

Evaluation and Innovation of Methods for Measuring the Development Level of Urban Digital Economy

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Abstract: With the continuous development of Internet technology, the digital economy has become a new engine of contemporary economic development. In particular, on March 12, 2021, China released the "14th Five Year Plan" and the Outline of Vision Goals for 2035, clearly proposing to "create new advantages of the digital economy". Based on this background, this article first analyzes and evaluates the mainstream methods for measuring the development level of the digital economy in China and foreign countries. It is found that the current measurement methods and indicator selection vary greatly, and the accuracy and credibility of the measurement are questionable. Therefore, this article proposes to use Data Envelopment Analysis (DEA) method to measure the level of digital economy development in Chinese cities, and elaborates on its rationality.

Keywords: Digital economy; Measurement of development level; Data Envelopment Analysis (DEA).

1. Introduction

In 2016, the G20 Hangzhou Summit adopted the G20 Digital Economy Development and Cooperation Initiative, which for the first time was listed as an important topic in the G20 innovation growth blueprint. On January 12, 2022, the "14th Five Year Plan" for the development of the digital economy was released. The plan focuses on the deep integration of digital technology and the real economy, strengthens the construction of digital infrastructure, improves the governance system of the digital economy, synergistically promotes digital industrialization and industrial digitization, empowers the transformation and upgrading of traditional industries, cultivates new industries, new formats, and new models, and continuously strengthens, optimizes, and grows China's digital economy. Provide strong support for building a digital China. However, the development of China's digital economy still faces the fact that it is large but not strong. Therefore, based on the urban level, studying the high-quality development of China's digital economy has become an important issue in today's era. However, before this, a key issue that urgently needs to be solved is how to scientifically measure the level of China's urban digital economy development. The purpose of this study is to solve this measurement problem. This article first introduces the mainstream methods for measuring the level of digital economy development both domestically and internationally, and analyzes their advantages and disadvantages. Then, it elaborates in detail on the scientificity of using Data Envelopment Analysis (DEA) to measure the level of urban digital economy development in China, providing methodological experience for related research.

2. The Main Methods and Evaluation of Measuring the Development Level of Digital Economy

2.1. Scale measurement

The so-called scale measurement method refers to measuring the output value of the digital economy in

accordance with the principle of GDP measurement. Therefore, the main methods that can be used are the production method and the expenditure method. Representative researchers mainly include institutions such as BEA in the United States, Tencent Research Institute, and China Academy of Information and Communications Technology. Ran et al. (2023) chose the input-output method to measure the level of digital economy, that is, the scale of industrial digitization, and measured the contribution of information and communication technology to the added value of other industries [1]. This scale measurement method can directly reflect the level and scale of development, and can calculate its proportion in GDP. Another advantage is that it can analyze the development of the digital economy in various industries. However, the drawback of this method is that the product classification standards for the digital economy are inconsistent both domestically and internationally, making it difficult to compare and analyze. Additionally, for the emerging species of the digital economy, data may not be unavailable.

2.2. Exponent measurement

The so-called index method refers to selecting a series of indicators related to the digital economy, constructing a large indicator system, and using measured indicators to represent the development level of urban digital economy. The representative researchers include Beijing Big Data Research Institute, Sheng and Liu (2022)[2], OECD, and Eurostat. Li and Wang (2023) divided the benchmark layer into innovation, coordination, openness, green, and sharing when measuring the development level of China's provincial-level digital economy. In the indicator layer, secondary indicators such as technological progress, human capital, industrial coordination, urban-rural coordination, resource conservation, foreign trade, consumption level, and development scale were used[3]. The advantage of the index method is that it is easy to calculate and can be extended downwards through various indicators, making it easy to judge the development situation of heterogeneous dimensions and facilitating the planning of the future of the digital economy[4]. However, its results have no absolute significance, and the selection, weighting, and

assignment of indicators may be subjectively influenced, so its scientificity and accuracy are also questionable.

3. A New Approach to Measuring the Development Level of Urban Digital Economy

3.1. Introduction to Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a commonly used evaluation model in efficiency evaluation. It integrates multiple disciplines such as operations research, economics, econometrics, and statistics, and is a widely used evaluation method. The basic idea is to comprehensively analyze the input and output data of decision units (DMUs) to obtain relative efficiency indicators for each decision unit. Then, all DMU efficiency indicators are sorted to determine the relatively effective DMU. The main feature of this method is its applicability to the comprehensive evaluation of the effectiveness of multiple outputs and inputs. In addition, Data Envelopment Analysis (DEA) can use projection methods to identify the reasons for non DEA effectiveness or weak DEA effectiveness, as well as the direction and degree of improvement that should be made. As a tool to provide management decision information for managers, it has been widely used in other fields of research.

3.2. The Benefits of Data Envelopment Analysis (DEA)

The advantage of the data envelopment analysis method is that it does not directly process data, so the most effective indicators for decision-making units are independent of the dimension selection of input and output indicator values, which makes the data envelopment analysis method highly flexible. In addition, the data envelopment analysis method endogenously determines the weights of input and output for decision-making units through optimization methods, thereby avoiding the subjective impact on weight allocation. This method reduces human intervention, making the results more objective and persuasive. Finally, data envelopment analysis can not only help evaluate the efficiency and development level of existing systems, but also identify potential areas for improvement, providing strong support for decision-making.

3.3. The idea of measuring the development level of urban digital economy through data envelopment analysis (DEA)

Specifically, cities can be seen as decision-making units, and inputs related to the digital economy (such as urban digital infrastructure construction, human capital investment, etc.) and outputs (such as digital economy output) form the basis of the evaluation model. The DEA model can identify cities that have performed well in the development of the digital economy. Because the impact of urban digital

economy involves multiple complex dimensions such as economy, politics, society, and cultural environment, and the DEA model can precisely avoid these issues. As mentioned earlier, data envelopment analysis can evaluate the efficiency of urban digital economy development, identify cities with higher efficiency in digital economy development, and measure the level of development based on efficiency. More importantly, by comparing the development of digital economy in different cities, Data Envelopment Analysis (DEA) can identify inefficient links or input factors, thereby providing directions for improvement and development for cities. This helps to integrate the digital economy with overall urban development, and is also of great significance for formulating targeted digital economy development strategies.

4. Conclusion

In summary, the current measurement methods for the digital economy at home and abroad can generally be divided into scale measurement and index measurement. However, both methods have their own advantages and disadvantages, and cannot provide accurate methods for measuring the development level of urban digital economy. Therefore, this study innovatively proposes to use Data Envelopment Analysis (DEA) to measure the development level of China's urban digital economy. The DEA model can identify cities that perform well in the digital economy and avoid the impact of complex relationships among various dimensions of the city. More importantly, the level of digital economy development measured by the DEA model can be combined with the long-term coordinated development of the city as a whole, providing new ideas for measuring the efficiency of economic development in related research.

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