, this article the logarithm of the total population of prefecture-level cities was chosen as the indicator of this variable.
- The level of human capital accumulation *university*. The transformation and upgrading of the service industry means that the regional service industry gradually transforms from a labor-intensive to a knowledge-intensive industry. Therefore, it will be affected by the level of human capital accumulation. Therefore, the logarithm of the number of universities in prefecture-level cities is chosen as this indicator.

Model construction

In order to study the impact mechanism of digital economic development on the transformation and upgrading of the service industry in the western region, this study constructed the following econometric model:

$$upgrade_{it} = \alpha + \beta_0 Dige_{it} + \beta_1 agdp_{it} + \beta_2 urban_{it} + \beta_3 scale_{it} + \beta_4 university_{it} + \varepsilon_{it}$$

Among them, *i* represents the prefecture-level city, and *t* represents the year. The following table lists the variables used in this study and their data characteristics.

Table 4. Descriptive statistics of variable indicators

variable	Number of samples	mean	standard deviation	minimum value	maximum
upgrade	475	0.150	0.058	0.046	0.411
Dige	475	0.203	0.531	-0.920	3.439
agdp	475	10.674	0.525	9.384	12.281
urban	475	0.974	0.220	0.079	1.107
scale	475	5.642	0.801	3.045	8.136
university	475	1.142	1.102	0	4.174

4.2. Empirical Analysis

Regression Analysis

In order to effectively process and analyze panel data, it is necessary to take into account the endogeneity and heterogeneity of the model and select an appropriate estimation method. Panel data models usually have three forms, namely mixed estimation models, fixed effects models and random effects models, among which fixed effects and random effects models are both variable intercept models. This study first uses the mixed regression model for verification, and uses the F test to determine whether the mixed regression estimation method is used. However, the regression results show that the regression coefficients of the explanatory variables on the explained variables are not significant, and the F test results reject the null hypothesis at the 1% significance level. Since the mixed estimation model requires that there are no significant differences between individuals in time and cross-section, it can be speculated that using mixed regression that ignores sample characteristics may lead to biased

Table 5. Descriptive statistics of variable indicators

variable	Model
Dige	0.204* (0.076)
agdp	0.029*** (0.006)
urban	0.068*** (0.013)
scale	-0.007 (-1.59)
university	0.017*** (0.00)
Constant term	-0.189* (0.07)
Hausman test	10.08*** [0.0000]
Observations	475
R-squared	0.552

Note: ***P < 0.01, **P < 0.05, *P < 0.1. The t value is in () and the P value is in [].

empirical analysis results. Next, we use the Hausman test to determine whether the fixed effects model or the random effects model is the optimal estimation method.

According to the regression results in Table 5, the results obtained using the fixed effects model are optimal. In addition, the Hausman test was used to test whether there is a correlation between the random disturbance term and the explanatory variable. The result showed that the P value was less than 0.01, rejecting the null hypothesis that the random disturbance term has nothing to do with the explanatory variable. This further supports that the fixed effects model is optimal. conclusion.

According to the regression results in Table 5, after controlling for per capita GDP, urbanization level, city size, human capital accumulation level and other factors, the regression coefficient of the explanatory variable is 0.204. This regression coefficient has been tested at the 10% significance level, proving that the level of digital economy development has a positive effect on the optimization and upgrading of the service industry industrial structure. This means that increasing investment in digital economy construction and improving the development level of the digital economy will help optimize the industrial structure of the western service industry. According to the above analysis, the reason is that the popularization of the Internet and the development of digital inclusive finance in the development of the digital economy have provided support for the smooth promotion of the transformation and upgrading of the service industry. In terms of supply and demand in the service industry, the development of the digital economy has broadened information communication channels and reduced transaction costs, and has significant positive external effects on the transformation and upgrading of the service industry; at the same time, the development of the digital economy has directly and indirectly affected corporate financing. Played an important role in reducing costs. The development of the digital economy helps optimize resource allocation in the service industry. It can reduce the degree of information asymmetry, accelerate the flow of data, labor, capital and other factors, thereby improving the efficiency of resource allocation. In

addition, the development of the digital economy has also promoted the development of the service industry in a knowledge-intensive direction, transforming the service industry from a traditional labor-intensive to a technology-intensive one.

Regarding the control variables, according to the results in the table, the economic development level has a significant regression coefficient of 0.029 at the 1% significance level, which shows that with the improvement of the regional economic development level, the service industry industrial structure has been optimized and upgraded. This is because in the process of economic growth, the market system has been improved and the free flow of factors has accelerated, thus promoting the transformation and upgrading of the service industry to higher quality. The regression coefficients of the urbanization level in the model are 0.068 respectively, and they are all significant at the 1% level, reflecting a positive correlation between the urbanization level and the optimization and upgrading of the service industry structure. The improvement of the urbanization level is conducive to the manufacturing industry structure. adjustment. It shows that continuing to increase the free flow of population, coordinating the coordinated development of urban and rural areas, and optimizing the allocation of labor factors can upgrade the structure of the service industry. Utilize the economies of scale of factor aggregation and introduce high-quality resources and advanced technological concepts to provide better conditions and environment for the transformation and upgrading of the service industry.

5. Paths and Policies for Digital Economy to Drive Transformation and Upgrading of Western Service Industry

5.1. Conclusion

This article studies the theoretical mechanism of Internet popularization and digital inclusive finance on the transformation and upgrading of the service industry in the context of the digital economy. By measuring the differences in the degree of advanced service industry structure in western provinces, it is found that the uncoordinated degree of transformation and upgrading of the service industry is the main reason. Next, this paper uses the fixed effects model to conduct an empirical analysis on the panel data of prefecture-level cities in 12 western provinces for a total of 5 years from 2016 to 2020. The results show that the level of digital economy development has a significant promoting effect on the transformation and upgrading of the service industry. The popularization of the Internet has reduced internal transaction costs and information asymmetry in the service industry, while digital financial inclusion has reduced financing costs and enabled the service industry to develop in a knowledge-intensive direction. The popularization of the Internet has reduced the cost of information collection for service industry companies and consumers in terms of demand and supply, and at the same time reduced the mismatch of consumer information. With the rapid development of the digital economy, digital elements and the service industry continue to integrate and integrate with each other, enabling the optimal allocation of resources and thus realizing a new situation in the industrial structure.

5.2. Policy Recommendations

First, in order to promote the transformation and upgrading of the service industry in the western region, the government should formulate targeted policies to encourage and guide the development of digital industries in the region. Policy formulation should take into account the actual conditions of different regions. For example, in terms of Internet penetration, policies can increase Internet penetration by increasing investment and financial support in information facilities, strengthening network coverage and bandwidth and other hardware facilities. Regarding talent introduction policies, the government can encourage digital industry enterprises to develop in the western region through funds and tax incentives, and at the same time provide training and talent services. In addition, for the development of the digital service industry, the government can increase support for small and medium-sized enterprises, establish digital service industrial parks, encourage enterprises to transform and upgrade, provide more diversified digital services, and promote the coordinated development of the industry. Policy formulation should take into account regional characteristics and differences, adapt measures to local conditions, and improve the pertinence and effectiveness of policy implementation.

Second, the government should actively promote the integration and innovation of digital technology and service industry, cultivate the sharing economy and new economic growth points, provide an open environment for mass entrepreneurship and innovation, and provide strong support for the transformation and upgrading of the service industry. The government can encourage financial institutions to increase financial support for technological innovation in digital economy and service industry enterprises, and at the same time increase credit support for digital inclusive finance to service industry enterprises. In addition, the government should also build a digital empowerment platform to promote the digital transformation of traditional service industries, promote the coordinated development of all links in the service industry chain, and form a more open, inclusive, and collaborative digital ecosystem.

Third, the government should strengthen the integration of digital economy and service industry-related technologies, promote the digital transformation of traditional service industries, improve the digital level of service industry enterprises, and improve service quality and efficiency. The government can set up an innovation and entrepreneurship fund for Internet technology talents to encourage Internet technology talents to actively participate in digital transformation, promote the deep integration of the digital economy and the service industry, create a public service cloud platform for the transformation and upgrading of traditional service industries and small and medium-sized service enterprises, strengthen demonstration effects, and focus on Use multiple resources to build an innovation and entrepreneurship platform to help service industry enterprises transform and upgrade.

Fourth, the government should increase investment in the digital economy industry, solve key symbiotic issues among enterprises during the transformation of traditional industries, and achieve healthy operation of the ecosystem. The government can guide enterprises to increase investment in digital transformation, support the development of

digital economy and service industry enterprises, promote the upgrading of the digital industry, cultivate new momentum for the digital economy and service industry, and improve the "digital industrialization" level of western cities. At the same time, the government should explore new models for the development of the sharing economy, promote the development of new digital industries, pay attention to the coordinated development of the digital economy and the service industry, apply new technologies such as blockchain and quantum technology to the digital economy industry, and promote the development of the digital economy industry, innovation and upgrade.

Conflict of interest: none.

References

Adda, M., & Saad, R. (2014). A Data Sharing Strategy and a DSL for Service Discovery, Selection and Consumption for the IoT. *Procedia Computer Science*, *37*, 92–100. https://doi.org/10.1016/j.procs.2014.08.017

Baumol, W. J. (1967). Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis. *American Economic Review, 57*(3), 415–426.

Dagum, C. (1997). A New Approach to the Decomposition of the Gini Income Inequality Ratio. *Empirical Economics, 22(*4), 515–531. https://doi.org/10.1007/BF01205777

Dong, P. (2015). Industrial Internet promotes the upgrading of China's service industry. *Enterprise Economics, 3*, 10–13.

Eichengreen, B., & Gupta, P. (2013). The Two Waves of Service-sector Growth. *Oxford Economic Papers, 65*(1), 96–123. https://doi.org/10.1093/oep/gpr059

Kaplinsky, R., & Morris, M. (2012). *A Handbook for Value Chain Research.* IDRC.

Pisano, P. (2015). Identify Innovative Business Models: Can Innovative Business Models Enable Players to React to Ongoing Trends? *Journal of Entrepreneurship Research, 3*, 181–199. https://doi.org/10.1515/erj-2014-0032

Wang, Z. (2013). Current status, trends and impact of global technological innovation on China. *Business Times, 5*, 57–60.

Wang, X. (2015). Leading the transformation and upgrading of Guangdong's service industry with the Internet. *Scientific Management Research, 12,* 13–15.

Wang, W., Niu, Z., & Sun, Z. (2020). Service industry under the impact of industrial robots: structural upgrading or low-end locking. *Statistical Research, 37*(7), 54–65.

Wong, C. W. Y., Lai, K., Cheng, T. C. E., & Lun, Y. H. V. (2015). The role of IT-enabled collaborative decision making in inter-organizational information integration to improve customer service performance. *International Journal of Production Economics*, *159*, 56–65. https://doi.org/10.1016/j.ijpe.2014.02.019

Yu, Y., & Pan, Y. (2019). The mystery of the coexistence of China's rapid economic growth and lagging service industry structural upgrade - an explanation based on the perspective of local economic growth target constraints. *Economic Research, 54*(3), 150–165.

Zhang, L. (2015). The value creation model of the sharing economy and its impact. *Academic Frontiers, 10*, 22–24.

Zeng, S., & Gao, Y. (2016). The mechanism, path and countermeasures of Internet technology innovation driving the transformation and upgrading of the service industry. *Journal of Hunan University of Science and Technology, 19*(5), 123–127.

Zhao, T., Zhang, Z., & Liang, S. (2020). Digital economy, entrepreneurial activity and high-quality development - Empirical evidence from Chinese cities. *Management World, 36*(10), 65–76.