



A Method for Measuring the Digital Economy

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ABSTRACT

Against the background of the integration of technological revolution and industrial transformation, the digital economy has become a core driving force for high-quality development, but it faces problems of ambiguous definition and inconsistent measurement systems. This paper first sorts out the definitions of the digital economy by international organizations and academic circles, then defines its connotation and summarizes its four main characteristics. Subsequently, it constructs a measurement system based on two criteria (internet progress and digital finance) with four sub-components, and uses the entropy method to calculate the digital economy level of 258 prefecture-level cities in China from 2011 to 2022. The results show an obvious unbalanced development: Eastern China has the highest level, followed by Central China, and Western China is the weakest. Finally, targeted suggestions are put forward for the three regions to promote the coordinated development of the

1. Introduction

Against the backdrop of the in-depth integration of the new round of technological revolution and industrial transformation, the digital economy has become a major economic form after the agricultural and industrial economies, reshaping global resource allocation and serving as a core engine for high-quality development. Driven by the upgrading of digital technologies such as AI and big data, its connotation has continuously expanded, profoundly changing production and life and playing an irreplaceable role in global economic recovery.

Highly valued globally, countries have introduced strategies to promote its development, with China's digital economy expanding from 11.2 trillion yuan in 2012 to 53.9 trillion yuan in 2023. However, two core challenges remain: ambiguous and divergent definitions, and inconsistent measurement systems. Different stakeholders have differing views on its connotation, with no widely recognized unified definition.

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Traditional measurement methods fail to adapt to its characteristics, leading to fragmented systems worldwide. These systems have limitations in reflecting its full scale and value. Clarifying its connotation and building a scientific measurement system are urgent tasks. This paper focuses on these two issues, aiming to provide theoretical and practical support for digital economy research and policy-making.

2. Definition and Core Meaning of the Digital Economy

The term "digital economy" first appeared in the 1990s, and its meaning has grown richer as digital technologies have advanced. Although no single definition has been agreed upon, there is broad agreement on its main components and characteristics. Drawing on existing work, this paper summarizes the definition and core meaning of the digital economy.

Looking at international organizations, the OECD describes the digital economy as technology-based economic activities that include digital infrastructure, digital goods and services, and the digital transformation of industries[3].

The World Bank sees it as a new form of economy that makes resource allocation more efficient, covering digital production, distribution, exchange, and consumption[4].UNCTAD stresses that it relies on data as a core factor and uses technologies like the Internet, big data, and AI to connect economic activities.In academic circles, opinions vary[5].Some researchers take a broad view, including both digital industrialization and industrial digitalization. Others prefer a narrower definition, focusing only on digital sectors like ICT, software, and e-commerce.

Bringing these views together, this paper defines the digital economy as a new type of economy that uses digital knowledge and information as key inputs, relies on modern information networks as its main infrastructure, and uses the integration of ICT as a major driving force. This allows digital technology and the real economy to become deeply intertwined. Its core meaning includes data as the central factor, digital infrastructure as the base, and the blending of technology and industry as the main path.

The digital economy has four main traits: it reaches deeply into many industries and regions; it is highly innovative, with new technologies and business models constantly appearing; it makes resource allocation more efficient and lowers costs; and it is inclusive, helping to narrow gaps between regions and groups.

3. Digital Economy Evaluation

This study assesses the level of urban digital economy development by virtue of two core criteria: internet progress and digital finance. Four sub-components are identified herein to characterize internet development, including the labor force in the computer services and software industry, the number of mobile phone users at the end of the year, the quantity of broadband internet subscribers, and the income obtained from telecommunications services. Regarding digital finance, it refers specifically to the Digital Inclusive Finance Index. The entropy method is adopted to calculate the relevant data of the digital economy.

The Entropy Method. The exact steps for putting this into action are as follows:

First, standardized processing.

$$Y_{it} = \left\{ \begin{array}{l} \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})}, \\ \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_{ij})}, \end{array} \right.$$

Among them, i represents the city and j represents the measurement indicator. X_{ij} and Y_{ij} denote the indicator values before and after standardization, respectively.

Second, calculate the information entropy.

$$E_j = -\frac{1}{\ln n} \sum_{i=1}^n \left[\left(\frac{Y_{ij}}{\sum_{i=1}^n Y_{ij}} \right) \ln \left(\frac{Y_{ij}}{\sum_{i=1}^n Y_{ij}} \right) \right]$$

Third, construct the weight indicator.

Weigh the indicators and their weights to get the final level of growth in the digital economy.

Based on the above methods, this paper calculates the digital economy level of 258 prefecture-level cities in China from 2011 to 2022 and presents it in the form of statistical description.

Table 1. Descriptive Statistics of Main Variables

№	Variable	Mean	Minimum Value	Maximum Value
<i>1</i>	1	2	3	4
2	digital economy	0.060	0.004	0.805

Due to the space limitation of this paper, it is impossible to present all the data. However, in terms of Eastern, Central and Western China, the digital economy level in Eastern China is the highest, followed by Central China, and Western China is the weakest. For this reason, we should make corresponding preparations.

Table 2 Descriptive Statistics of Main Variables

№	digital economy	Mean	Minimum Value	Maximum Value
<i>1</i>	1	2	3	4
2	Eastern China	0.559	0.469	0.805
3	Central China	0.212	0.125	0.612
4	Western China	0.020	0.004	0.101

4. Conclusion and Suggestions

This study finds an obvious unbalanced development of the digital economy among Eastern, Central, and Western China. Eastern China has the highest level, Central China is in the middle, and Western China lags behind, which calls for targeted measures to promote coordinated development.

Eastern China should strengthen core technological innovation and drive regional synergy by transferring advanced experience to the central and western regions. Central China needs to accelerate the digital transformation of traditional industries and improve digital infrastructure to catch up. Western China should prioritize infrastructure construction, introduce digital talents via policies, and develop characteristic digital industries based on local advantages to narrow the gap.

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