Research on the Statistical Measurement and Improvement Paths of Service Industry Productivity in the Context of the Digital Economy

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Abstract: In the context of the digital economy, the development of all industries has been greatly influenced. Industry development models have been innovated, driving improvements in product production and service efficiency. Among all industries, the service industry has the highest degree of integration with the digital economy. Digital technologies have fully penetrated the service industry, exerting a significant impact on its productivity. Starting from the connotation and development status of the digital economy, this paper analyzes the relationship between the digital economy and the productivity of the service industry, studies the statistical measurement and improvement paths of service industry productivity under the background of the digital economy, and aims to further promote the integration of the digital economy and the service industry, contributing to high-quality economic development.

***Keywords*:** digital economy; service industry productivity; statistical measurement; improvement paths

1. Introduction

At present, China's economy is in a critical period of transition from high-speed growth to high-quality development, making the transformation and upgrading of the economic structure particularly important. Since the reform and opening-up, influenced by economic development, the proportion of the primary industry in the industrial structure has continued to decline, the proportion of the secondary industry first rose and then fell, while the proportion of the tertiary industry has continuously increased. The service industry has begun to dominate the economy, marking China's entry into the service economy era. Under the background of the digital economy, the productivity of the service industry is greatly affected by the digital economy. Conducting accurate statistical measurements and researching the paths to improve service industry productivity are of positive significance to the development of both the service industry and the broader economy and society.

2. Overview of the Digital Economy

The digital economy itself is a novel economic form, with economic development as its core support. When combined with the internet and data as production factors, it can effectively accelerate the digitalization process of various industries and deeply integrate with digital industries. According to the China Digital Economy Development Index Report (2024), in 2023, the scale of China’s digital economy reached 53.9 trillion yuan, an increase of 3.7 trillion yuan year-on-year. The role and status of the digital economy in the national economy have gradually emerged, and its integration with the real economy continues to deepen. The penetration rates of the digital economy into the primary, secondary, and tertiary industries reached 10.78%, 25.03%, and 45.63%, respectively.

At present, on a global scale, the digital economy has developed into a main driving force for rapid economic growth and can also promote the transformation and upgrading of industrial structures [1]. Domestically, the digital economy has maintained a relatively high growth rate for many consecutive years, exceeding the GDP growth rate of the same period, and has gradually become an important force driving economic growth (see Table 1).

Table 1. Development of China's Digital Economy from 2017 to 2023

Year	GDP Growth Rate (%)	Digital Economy Growth Rate (%)	Digital Economy Scale (Trillion Yuan)	Proportion of Digital Economy in GDP (%)
2017	6.9	20.3	27.2	32.9
2018	6.8	20.9	31.3	34.8
2019	6.1	15.6	35.8	36.2
2020	3.1	9.7	39.2	38.6
2021	8.1	16.2	45.5	39.8
2022	3.1	10.3	50.2	41.5
2023	5.4	7.39	53.9	42.8

3. The Relationship Between the Digital Economy and Service Industry Productivity

The mechanism by which the digital economy improves the productivity of the service industry includes employment substitution effects, structural dividend effects, and economies of scale. It can influence the productivity of the service industry from the following aspects:

3.1 Changing the Production Function

With the rapid development of technologies such as big data, the Internet of Things, and artificial intelligence, data has become a new factor of production and a strategic resource. Traditional forms of the production function have not incorporated data as an endogenous production factor. The value added generated by data factors and digital technology has formed a corresponding substitution relationship with traditional production factors and technologies. While traditional factors of production are subject to the law of diminishing marginal returns, data factors are different—they possess high technological content and characteristics of economies of scale. With the rational input of data resources, the productivity of the service industry can be improved, thereby providing effective support for the transformation and development of traditional service industries.

3.2 Accelerating the Economic Cycle

The economy and society have a complete dynamic cycle process, including production, distribution, circulation, and consumption. In this cycle, each link generates corresponding information flows, such as resource usage information in the production link, product allocation information in the distribution link, logistics information in the circulation link, and payment information in the consumption link. In the past, due to limitations in the development level of information and communication technology, the efficiency of information flow within the economic cycle was relatively low, which restricted the effectiveness of these processes. In the context of the digital economy, the development of information technology has enhanced the interactivity of data and information at each stage, improved the efficiency of information circulation, reduced redundancy in production and circulation, and accelerated the economic cycle. By investing data factors into the production process, synergy between various links can be strengthened, and problems of information asymmetry can be reduced [2].

3.3 Knowledge Spillover Effect

From the connotation of the digital economy, information and communication technology is a form of codified knowledge, which means that the development of the digital economy has the nature of dissemination and diffusion. It can closely connect people and things in reality and even achieve "the Internet of Everything" with the support of the Internet of Things, breaking the spatial limitation of knowledge transmission, thus endowing the digital economy with a knowledge spillover effect. According to Krugman's theory of spatial economics, there are three sources of agglomeration: knowledge spillovers, linkage effects, and thick labor markets. Under the influence of the digital economy, knowledge first spreads and diffuses in universities and research institutions, then spills over to other sectors, thereby boosting the productivity of the service industry.

4. Statistical Measurement of Service Industry Productivity in the Context of the Digital Economy

4.1 Constructing a Multidimensional Indicator System

In constructing an indicator system, the commonly used method is the entropy method. A corresponding digital economy development index is built from three different dimensions: digital infrastructure, digital industrialization, and industrial digitalization. The calculation of service industry productivity often adopts the DEA-Malmquist index method, which can be decomposed into two core elements: technological progress and improvement in technical efficiency.

4.2 Developing an Integrated Measurement Model

Based on the development of the digital economy in China, the integrated measurement model can be comprehensively analyzed using a spatial econometric model. The integration of China's digital economy and service industry shows significant regional heterogeneity: the integration degree in eastern regions reaches 0.58, significantly higher than that in central and western regions (0.32–0.41), thereby creating a corresponding “digital divide.” The main reason for this lies in the significant differences among regions in digital infrastructure construction and digital talent reserves [3].

4.3 Determining Core Statistical Methods

4.3.1 Determining the Index of Service Production

The Index of Service Production (ISP) refers to the change in service industry output during the reporting period relative to the base period after removing price factors. It can reflect short-term fluctuation trends. Taking the base period as 100, if the ISP is greater than 100, it indicates an overall growth in the service industry; conversely, if it is less than 100, it indicates an overall decline in the service industry. The ISP can be calculated using the Laspeyres method, which includes five steps:

(1) Collect representative indicators and deflators for each major category of industries, and conduct preprocessing such as outlier treatment and missing value imputation.

(2) Deflate the representative indicators for each major category of industries to obtain constant-price growth rates.

(3) Based on the quantitative relationship between constant-price index values and constant-price added value growth rates from previous years, determine the production index for each major industry category.

(4) According to the value-added proportion of each major industry category within its broader industry classification, obtain the industry classification production index through weighted synthesis.

(5) Use the proportion of each industry classification in the total value-added of the service industry as weights to calculate the Index of Service Production.

There are two primary sources of basic data in ISP compilation. The first is national statistical survey data, which are obtained from statistical survey projects organized and implemented by the National Bureau of Statistics, including data such as business statistics for real estate development projects, and sales statistics for wholesale and retail trade [4]. The second is departmental statistical data, such as those obtained from the Ministry of Transport and the National Financial Regulatory Administration. The ISP covers market-based activities in 40 major industry categories across 13 industry classifications, including wholesale and retail, transportation, and information technology. It excludes non-market activities (such as non-enterprise units in education and healthcare) and certain major industry categories (such as auxiliary activities in agriculture, forestry, animal husbandry, and fisheries).

4.3.2 Implementing Digital Economy Classification

According to the Statistical Classification of the Digital Economy and Its Core Industries standard, the service industry's digital economy can be divided into two categories. One is digital efficiency-enhancing industries, such as the digitalized segments of traditional service sectors like the digital economy and smart logistics. The other is digital product service industries, which include the wholesale, retail, and leasing of digital products. In the classification of the digital economy, the input-output table can be used to quantify the added value of the service industry's digital economy, while also distinguishing between direct contributions (digital technology application industries) and indirect contributions (industrial digitalization).

5. Paths to Improve Service Industry Productivity in the Context of the Digital Economy

5.1 Direct Technological Empowerment

The application of digital technologies in the service industry can significantly enhance production efficiency. Robots can replace manual labor for repetitive tasks, reducing manpower while improving efficiency. Big data analysis can optimize service processes—for example, applying big data to logistics route planning can provide accurate decision support, improving logistics efficiency by 30%–40%. At the same time, digital technologies can effectively control transaction costs in service production. Through information matching, they shorten the supply-demand connection chain and reduce the costs of information retrieval and negotiation [5]. Moreover, the existence of blockchain smart contracts reduces supervision and default risks, lowering service contract execution costs by 28%.

5.2 Optimization of Factor Allocation

Data resources can partially replace traditional factors. By leveraging data-driven methods, service response speed can be increased, providing users with a better service experience. Meanwhile, digital skills training significantly increases the density of technical service industry talent. Studies have shown that for every 1% increase in technical service talent density, service industry productivity can grow by approximately 0.23%. Digital technologies lower the participation threshold for the service industry to some extent, enhance supply-demand matching efficiency, and lead the optimization of factor allocation in the service sector, resulting in a greater supply of high-quality services. In the context of increasingly diversified market demand and personalized service needs, digital technology, with its high efficiency and low cost, can accurately match market demand, rapidly achieve the minimum economic scale of service provision, and activate high-quality niche markets [6].

5.3 Business Model Innovation

The application of the digital economy in the service industry helps overcome time and space constraints. For example, online education and telemedicine can effectively eliminate spatial barriers, expanding the number of service recipients by 3–5 times. Services such as intelligent customer service and 24-hour unmanned retail extend service hours and improve capacity utilization. Furthermore, the digital economy can activate the long-tail market to some extent. By leveraging digital platforms, niche demands can be aggregated—for instance, customized audiobooks—allowing some low-frequency services to achieve large-scale profitability. The continuous increase in digital penetration in the service industry has given rise to a range of new service formats, such as new retail and the industrial internet.

5.4 Strengthening Intelligent and Digital Leadership

Intelligent digitalization can drive improvements in service industry productivity through element integration and model reconstruction. Taking AI technology as an example, it can empower business processes and replace routine manual operations. For instance, AI-powered audit systems in the financial services sector can reduce the processing time of a single transaction by at least 50% and lower error rates by approximately 70%. Digitalization of the catering supply chain (e.g., Meituan's "Kuailv Procurement") can shorten procurement time for ingredients by at least 80% and increase inventory turnover by around 35%. The use of data factors can promote precise demand matching [7]. For example, Alipay's digital employment platform aggregates over 20 million job listings, improving matching efficiency by 50%. Shopping platforms like Taobao and JD.com build user profiles through intelligent marketing systems, enabling precise service targeting and significantly boosting conversion rates in the retail industry.

5.5 Enhancing Top-Level Design

In the context of the digital economy, governments at all levels should enhance top-level design and promote service industry productivity through systematic policy packages. First, industrial policies should provide precise empowerment. Local governments can encourage enterprises to purchase productive services, such as internet design services, to reduce transformation costs and provide professional support, complemented by special funds to enhance technological empowerment capabilities. The integration of scientific and technological services, manufacturing, and modern logistics can reduce operational costs through industrial chain coordination. At the same time, efforts should be made to expand and improve life-oriented services, innovate consumption scenarios, cultivate new consumption growth points, and activate consumption potential. Second, the innovation of factor guarantee mechanisms should be promoted. The marketization of data factors should be advanced. Local governments can establish whitelists for data service enterprises and cultivate leading companies in data collection and computing storage, driving service industry productivity growth with data factors. Financial and tax policies should tilt in favor of the service industry—for instance, guiding financial institutions to reduce fees and share profits to recover non-performing assets and improve capital utilization efficiency [8].

6. Conclusion

In conclusion, the development of the digital economy can enhance the productivity of the service industry and promote its digital transformation. In practice, the digitalization of productive services should be accelerated, the proportion of the service industry should be increased, and the spatial layout of the digital industry should be optimized to fully leverage the knowledge spillover and economies of scale brought by digital industry agglomeration. In future development, a closed-loop system of "technology–data–institution" should be established to accelerate the replacement of repetitive labor by AI, advance the market-oriented reform of data factors, and promote cross-regional digital collaboration, thereby improving service industry productivity.

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