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A Coupling Coordinated Model

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Coordination between Governmental Resources and Citizen Engagement with Open Government Data: A Coupling Coordinated Model

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ABSTRACT

Abstract: Government resources used for opening data and citizen engagement with open government data (OGD) are expected to have a mutual influence, but this has not been empirically investigated. Therefore, this paper investigates this mutual relationship by measuring both governmental resources and citizen engagement based on resource-based theory. The weight of their measurements is evaluated by the entropy method. Data was collected from 337 Chinese municipal governments to investigate whether governmental resources and citizen engagement with OGD are dependent. The findings by a coupling coordinated model and regression analysis revelated that: Although governmental resources and citizen engagement with OGD have a strong interaction, the coordination between them is low. An explanation for this is that the development of citizen engagement with OGD lags behind the deployment of governmental resources in most Chinese cities.

KEYWORDS

coordination, governmental resources, citizen engagement, open government data

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1 INTRODUCTION

Open data can facilitate interactions between governments and citizens [1]. Therefore, many governments are spending a large number of resources on opening their data to the public to stimulate interaction and public value creation. However, whether governments putting more resources into open government data (OGD) can receive more requests/responses from citizens is an open question [2]. Paying more attention to OGD by the citizens can push local administrations to improve their practices and increase their responsiveness to OGD requests [2]. Hence government resources and citizens' engagement have a mutual effect. However, this mutual influence between governmental resources and citizen engagement has not been theoretically explained or empirically investigated. Therefore, this study aims to analyze the mutual influence between governmental resources and citizen engagement to answer whether a city's governmental resource in OGD is coordinated with its citizen engagement.

Cordella and Paletti (2019) found that there are inequalities in service delivery across Italy's 20 regions, including differences in digital government capabilities and inefficient duplication of digital infrastructures [3]. Only a few studies have focused on the importance of coordination between the data providers and users. Janssen and Zuiderwijk investigated this relationship by looking at the diversity of infomediary business models between the government and the public [1]. Styrin et al. regard government as a platform to show that platform participation has wide differences in diverse input from governments by case study [4], and therefore platform needs to create more equity in services and digital capabilities [3]. De Tuya and colleagues use a case study to show that many cities have no adequate technical capabilities, IT staff, and lack the Government Chief Information Officer (GCIO) in managing the resources, which is harmful to the value generation for both governments and citizens [5]. Zuiderwijk and Janssen identified challenges in the coordination from data providers affecting data users in a theoretical introduction [6]. However, they did not conduct an analysis of the coordination mechanism between the government and the public. In conclusion, the coordination between governmental resources has received attention, but little is known about what coordination is and how to measure it. Furthermore, often qualitative research methods are used, and hardly any quantitative research methods.

The resource-based theory (RBT) supplies a relatively complete analytical framework for investigating diverse governmental resources, which helps complement the simplification of resource study in existing research [7]. Through the experience of 337 municipal cities in China, this study establishes an evaluation index system of the coupling coordination and uses the coupling coordination model to evaluate interactive connections between governmental resources and citizen engagement.

The structure of the paper is as follows: Section 2 presents the measurements of governmental resources and citizen engagement. This section also introduces the coupling coordinated model and how to design the weight of indicators before using this model. Section 3 shows the results of the coupling coordinated model by a coupling degree, coupling coordinated degree, and the relative development of the two. Section 4 concludes the paper and provides further research recommendations.

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2 RESEARCH BACKGROUND

In this section, we first discuss government resources and how they can be measured. This is followed by citizen engagement and their measurement.

2.1 Governmental resources measure

The RBT provides an important explanation that diverse resources equipped with every organization differentiate its competitive performance and advantages [8]. Resources can be classified into three groups: tangible, human, and intangible resources in Grant's classification. Hereafter, we will use this typology to divide governmental resources into tangible resources, human resources, and intangible resources. Tangible resources include financial assets and physical support such as OGD platforms, data resource, and finance. Intangible resources encompass assets such as the OGD policy and the OGD activity. Human resources include leaders and OGD-related agencies.

2.2 Citizen engagement with OGD measure

Citizen engagement with OGD refers to activities executed by citizens to yield artifacts like applications, maps, visualizations, writings, or news based on the modification of government data into truth, knowledge, understanding, interface, latest data, or service . We use data finding, data use and data feedback to measure it. Our data focuses on municipal cities.

2.3 The coupling coordination model

The coordination development between government resources and citizen engagement is a key issue to realize the sustainable development of government and improve the interaction between government and citizens. To this problem, the coupling coordination model, which is widely used to describe the degree of interaction between systems, is adopted in this study [**?**]. Coupling is a concept from physics, and it is a phenomenon in which at least two physical systems impact mutually through various types of interactions [10, 11]. Coordination requires a balanced and consistent interaction between them [12].

Before assessing the level of governmental resource and citizen engagement with OGD and the coupling coordinated development degree, each indicator needs to be given a reasonable weight in the evaluation system. The development of governmental resources and citizen engagement with OGD varied in these 337 municipal cities in China. Therefore, each indicator's weight is determined based on the Entropy method. The detailed steps are shown as follows. The steps include (1) standardizing the raw data, (2) calculating the index value ratio, (3) calculating the entropy, and (4) fixing the weight coefficient.

2.3.1 The weighting approach: the entropy method. We choose the entropy method because it is a weighting method that measures value dispersion. The weight of an indicator refers to the relative importance of the indicator in the overall evaluation [13]. This method's starting point is to determine the weight coefficient according to the degree of difference between the index values of each evaluation index. The entropy method avoids the interference of human factors in the process of determining the weight coefficient and can be more objective. It reflects the importance of each evaluation index in the comprehensive evaluation index system. Therefore, the entropy method is widely used in various disciplines, and we choose this method to weigh the subsystems and indicators of the governmental resource and the citizen engagement with OGD.

In the comprehensive evaluation, there are differences in type inconsistency and dimension inconsistency among the evaluation indicators. To eliminate the influence of these differences, it is necessary to perform dimensionless processing on these evaluation indicators. We firstly standardize the indicators by the standardized method. In this paper, the raw data need to be standardized using the extreme value processing method. Secondly, we calculate the index value ratio and calculate its entropy. The next step is to calculate the coefficient of difference of the evaluation index, and then the weight coefficient is fixed.

2.3.2 Coupling models and indicators. After the weights are determined, the next step is to calculate the coupling degree, the coupling coordinated degree, and the relative development between governmental resources and citizen engagement with OGD. This study applies the concept of coupling in physics to express the coupling degree of the two. The coupling coordinated degree model is constructed as follows by Eqs.

$$C = \sqrt{\frac{U_{GR} * U_{CE}}{\left(\frac{U_{GR}+U_{CE}}{2}\right)^2}} \tag{1}$$

$$T{=}aU_{GR} + bU_{CE},\ \text{a}{+}b{=}1,\ a > 0,\ b > 0 \tag{2}$$

$$D = \sqrt{C * T} \tag{3}$$

C represents the coupling degree, and D represents the coupling coordination degree. $U_{GR}$and U_{CE} represent the comprehensive functions of governmental resource (GR) and citizen engagement (CE) respectively. T represents the index of the coupled and coordinated development level. a and b stand for their contributions of GR and CE respectively, and we set them at 0.5 to represent equal importance. β is the relative development model, which is shown in Eq. 4).

$$\beta = \frac{U_{CE}}{U_{GR}} \tag{4}$$

3 RESULTS

Using the calculation method for the governmental resources, the citizen engagement and the coupling coordination model, we calculated the coupling degree, the coordination degree, and the relative development index in 337 municipal cities in 2019.

3.1 Spatial differences in the coupling degree between governmental resources and citizen engagement

In the real world, the development of governmental resources and citizen engagement usually have an interactive relationship. The paper used the coupling degree to represent the interaction degree of the the subsystems.

Table 1: The indicators of governmental resources and citizen engagement with OGD

Variable	Dimension	Index I	Index II	Score standard
Governmental resource	Tangible resources	OGD platform	Equipped with OGD platform	No 0; No but has cooperation with a compony 1; Enacted-way 2; independent platform 3
		Data resource	Showing data set quantity	Yes 1; No 0
			Showing data quantity of platform	Yes 1; No 0
			Data field diversity	More than one field, 2; only one field, 1; None 0
			Without data fragmentation	Yes 1; No 0
			Without data missing	Yes 1; No 0
			Data update	None, 0; Year, 1; Month, 2; Week, 3; Day, 4
		Finance	Financial general budget revenue	Local general public budget revenue in 2019 with primary data
	Intangible resources	Policy	Local regulations > local rules> regulatory ducuments > act opinions > No OGD related policy	Local regulations, 4; Local rules, 3; Regulatory ducuments, 2; Act opinions, 1; No OGD related policy, 0
			Municipal government has specific OGD policy	Yes 1; No 0
			Policy consider OGD as an impormant program of government	As an important project, 2; involve but not important, 1; no, 0
			Policy contain OGD catalog or list	Yes 1; No 0
			Involving opening method	Yes 1; No 0
			Involving data security	Yes 1; No 0
			Involving data governance Involving data quality	Yes 1; No 0
			Involving data privacy	Yes 1; No 0
			Involving collection of citizen requirements	Yes 1; No 0
		OGD activity	Having a continuous and large open data competition	Yes 1; No 0
			Having small and continuous open data activities	Yes, 2; Small activities but not continuous, 1; None, 0
	Human resource	Leaders	The leader's governmental work report involves OGD	Yes 1; No 0
			The annual work plan of government involve OGD	Yes 1; No 0
		Agencies	Establishing a data management department	Yes 1; No 0
			The data management department has clear responsibilities	Yes 1; No 0
Citizen engagement with OGD		Data finding	Administrative level of the data management	Provincial level 3; Sub-provincial level 2, Prefecture-level city, 1
				Yes 1; No 0
				Yes 1; No 0
			Whether the data set display is eye-catching	Yes 1; No 0
			Whether to provide an open data catalog	Yes 1; No 0
			Having a search function	
		Data use	Providing related data or applications on the same subject	Unconditional, 2; conditional, 1; can not be obtained, 0
			Data can be obtained unconditionally	Yes 1; No 0
				Yes 1; No 0
			With platform interoperability	Yes 1; No 0
			No irrelevant results	Yes 1; No 0
			No unavailable results	Yes 1; No 0
			No data source unknown	Yes 1; No 0
			Diversity of data users	Yes 1; No 0
			Diversity of results	Yes 1; No 0
				Yes 1; No 0

Data feedback	Diversity of subject areas	Yes 1; No 0
	Provide results submission channels	Yes 1; No 0
	Show data utilization results	Yes 1; No 0
	Mark the source information of the utilization results	Yes 1; No 0
	Effectively respond to data requests	Yes 1; No 0
	Provide data set publisher contact information	Yes 1; No 0
	With user evaluation, opinions and suggestions, and data error correction functions	
	Involving interconnected processes	
	Involving standardized and planned processes of feedback	

The measurement results show that 270 cities' the coupling degree of China's governmental resources and citizen engagement is between 0.50 and 0.80, which falls in the running-in state. It indicates that the two systems are in a state where the two are in the stage of mutual familiarity and adaptation. The possible reason is that many municipal governments put increasing resources to promote citizen engagement and citizens' requirements for data and services from government are higher nowadays in China. The two systems are constantly touching and interacting to increase their understanding of each other.

3.2 Spatial differences in the coupling coordination degree between governmental resources and citizen engagement

The calculation results of the coordination degree show that the coordination degree of China's governmental resources and citizen engagement present a low level of coordination. The coordination degree is between 0 and 0.3, and most cities are on the verge of low coordination. Besides, the coordination degree of cities on the east coast (green color) is relatively higher within moderate coordination. These cities are mainly located in Guangdong province, Jiangsu province, and Zhejiang province, which are the most developed provinces in China. These governments have a rich economic-social foundation, finance, technology, and talents to promote the development of OGD and citizen engagement with OGD.

3.3 Spatial differences in the coupling coordination degree between governmental resources and citizen engagement

According to the relative development model of governmental resource and citizen engagement, we can see that three kinds of relative development exist at the same time in China. Most obviously, more than half of the cities are marked in blue, meaning that citizen engagement lags behind the governmental resources in these cities. The likely reason is that although many local governments take many treasures to improve citizen engagement, citizens need more time to realize their consciousness of the advantage of OGD, and to start participation with OGD.

3.4 Comparing analysis of a coupling degree, a coupling coordinated degree and the relative development

We can get some main conclusions by comparing the three maps. Firstly, the general coupling degree is high within most of the cities ranging from 0.5 to 0.8. suggesting that the interaction between governmental resources and citizen engagement is high in China. Secondly, although the two have a strong interaction, the coordination between them is very low based on the coupling coordinated degree of them (less than 0.3 generally). The relative development can find the reason for this low coordination. The development of citizen engagement with OGD lags behind the governmental resource in most Chinese cities, which leads to low coordination.

4 CONCLUSIONS AND FURTHER RESEARCH DIRECTIONS

This paper focuses on investigating whether the governmental resource and citizen engagement with OGD are coordinated and what factors affect the coordination. Based on the resource-based theory, a model for governmental resources consisting of tangible, intangible, and human resources is developed. 337 Chinese municipal cities are analyzed to investigate its mutual effects and citizen engagement. The findings show that although governmental resources and citizen engagement with OGD have a strong interaction, their coordination is very low. The reason for this low coordination is that the development of citizen engagement with OGD lags behind the governmental resource in most Chinese municipal cities.

The coordination between data supply and demand has received attention but lacks empirical investigation. This paper tries to investigate it by building a model of government resources and offering a coupling coordinated analysis. Methodologically, we first introduce the method of a coupling coordinated model in the OGD field.

There are various directions for further research. Firstly, our samples come from a single country. Samples from other countries can increase the generalizability of the results. Secondly, the coordination of governmental resources and citizen engagement with OGD is not necessarily static and may change over time. The analysis of the coupling coordination is more meaningful with panel data.

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