Empirical Analysis of Big Data-Driven Precision Supply of Public Services in Urban and Rural Communities

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Abstract. With the in-depth development of information technology, the emerging information technology represented by "cloud, big, material, mobile, and intelligence" has begun to lead the current social trend, and is generally integrated with social life. Among them, big data technology, which focuses on the collection, cleaning, analysis and utilization of massive multi-source heterogeneous data, has become a typical representative of emerging information technology. The rare forward-thinking realization path provided by big data technology for the field of public services greatly promotes the structural public service provision, and also extremely obviously strengthens the personification orientation of scenario-based non-structural public service provision. Based on the limited nature of public resources, we are required to face the problems of how to satisfy the mutated and diversified complex demands of community residents, how to lead the creation of community residents' demands, how to utilize the big data technology for the precise configuration and forward-looking supply of public services, and how to provide scenario-based non-structural public services, etc., and the precise supply of public services for urban and rural communities driven by big data has become an important research topic. This paper focuses on the actual equalization of basic public services in urban and rural areas in China, embodies the manifestation of data-driven practice with digital government construction, analyzes the mechanism of digital government construction affecting the equalization of basic public services in urban and rural areas, and further determines the impact of data-driven on the precise supply of public services in urban and rural communities with empirical analysis.

Keywords: big data-driven;Community public services;Precision supply;empirical analysis

1 Introduction

In the field of public services, data-driven public service provision research takes note of the ideas and methods that big data technology brings to the deepening of public service provision research, and also takes into account the problems endogenous to the application of big data, such as data security, data ethics, and algorithmic discrimination. Thus, the study of big data-driven precision supply of public services in urban and rural communities can greatly promote scientific governance research based on data governance in the context of a complex society.Taking into account factors such as the construction of digital government and the real demand for equalization of basic public services in urban and rural areas, the path of digital

PMBDA 2023, December 15-17, Nanjing, People's Republic of China

DOI 10.4108/eai.15-12-2023.2345405

government construction to promote the equalization of high-quality basic public services in urban and rural areas is systematically sorted out and empirically tested.

2 Backgrounds

Existing research on digital government-driven equalization of basic public services mainly includes two aspects: efficiency and equity.The research in efficiency mainly focuses on the following directions: first, digital government construction has a significant impact on improving the efficiency of basic public service supply. According to HongbinZhang (2018), big data promotes the structural innovation of basic public service supply from the source, and by making full use of big data technology, it can improve the supply efficiency while reducing the cost of public services and realize the optimal allocation of public service resources[1]. DM Nazarov has proposed a scheme and technology for establishing predictive analytics models within SAP Analytics Cloud digital services based on open data registered according to the laws of the Russian Federation[2].

Second, analyzed from the perspective of information and resources, digital government construction has an important impact on promoting the high-quality development of basic public services. According to the research of BoWang(2018), big data thinking and technology have brought about a profound impact on the reform of basic public services in China, and the construction of digital government can eliminate the administrative barriers between urban and rural areas and regions, and realize the integration of urban and rural basic public services through the allocation of basic public service resources across urban and rural areas and across regions[3]. Bordeleau F È proposes a model that describes the main factors for the success or failure of digital change[4].The study of Wang (2020), on the other hand, argues that the government can improve the decision-making level, input efficiency, and service results of basic public service provision through digital transformation, so as to improve the capacity of basic public service provision[5].

Finally, analyzed from the perspective of capability, the core governance capability of the government in the context of big data is transformed into data governance capability. According to LiuZe(2020), this shift in capacity promotes the innovation of governmental governance subjects, relations, and governance modes, which in turn improves governance effectiveness[6]. At the same time, the digital government can also achieve scientific decision-making, accurate governance and efficient service, and promote the modernization process of national governance[7]. Zou Shubin et al. (2020) pointed out that e-government has promoted the construction of a data-oriented government, and based on this, the government's governance capacity has been improved[8].(Hentschel, 2020) present tentative design principles for cloud broker platforms, combining the concept of platforms with findings from research on guidance support systems[9].

3 Research Methods

Based on the panel data of 286 prefecture-level cities from 2009 to 2018, this paper quantitatively investigates the impact of digital government construction on the equalization of urban and rural basic public services. By exploring the mechanism of action and path of

realization, it expands the theory of digital government construction, clearly presents the intrinsic connection between urban and rural basic public service equalization and digital government construction, promotes the structural reform of the supply side of urban and rural basic public services, and facilitates the equalization of urban and rural communities' basic public services.

This paper refers to the construction of the basic public service evaluation index system of existing studies, combining the availability of data, and finally selects five first-level indexes and eleven second-level indexes, such as infrastructure, public education, health care, employment and social security, and environmental protection, and applies the principal component analysis method to calculate the level of urban and rural development of basic public services in each region.

The explanatory variables refer to the conceptual definitions and measurement dimensions of digital government construction in existing studies to construct the measurement indexes of digital government construction level in this paper. The digital infrastructure is selected to be measured from the technology dimension, the government dimension is selected to measure the government's investment, the market dimension is selected to measure the ratio of the employees of research and comprehensive technical services to the year-end population of the region, the digital industry dimension is measured, and finally, the number of social organizations is selected to be the ratio of the year-end population of the region, and the public participation dimension is selected to measure the construction of the digital government.

In order to prevent the regression results from being biased, this paper introduces the industrial structure and per capita GDP indicators as control variables that Reduce the influence of other variables that may be highly correlated with the equalization of urban and rural basic public services.

3.1Measurement model setting

Scholars generally agree that digital government is the application of information and communication technology[10].Referring to the conceptual definition and measurement dimensions of digital government construction by Guo Lei et al. (2021)and Liu Fei et al.(2021), this paper constructs the measurement indicators for the level of digital government construction[11][12].The level of digital government construction is characterized by dynamics, this paper adopts the ADL model to calculate the development level of urban and rural basic public services and the panel data of digital government construction level in each region, and applies the systematic GMM estimation method to study the impact of digital government construction on the development level of urban and rural basic public services. The basic model of development level is as follows:

$$\begin{aligned} pubindicator_{i,t} = {} & \alpha pubindicator_{i,t-1} + \beta_0 diggovment_{i,t} + \beta_1 diggovment_{i,t-1} + \\ & \gamma_0 strindu_{i,t} + \gamma_1 strindu_{i,t-1} + \varphi_0 rgdp_{i,t} + \varphi_1 rgdp_{i,t-1} + \mu_i + \rho_t + \nu_{i,t} \end{aligned} \tag{1}$$

where $pubindicator_{i,t}$ and $pubindicator_{i,t-1}$ denote the level of urban and rural basic public service development in region i in the current period (period t) and the lagged period (period t-1); $diggovment_{i,t}$ and $diggovment_{i,t-1}$ denote the level of digital government

construction in region i in period t and period t-1; μ_i and ρ_t denote the region and time fixed effects, and $\upsilon_{i,t}$ denote the error term.

Replace the level indicators in the overall model with urban-rural basic public service differentiation indicators to empirically analyze the impact of digital government construction on the level of urban-rural basic public service differentiation. The specific form of the model is as follows:

$$E_{i,t} = \chi E_{i,t-1} + \delta_0 diggovment + \delta_1 diggovment_{i,t-1} + \sigma_0 strindu_{i,t} + \sigma_1 strindu_{i,t-1} + \tau_0 rgdp_{i,t} + \tau_1 rgdp_{i,t-1} + \mu_i + \rho_t + \upsilon_{i,t} \quad (2)$$

$E_{i,t}$ Indicates the urban-rural basic public service differentiation in area i in the current period and the lagged period. μ_i denotes a fixed area effect that is not subject to time correlation and has a significant effect on the level of urban-rural basic public service differentiation. Because the inclusion of lagged period variables as instrumental variables in the model will result in different degrees of estimation bias, this paper adopts the generalized method of moments for dynamic panel data to conduct unbiased estimation to achieve the purpose of eliminating the impact of area effects.

3.2Data sources

The urban and rural basic public service score level is selected from the data of 286 prefecture-level cities indicators in China during 2009-2018. The data come from China Statistical Yearbook and China Urban Statistical Yearbook. In order to better handle the missing values of the samples, the missing data were firstly made up by consulting the relevant statistical yearbooks; some data that could not be made up by the yearbooks were made up using the simple interpolation method. After completing the data, the Principal Component Comprehensive Evaluation Method was applied to calculate the development level score and the differentiation score of urban and rural basic public services in each region to measure the level of equalization of urban and rural basic public services in each region. The higher the development level score, the higher the overall development level of urban and rural basic public services in the region; the smaller the differentiation index, the lower the degree of differentiation of urban and rural basic public services in the region.

4.Analysis of results

The coefficients of urban-rural basic public service differentiation in the seven regions were obtained through calculation, as shown in the *table 1*. The table encompasses the changes and development degree of urban-rural basic public service differentiation during the period of 2009-2018, focusing on analyzing the urban-rural basic public service differences among the seven regions from the spatial dimension. The larger the value of the coefficient of variation, the lower the degree of urban-rural basic public service equalization. It can be found that the development of urban and rural basic public services in Northeast, North, Central and East China is relatively balanced, the level of equalization of urban and rural basic public services

in Northwest and Southwest China is relatively in a reasonable range, and South China, indicating that the degree of equalization of urban and rural basic public services in the high regions is low. It can be seen that the current level of urban-rural basic public service differentiation in China is related to geographic location, basically presenting a spatial non-equilibrium characterized by a gradual increase from the west and south to the east and north.

Table 1. Table of coefficients of variation in public services among the seven major regions of China, 2009-2018

area	Northeastern	Northern	North western	South western	Southern China	central China	Eastern China
variation coefficient	0.30	0.32	0.49	0.45	0.56	0.31	0.33

This part uses the systematic GMM model to conduct regression analysis of digital government construction and urban-rural public service level scores in seven regions of China, as shown in Table2.Although the impact of digital government construction on the development of urban-rural basic public services in different regions is not significant, the control variables of per capita GDP current variable and industrial structure current variable have a significant impact on the level of differentiation of basic public services in East China. Specifically, for every unit of GDP per capita, the level of urban-rural basic public service differentiation will increase by 131.9%; for every unit of industrial structure (the ratio of the output value of secondary and tertiary industries to the output value of the tertiary industries), the level of urban-rural basic public service differentiation will increase by 124.02%, which is similar to the conclusion of the study by Xin Chongchong et al. that the industrial structure has an inhibitory effect on the narrowing of the gap of the inter-regional supply of public services. There is an inhibitory effect. Therefore, it is necessary to analyze the main factors hindering the equalization of basic public services between urban and rural areas from the dimensions of industrial structure and per capita GDP, and formulate targeted region-oriented policies according to local conditions.

Table2. Regression results on the differentiation of public services in different regions

Variables	Northeastern	Northern	North western	South western	Southern China	central China	Eastern China
Digital Government Construction Level	0.187 (0.17)	0.414 (0.71)	-0.263 (-0.23)	0.584 (0.99)	-0.493 (-0.64)	-0.743 (-0.33)	0.519 (0.37)
Digital Government Construction Level*	0.350 (0.15)	0.810 (1.52)	0.005 (0.00)	0.692 (0.92)	0.486 (1.04)	-0.909 (1.34)	-0.042 (-0.05)
Public Service Score*	-0.097 (-0.13)	-0.160 (-0.24)	-0.495 (-0.35)	0.346 (0.25)	0.193 (0.26)	1.374 (1.14)	1.199 (1.07)
GDP per capita	-0.022 (-0.05)	0.238 (1.06)	0.645 (1.01)	0.057 (0.11)	0.475 (1.02)	-0.239 (-0.41)	1.319** (2.36)
GDP per capita*	-0.284 (-0.41)	0.019 (0.04)	0.774 (0.33)	-0.721 (-0.80)	0.437 (0.36)	-0.414 (-0.46)	-0.336 (-0.21)
Industrial Structure	-17.89* (-1.69)	10.926 (0.96)	11.405 (0.32)	-42.274 (-0.83)	8.945 (0.13)	-18.940 (-0.53)	124.018* (1.67)

Industrial Structure*	19.214* (1.90)	-12.471 (-0.93)	-13.117 (-0.26)	40.906 (0.81)	-1.926 (-0.03)	24.990 (0.73)	-109.321(- 1.57)
Constant term	-2.822 (-0.27)	4.278 (0.34)	-5.037 (-0.10)	11.692 (0.77)	-37.626* (-2.44)	-19.369 (-0.68)	-73.536* (-1.94)
Sargan test	0.772	0.592	0.808	0.054	0.598	0.993	0.060
AR(2)test	0.699	0.764	0.951	0.583	0.726	0.386	0.377

Note: The explanatory variable is pubindicator; Sargan tests for overidentification; AR(2) tests for random error autocorrelation; the numbers in the table are p-values; ***, **, and * denote significance at the 1%, 5%, and 10% levels, with t-values in parentheses; and * in the name of a variable represents the lagged period for that variable, as follows.

5.Conclusions

(1) Digital government enhancement can effectively promote the development of basic public services in urban and rural areas and increase equalization, but it takes time to release the effect. Empirical and theoretical analyses agree that digital technology can improve the equalization of public services, but its driving effect has a time lag. Promoting big data technology-driven public services requires sustained investment and long-term planning to ensure that the value of the technology continues to be realized.

(2) The empirical analysis shows that higher per capita GDP and increased government investment have a positive impact on the development of basic public services in urban and rural areas. With the development of information technology, digital inequality stems more from structural differences in infrastructure, especially in resource-rich local governments with higher levels of infrastructure. These areas are more likely to build high levels of digital government and thus reap the benefits of big data.

6.Application of results

Relying on big data technology, it is possible to realize the collaborative supply of multiple subjects and promote the precise supply of public services. It is possible to realize full-cycle, multi-dimensional and multi-level mining of community residents' needs by collecting information on their personal statistical characteristics, behaviors and attitudes, and to promote two-way interaction between the government and community residents. By constructing a data portrait of community residents, it realizes an accurate description of community residents, and realizes dynamic prediction and direction guidance for demand satisfaction through simulation. It breaks the inherent mode, realizes the collaborative supply of the government, society and market, and improves the diversification and precision of public service supply with the mobility and diversity of big data.

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