

## Research on Evaluating Government Open Data Service Quality from Data and User Perspectives: Postprint

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### Abstract

[Purpose/Significance] Evaluating the service level of domestic government open data can provide references and a basis for the objective evaluation and policy formulation of government open data in China, thereby enhancing the effectiveness of government data opening. [Method/Process] From a micro-level perspective of data and users, an evaluation index system for government open data service level is established. Taking the “cultural leisure” thematic datasets on government open data platforms in eight regions including Wuhan as examples, the entropy method is employed to calculate the weights and comprehensive evaluation values of government open data service level. [Results/Conclusion] The service level of urban government open data in China exhibits the following characteristics: government open data service level demonstrates a high correlation with data usability and possesses hierarchical characteristics; the service level of government open data shows inconsistency across different regions.

### Full Text

#### Abstract

**Purpose/Significance:** Evaluating the service level of domestic government open data can provide reference and basis for the objective evaluation and policy-making of government open data in China, thereby improving the efficiency of government data opening. **Method/Process:** From the micro-level perspectives of data and users, this study establishes an evaluation index system for government open data service level. Taking the “Cultural Leisure” thematic datasets on government open data platforms in eight cities including Wuhan as examples, the entropy method is used to calculate weights and comprehensive evaluation values of government open data service levels. **Result/Conclusion:**

The service levels of urban government open data in China exhibit the following characteristics: government open data service level has high correlation with data availability and demonstrates hierarchical characteristics; service levels vary across different regions.

**Keywords:** Government open data; Entropy method; Service level

## 1. Introduction

Government open data service refers to the process by which government departments open data to the public through certain channels and means, primarily for the purpose of providing public services and meeting user needs. Effective evaluation of government open data services can help government departments comprehensively understand the current status of data quality, user utilization, and effectiveness, thereby implementing effective supervision and control over the opening process and further enhancing the level of government data opening. Current research on the evaluation of government open data services both domestically and internationally mainly focuses on perspectives of government, data, portals, and users.

Evaluations emphasizing the government perspective primarily manifest in aspects such as high-level leadership, policies, laws and regulations, and execution capabilities. Internationally, researchers mainly construct indicator systems through maturity models oriented toward government agency capabilities, expert reviews, and crowdsourcing methods to assess the impact of government agencies on economic, political, and social dimensions [?]. Domestic scholars primarily employ methods such as the Analytic Hierarchy Process to construct evaluation models and frameworks for government open data policies and implementation effects, evaluating China's government open data policy solutions and implementation outcomes [?].

Evaluations emphasizing the data perspective primarily manifest in aspects such as data accuracy, completeness, and openness. International scholars mainly construct evaluation models to assess the quality of government open data [?]. Domestic scholars focus on constructing evaluation indicator systems for meta-data quality and data quality of government data open platforms, employing methods such as Delphi method, fuzzy comprehensive evaluation, and data envelopment analysis for assessment [?].

Evaluations emphasizing the portal perspective primarily manifest in aspects such as website scale, performance, and influence. Internationally, researchers construct website evaluation models and employ expert review methods to assess open data portals and regional government data openness [?]. Domestic scholars primarily use BP neural networks, structural equation modeling, and the Technology Acceptance Model to evaluate government websites, platforms, and website service quality [?].

Evaluations emphasizing the user perspective primarily manifest in aspects such

as user-perceived quality and data usability. International scholars construct value models and technology acceptance models to evaluate data efficiency, effectiveness, and usability [?]. Domestic scholars introduce fuzzy comprehensive evaluation, Delphi method, and other research methods to study government open data quality, user satisfaction, and platform service performance [?].

From existing research findings both domestically and internationally, it is evident that scholars' research on government open data services is becoming increasingly mature, yet several shortcomings remain: (1) Research methods need improvement. Most existing studies adopt methods such as Analytic Hierarchy Process, Delphi method (expert survey), expert scoring, and fuzzy comprehensive evaluation to assess data quality, website performance, and user satisfaction. However, these methods involve certain subjective human factors, relying primarily on expert personal experience, which may be influenced by random factors and experts' subjective uncertainties during the actual evaluation process, affecting final results. (2) Lack of multi-perspective fusion evaluation at the micro level. Current research mostly constructs evaluation models from macro-level perspectives such as government, data, and platforms, with relatively single research perspectives. Few studies integrate micro-level data and user perspectives to construct evaluation models for government open data service levels—that is, research from micro-level perspectives of data characteristics, data utilization, and their effects. (3) The evaluation research is a dynamic process. This is related to data providers, portals, user utilization status, and attention levels. As the big data environment, government agency concepts, and user demands change, the ways and content of government data opening should continuously evolve, and the evaluation indicator system and weights should be adjusted and improved under new circumstances.

Based on this, drawing on existing research findings, this study integrates micro-level data and user perspectives to evaluate government open data service levels. Using literature analysis, existing evaluation indicator systems are integrated to establish a reasonable evaluation indicator system, and the entropy method is employed to calculate evaluation indicator weights and comprehensive evaluation values of government open data service levels. Taking the “Cultural Leisure” thematic datasets on government open data platforms in eight cities including Wuhan as examples for evaluation research, this study aims to provide a more scientific indicator system and evaluation method for government open data evaluation research in China, promoting the healthy development of local government data opening.

## 2. Research Approach to Government Open Data Service Level Evaluation

### 2.1 Research Perspective and Method Selection

Previous research findings reveal that few studies have conducted multi-perspective fusion research on government open data service levels from the

micro level. Micro-level government open data and user data possess certain universality and can reflect portal and government conditions to some extent. Therefore, this study evaluates government open data service levels from micro-level data and user perspectives.

China's government data opening movement is currently in its initial stage. As the environment, policies, government department concepts, and user demands continuously change, government data opening methods and content will also change accordingly. Therefore, the evaluation of government open data should be a dynamic and objective process. This study attempts to adopt dynamic and objective methods to better evaluate government open data service levels. The entropy method is a dynamic evaluation method with significant advantages in objective weighting, widely applied in economic management, enterprise management, decision control, and other fields, making it suitable as the evaluation method for this study.

## 2.2 Construction of Government Open Data Service Level Evaluation Indicator System

Constructing a reasonable evaluation indicator system is the core content of evaluating government open data service levels. Evaluation indicator concepts must be clear, explicit, scientifically connotative, and capable of reflecting government open data characteristics and actual conditions. Based on government open data principles, combined with general evaluation frameworks for government open data, and drawing on existing research findings both domestically and internationally, this study proposes modifications and additions of indicators such as APP applications, rating volume, page views, download volume, and the ratio of downloads to page views from micro-level data and user perspectives to measure government open data service levels. The final evaluation indicator system includes five first-level indicators: data quantity, data quality, data openness, data sustainability, and data availability, and fifteen second-level indicators such as total datasets and data capacity. Related indicators and parameter settings are shown in Table 1 .

**Data Quantity** includes total datasets and data capacity. Total datasets refer to the number of datasets opened under each thematic category on each platform, representing in this paper the number of datasets obtained from each platform's theme after data cleaning. Data capacity refers to the total data volume calculated by multiplying the number of entries (rows, i.e., data volume) of each dataset by the number of fields (columns) and summing them, primarily used to measure the actual data volume size of datasets provided by each platform.

**Data Quality** primarily manifests in data accuracy, completeness, and other aspects, summarized in this paper as absence of low-quality data and presence of poor-quality data. Absence of low-quality data refers to data without problems, low capacity, low data volume, fragmentation, or duplicate creation.

Poor-quality data refers to low-capacity data (two rows or less).

**Data Openness** primarily measures the degree of data openness, with second-level indicators including machine-readable format, open format, fixed links, and API interfaces. Machine-readable format measures whether data is convenient for users to obtain and utilize and whether it can be automatically read and processed by computers, such as XLS, CSV, TXT, XML, JSON, XLSX, WMS, WFS, RFT, XML, RDF formats, while DOC, PDF, JPG are non-machine-readable formats. Open format means downloadable datasets should be provided in open, non-proprietary formats, and no entity should exclude others from using data through format restrictions to ensure data can be accessed without specific (especially paid) software or applications, such as JSON, CSV, XML, TXT, KML, WMS, WFS, RTF, while XLS, XLSX, DOC, DOCX, PDF, ODT are not open formats. Fixed links refer to setting fixed URL links for datasets to help users discover and link to specific dataset locations, represented in this paper as RDF link format. API interfaces refer to whether platforms open API application interfaces to the public and support providing data through data call interfaces to meet some users' needs for developing applications.

**Data Sustainability** measures whether datasets on each platform have been updated since creation, primarily measured by data update types. Update timeliness is determined by the timeliness of each data update on the open data portal. This is summarized as dynamic updates and static updates, with quarterly, monthly, weekly, daily, and real-time updates considered dynamic updates, while no updates, irregular updates, annual updates, semi-annual updates, on-demand updates, and custom updates are considered static updates.

**Data Availability** primarily faces micro-level user perspectives. APP applications, data rating volume, page views, and download volumes are important manifestations reflecting user attention to data and data value. Current research mostly measures open data utilization effects from perspectives such as page views, download volumes, and rating volumes. Therefore, data availability is primarily measured by APP applications, rating volume, page views, download volume, and the ratio of download volume to page views. APP applications refer to whether platforms develop corresponding APPs from data to provide convenient services for the public. User ratings are the most direct reflection of user satisfaction with data quality and other content. Rating volume reflects data application quality and, to some extent, whether data opening truly enhances citizens' enthusiasm for participating in social governance and the efficiency of social governance. User page views and download volumes reflect, to some extent, public attention to government data and user participation on government open data platforms, mainly representing user behavior after data opening. To balance the overall attention level to the "Cultural Leisure" theme across cities, this study uses average page views and average download volumes, i.e., dividing the total page views or total download volumes of the "Cultural Leisure" theme by the total number of "Cultural Leisure" thematic datasets in that city. The ratio of download volume to page views is called the data

download rate; a higher download rate indicates higher data attention and can be used to measure the strength of data availability.

### 3. Empirical Analysis

#### 3.1 Sample Selection

Since 2012, China has established more than 50 local government open data platforms [?], but the themes on these platforms differ in quantity and name, with similar data having different names and themes across platforms. According to statistics, in terms of open data quantity, the “Cultural Leisure” category contains the most categories [?] and is one of the key areas of current Chinese government data opening. Therefore, this study selects “Cultural Leisure” thematic data as the experimental dataset.

As China’s government open data started relatively late and local government open data movements show significant differences, full sample analysis is not suitable. Considering the maturity of local government data opening and the difficulty of obtaining research samples, this study selects eight cities: Wuhan, Weifang, Shenzhen, Jinan, Harbin, Guiyang, Guangzhou, and Foshan as research cities. These eight cities’ government open data platforms share the same “Cultural Leisure” theme and are representative. The selected cities and themes are shown in Table 2 .

#### 3.2 Data Collection

Based on the above analysis, this study uses a combination of web crawlers and manual observation to obtain experimental datasets, with data collection ending on May 3, 2019. The collected indicator data undergo preprocessing to form the original dataset, with some indicator data shown in Figure 1 [Figure 1: see original paper] and Figure 2 [Figure 2: see original paper].

In terms of total datasets, each platform has relatively few “Cultural Leisure” thematic datasets, with Guiyang having the most (293) and Harbin the fewest (38). Regarding machine-readable format datasets, except for Wuhan and Guangzhou, most others provide machine-readable formats. In terms of open format datasets, Foshan, Guiyang, Harbin, Jinan, and Shenzhen provide 100% open formats, mostly using various open formats such as XLS, CSV, XML, and JSON to meet different user needs. However, Weifang and Wuhan datasets do not use open formats, with Weifang mostly using XLS format and Wuhan mostly using XLSX, JPG, PDF formats, and a small portion not providing open formats. Regarding page views and download volumes (see Figure 2), Jinan’s ratio of downloads to page views reaches 76.94%, indicating that Jinan’s “Cultural Leisure” thematic data attracts significant user attention, while Wuhan and Foshan only reach 1.84% and 3.69%, respectively, suggesting that the utilization degree of “Cultural Leisure” thematic data on these two platforms needs improvement. Shenzhen and Guiyang have high page views

but low download volumes, indicating regional differences in attention levels for the same thematic data.

### 3.3 Government Open Data Service Level Evaluation

For the above-constructed indicator evaluation system, this study adopts the entropy method as the evaluation method for government open data service levels, with specific steps as follows:

- (1) Preprocess the data collected in 3.2 to obtain the evaluation indicator dataset. Construct an initial data matrix  $X$  with  $m$  local government open data platforms and  $n$  evaluation indicators,  $X = (X_{ij})_{m \times n}$ , where  $m = 8$  and  $n = 15$  in this study.
- (2) Data standardization. Different indicators often have different dimensions and units. To eliminate potential impacts of indicator dimensions on evaluation results, indicator values require standardization. Since positive and negative indicators have different meanings—higher values are better for positive indicators and lower values are better for negative indicators—different methods are used to process positive and negative indicators as follows:

$$X'_{ij} = \frac{X_{ij} - \min\{X_j\}}{\max\{X_j\} - \min\{X_j\}} \quad (1)$$

$$X'_{ij} = \frac{\max\{X_j\} - X_{ij}}{\max\{X_j\} - \min\{X_j\}} \quad (2)$$

Formula (1) processes positive indicator data, and formula (2) processes negative indicator data.  $X'_{ij}$  represents the normalized indicator data,  $X_{ij}$  ( $i = 1, 2, \dots, m$ ,  $j = 1, 2, \dots, n$ ) represents the  $j$ -th evaluation indicator value of the  $i$ -th platform, and  $\max\{X_j\}$  and  $\min\{X_j\}$  represent the maximum and minimum values of the  $j$ -th evaluation indicator among these eight platforms, respectively.

- (3) Calculate indicator proportions, information entropy values, information entropy redundancy, and weights using the following formulas:

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^m X'_{ij}} \quad (3)$$

$$e_j = -k \sum_{i=1}^n P_{ij} \ln(P_{ij}) \quad (4)$$

$$g_j = 1 - e_j \quad (5)$$

$$W_j = \frac{g_j}{\sum_{j=1}^n g_j} \quad (6)$$

Where  $P_{ij}$  represents the proportion of the  $i$ -th platform under the  $j$ -th indicator;  $e_j$  represents the information entropy value of the  $j$ -th indicator ( $k > 0$ ,  $\ln$  is the natural logarithm,  $e_j \geq 0$ ). The constant  $k$  in the formula is related to the sample number  $m$ , generally set as  $k = 1/\ln(m)$ ;  $g_j$  represents the information entropy redundancy of the  $j$ -th indicator;  $W_j$  represents the weight of the  $j$ -th indicator ( $j = 1, 2, \dots, n$ ). By statistically analyzing  $W_j$ , the weights of various indicators for government open data service levels are obtained, as shown in Table 3.

Table 3 reflects the evaluation indicators and their weight coefficients for government open data service level evaluation. The ranking of first-level indicators is: data availability, data openness, data quantity, data sustainability, and data quality. Data availability has the largest weight, indicating that it is the most important first-level indicator in government open data service level evaluation. Data availability is primarily measured by APP applications, rating volume, page views, download volume, and the ratio of download volume to page views. Both APP applications and rating volume have relatively high weight proportions, reflecting user utilization behavior to a certain extent.

Based on the obtained government open data service level indicator values, the comprehensive evaluation value of government open data service level is calculated using the formula:  $Y_i = \sum X_{ij} \times W_j$ , with results shown in Table 4. From the perspective of first-level indicators, there are obvious hierarchical characteristics. Analyzing from the first-level indicator with the largest weight—data availability—reveals that Wuhan and Jinan are in the first tier, while Guiyang, Shenzhen, Harbin, Weifang, Guangzhou, and Foshan are in the second tier.

To more intuitively understand the service levels of government open data across regions, the above comprehensive evaluation values are multiplied by 100 and plotted as a line chart (see Figure 3 [Figure 3: see original paper]). Among these eight cities, Shenzhen ranks first in comprehensive service level evaluation value, far ahead of other cities. The Shenzhen government data open platform was launched on November 21, 2016. Although it started relatively late, it has a high government open data service level. Based on the comprehensive service level evaluation values, the ranking of government open data service levels across these eight cities is: Shenzhen, Jinan, Guiyang, Weifang, Wuhan, Harbin, Guangzhou, and Foshan.

#### 4. Conclusions and Discussion

Through analysis of the “Cultural Leisure” thematic government open data service level results, the following conclusions can be drawn:

- (1) Government open data service level has high correlation with data availability and demonstrates hierarchical characteristics. Data availability has the largest weight, indicating it is the most important first-level indicator in government open data service level evaluation. Data availability is measured by APP applications, rating volume, page views, download volume, and the ratio of download volume to page views. These indicators reflect user utilization behavior to a certain extent. From the perspective of data availability, user utilization of government open data shows hierarchical characteristics, with Wuhan and Jinan in the first tier and Guiyang, Shenzhen, Harbin, Weifang, Guangzhou, and Foshan in the second tier. From the raw data of data availability, only a few government open data platforms provide APP applications, and governments should actively take measures to improve relevant APP development capabilities.
- (2) Government open data service levels across regions show inconsistency. Based on comprehensive evaluation values and rankings of government open data service levels, they can be divided into two categories: Guiyang, Shenzhen, Jinan, and Weifang as the first category, and Wuhan, Guangzhou, Harbin, and Foshan as the second category. The second category of cities opens fewer datasets, has no fixed links, and most data are dynamically updated, which is not conducive to data sustainability. Therefore, governments should increase efforts to open more useful datasets and accelerate dataset update frequencies to enable users to quickly and efficiently use these datasets to create more application value.
- (3) The evaluation research of government open data service level is a dynamic process. This is related to data providers, portals, user utilization status, and attention levels. As the big data environment, government agency concepts, and user demands change, the ways and content of government data opening should continuously evolve, and the evaluation indicator system and weights should be adjusted and improved under new circumstances.

## 5. Limitations and Future Directions

This study establishes an evaluation indicator system for government open data service levels from micro-level data and user perspectives, selects “Cultural Leisure” thematic datasets on government open data platforms in eight cities (Wuhan, Weifang, Shenzhen, Jinan, Harbin, Guiyang, Guangzhou, and Foshan) as research samples, uses the entropy method to calculate indicator weights and comprehensive evaluation results of government open data service levels, and finds that government open data service level has high correlation with data availability and that service levels vary across cities. Although the entropy method can effectively reduce subjective human factors in the evaluation process and improve evaluation reliability, it also has some shortcomings and deficiencies. For example, there is no unified standard for measuring and evaluating government open data service levels, and the rationality of some indicators requires further verification. In response to these limitations, future research will

conduct in-depth exploration and improvement. Nevertheless, the application of the entropy method in government open data service level evaluation provides a new research method and tool for further research on government open data service evaluation, which has important theoretical significance and practical guidance for enhancing government data opening.

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## Author Contributions

Lin Ping: Responsible for data collection and analysis, drafting and revising the manuscript, and final version revision; He Siqu: Responsible for data collection and analysis, final version revision; Duan Yaoqing: Provided overall research ideas and writing guidance.

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## Research on the Service Level Evaluation of Government Open Data from Data and User Perspectives

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**Abstract:** [Purpose/significance] The service level evaluation of domestic government open data can provide reference and basis for the objective evaluation and policy-making of government open data in China, thus improving the efficiency of domestic government data opening. [Method/process] From the micro-level perspectives of data and users, this paper establishes an evaluation index system for government open data service level. Taking the “Cultural Leisure” thematic datasets on data open platforms of Wuhan and other eight cities as examples, the entropy method is used to calculate the weight and comprehensive evaluation value of government open data service level. [Result/conclusion] The service level of urban government open data in China has the following characteristics: government open data service level is highly correlated with data availability and is hierarchical; the service level of government open data varies across regions.

**Keywords:** government open data; entropy method; service level

*Note: Figure translations are in progress. See original paper for figures.*

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