

Empirical Study on the Contribution of Infrastructure to the Coordinated Development between Urban and Rural Areas: Case Study on Water Supply Projects

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Abstract

The gap between urban and rural areas is one of the key factors that may affect justice, equity, harmony and stability of the society. This is especially true in a developing country like China. Urban-rural coordination will help narrow the gap between city and countryside; more importantly, infrastructure is viewed as a crucial element in bridging the gap and facilitating a coordinated development. Based on the previously established evaluation index system and evaluation model for infrastructure contribution to urban-rural coordination, this paper makes an empirical study using the data from projects of Chongqing Urban-Rural Infrastructure Coordination Demonstration Program. The results of the study indicate that the contribution of infrastructures to urban-rural coordination increases with the growing equity of investment, and infrastructure plays a significant role in closing the urban-rural gap and gradually achieving the urban-rural coordination. Therefore, conclusion is made that the infrastructure investment between town and country should be balanced in a manner that is “equity-oriented and efficiency-emphasized” in order to attain the strategic goal of urban-rural coordination and promote social justice.

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1. Introduction

Infrastructure not only plays an important role in the social and economic activities of a country, a developing country in particular, but also makes an indispensable contribution to the urban-rural coordinated development in a country or region. As the existing evaluation models are found not able to effectively assess or scale the contribution of infrastructure to urban-rural coordination, it is necessary and

imperative to establish a practical and applicable model to evaluate the infrastructure contribution to urban-rural coordination.

The research team has made three rounds of questionnaire survey for comparison and determination of the weights and reference values of evaluation indicators,^[1] based on the empirical data collected from Chongqing urban-rural coordination infrastructure development demonstration program and information acquired from related statistical yearbook (manual), specifications, standards and other research findings.^[2-10] Further, the team has established a model to assess the infrastructure contribution to urban-rural coordination on the basis of the existing evaluation models in this connection, and derived evaluation formula to calculate the contribution of water supply infrastructure to the urban-rural coordination.^[11] This is a significant instrument and reference for the quantitative analysis of infrastructure contribution to urban-rural coordination.

Nevertheless, the evaluation model for infrastructure contribution to urban-rural coordination should be empirically proved for its reliability and feasibility. Chongqing, a “National Pilot Zone of Comprehensive Concerted Reforms for Urban/Rural Coordination” approved and established by the National Development and Reform Commission in June 2007,^[12] launched the Chongqing Urban-Rural Infrastructure Coordination Demonstration Program (hereinafter referred to as “Demonstration Program”) under the loan of the Asian Development Bank in 2008. This program is one of the first infrastructure construction packages designed for urban-rural coordination and in this background. The program is comprised of two major parts, namely water supply and road construction, covering 30 projects over 8 districts or counties, among which 9 are water supply projects targeted at construction of water plants, pipelines and related facilities, and 21 are newly initiated or expanded road construction projects. The samples and cases for empirical analysis in this paper are mostly from water supply projects of this program.

2. Empirical Study

2.1 Evaluation model and standards

According to the conclusions of Research on Evaluation Model for Infrastructure Contribution to Urban-Rural Coordination, Y is the contribution of infrastructure to urban-rural coordination, whilst X_{ij} , representing an evaluation index, remains unchanged. The following is the formula and evaluation standards:

1) The model of water supply project

$$Y = \alpha * \{0.4 * [0.27 * (X_{11}/7.25 - 1) + 0.24 * (X_{15}/16.97 - 1) + 0.22 * (X_{16}/17939.8 - 1) + 0.27 * (X_{17}/2.72 - 1)] + 0.34 * [0.2 * (X_{21}/1.22 - 1) + 0.27 * (1 - X_{22}/42.16) + 0.2 * (X_{26}/27.7 - 1) + 0.17 * (X_{27}/0.73 - 1) + 0.16 * (1 - X_{28}/0.41)] + 0.26 * [0.21 * (1 - X_{34}/0.63) + 0.3 * (1 - X_{35}/0.13) + 0.22 * (X_{36}/0.54 - 1) + 0.27 * (X_{37}/4.71 - 1)]\} + (1 - \alpha) * \{0.44 * (1 - X_{43}/1.8) + 0.32 * [0.46 * (1 - X_{51}/3.78) + 0.54 * (1 - X_{55}/7.48)] + 0.24 * [0.34 * (1 - X_{61}/0.59) + 0.39 * (1 - X_{62}/0.28) + 0.27 * (1 - X_{63}/2.1)]\} \quad (1)$$

In this formula, the weight of an efficiency indicator is α , and the weight of an equity indicator will be $1 - \alpha$, where $0 \leq \alpha \leq 1$.

2) Evaluation criteria

When $Y \geq 0$, the project is acceptable. Specifically speaking, when the value of Y is above zero, the infrastructure contribution to urban-rural coordination is positive, which means it is beneficial to narrowing the urban-rural gap; when the value of Y is zero, the infrastructure contribution to urban-rural coordination is nil, which means the urban-rural gap remains unchanged.

When $Y < 0$, the project is unacceptable, because the infrastructure contribution to urban-rural coordination is negative, leading to the urban-rural gap widened.

With the above model formula and evaluation criteria, Chongqing urban-rural coordination infrastructure development demonstration program or other infrastructures, water supply projects particularly, to be executed for the purpose of urban-rural coordination, can be evaluated and quantified with regard to their contribution to the urban-rural coordinated development, because their degree of contribution may be calculated through expert judgments and indicators.

2.2 The principle in value-taking for α

With economic growth in the west, the theory of equality and efficiency has gone through three major stages: from the end of 19th century to early 20th century, welfare economics represented by “economic interventionism”, “neo-classic synthesis” and “welfare economic school” advocated “the priority of equality”; following World War II, scholars, mainly those believing in economic liberalism, promoted “the priority of efficiency” and free market mechanism as a countermeasure against “efficiency crisis” emerging from the western countries. Since early 1970s, economists, represented by Arthur M. Okun, put forward a theory of alternation between equality and efficiency, arguing that both equality and efficiency have their own merits and should be integrated in the full play of market mechanism.^[13]

The real intention of China’s policy of coordinated urban and rural development is to provide urban and rural residents with equal opportunities for development, facilitate an appropriate flow and optimized allocation of resources, strengthen the role of city in leading rural development and the role of rural areas in stimulating urban growth and ultimately narrow the gap between urban areas and rural districts. In this way, both urban and rural community, as well as their economy, can be put into a balanced, sustainable and coordinated track.^[14]

Based on the experience from developed countries, the infrastructure investment distribution among regions (highway construction, for instance) largely follows three principles: equality, efficiency and neutrality. The gap of development between cities and villages is a factor to be considered in the first instance when China formulates policies for the infrastructure investment distribution among regions. Since the issue of urban-rural dual structure has become prominent, infrastructure investment should have a full play in its role as an economic policy to bridge the income gap among regions. Therefore, a policy demonstrating that “equality is predominant and efficiency is important” should be set down.^[15]

Although α represents the weight of efficiency indices, equity is an indispensable component of the model in terms of model structure and the connotation of urban-rural coordination. This is the principle to be followed as far as possible when value is assigned to α to evaluate the contribution of Demonstration Program or other infrastructure to urban-rural coordination.

2.3 The result of evaluation

The values of project indices need to be applied to corresponding formula to verify the contribution of the Demonstration Program to urban-rural coordination. Besides, α is a continuous variable ($0 \leq \alpha \leq 1$). For convenience of calculation, it is assumed that α is one of the discrete values between $[0, 1]$ at an interval of 0.1. Then, the contribution of projects of the Demonstration Program can be acquired by taking different value of α (see Table 1).

<Insert Table 1 here>

In addition to the above, diagram is a visually clearer way to display the extent and trend of the contribution of projects to urban-rural coordination while α is changing (see Fig. 1 for details).

<Insert Fig. 1 here>

The above-mentioned figures show that under the principle of being “equity-oriented, efficiency-emphasized”, the weight of efficiency indices α is ≤ 0.5 and the contribution Y of each water supply project in the Demonstration Program is above zero, indicating the project is acceptable; in other words, the

contribution of Chongqing Urban-Rural Infrastructure Coordination Demonstration Program is positive and beneficial to narrowing the urban-rural gap.

3. Discussion

3.1 *The relation between α and contribution*

The definition of α is very clear, i.e. the weight of efficiency indices, and besides $0 \leq \alpha \leq 1$. Seeing from the aforesaid figures, we will find the contributions of all water supply projects are all monotone decreasing with the increase of α within $[0, 1]$, with the only exception of the Longtan Town Water Supply project, the contribution of which slightly increases due to the relatively large efficiency indices. This shows that α is in inverse proportion to the contribution, i.e. the infrastructure contribution to urban-rural coordination will reduce, even below zero for some projects, as the weight of efficiency index increases and weight of equity index decreases. It is therefore concluded that overemphasis on efficiency and negligence of equity will fail to contribute to urban-rural coordination; and what's worse the urban-rural gap is to be enlarged.

3.2 *Evaluation of the significance of the model*

Further explanation can be found from this empirical study on the evaluation model that infrastructure contribution to urban-rural coordination is mainly reflected by both equity and efficiency, regardless of the value of α (except when $\alpha=0$, the contribution is only from equity and when $\alpha=1$, the contribution is only from efficiency). Moreover, the results of verification for projects also show that the infrastructure's role in the social and economic activities of a country and its contribution to the regional urban-rural coordination are not only reflected by efficiency, but more importantly, by the equity.

3.3 *Applicability and reliability of evaluation model*

The applicability and reliability of the evaluation model have been approved by the above verification for all water supply projects of the Demonstration Program. Nevertheless, as Chongqing Urban-Rural Coordination Infrastructure Development Demonstration Program is limited in number, scale, type and location, the evaluation model derived from the Program is also confined in its application. Likewise, the reliability of the model, relying on the trueness and accuracy of project and statistical data, is also dependent on the professional and objective judgment of experts and the continuous improvement in practice. Therefore, it is beneficial exploration and attempt to establish a model for evaluating infrastructure contribution to urban-rural coordination; and this model is relevant and reliable for quantitative evaluation and measurement of the contribution.

4. Conclusion

It is the result of the study that the infrastructure contribution to urban-rural coordination will decrease with the growing weight of efficiency indices, indicating the upward trend of urban-rural gap when efficiency is overemphasized and equity is neglected during infrastructure investment. The gap of development between cities and villages is a factor to be considered in the first instance when China formulates policies for the infrastructure investment distribution among regions. The infrastructure investment should be focused on rural areas, especially for the cities in middle or western China, such as Chongqing, where the problem of dual urban-rural structure is remarkable and the urban-rural gap is large.

Besides, the majority of the projects reach a similar conclusion that the infrastructure contribution to urban-rural coordination will constantly increase when the weight of efficiency indices gets lower and the weight of equity indices grows up, until it reaches the maximum when the former is reduced to zero and the latter is 1. Therefore, the problem of dual rural-urban structure currently faced by Chongqing will be alleviated by using infrastructure investment as an economic tool to bridge the urban-rural gap and gradually attain the goal of coordinated development. On the other hand, the contribution of the infrastructure increases as the weight of equity indices (i.e. the equity of investment) grows. Based on the above rationale, the infrastructure investment between town and country should be balanced in a manner that is “equity-oriented and efficiency-emphasized” in order to achieve the strategic objective of urban-rural coordination.

Thus derived the central tenet of urban-rural coordinated development and reform of Chongqing-----social justice and equity shall be promoted in parallel with economic growth.^[16] In other words, the urban and rural residents are entitled to equal opportunities for development, the overall planning should be made to cover both the town and the countryside, the policies should be adjusted where residence registration, land, social security, etc. are concerned, the resources (such as investment into country road, water supply to small towns) should be allocated, and incessant efforts should be put into the interaction of urban and rural areas, so that the urban-rural gap may be narrowed and the social and economic development may be balanced, sustained and coordinated.

Finally, the methods and practices of study in this subject will serve as a good reference to other similar researches on the infrastructure contribution to urban-rural coordination.

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Table 1 The table of the contribution value of the water supply project

District(County)	Project site	$\alpha=0.0$	$\alpha=0.1$	$\alpha=0.2$	$\alpha=0.3$	$\alpha=0.4$	$\alpha=0.5$	$\alpha=0.6$	$\alpha=0.7$	$\alpha=0.8$	$\alpha=0.9$	$\alpha=1.0$
Chengkou	Gaoguan	0.38	0.34	0.30	0.26	0.23	0.19	0.15	0.12	0.08	0.04	0.01
Fengjie	Caotang	0.38	0.34	0.30	0.27	0.23	0.20	0.16	0.13	0.09	0.06	0.02
	Hongtu	0.38	0.33	0.29	0.25	0.21	0.17	0.13	0.09	0.05	0.01	-0.03
Youyang	Longtan	0.38	0.38	0.38	0.38	0.39	0.39	0.39	0.39	0.40	0.40	0.40
	Mawang	0.38	0.35	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.19	0.17
Yunyang	Jiangkou	0.38	0.35	0.33	0.30	0.28	0.25	0.23	0.21	0.18	0.16	0.13
	Nixi	0.38	0.32	0.27	0.22	0.17	0.12	0.07	0.02	-0.03	-0.08	-0.13
	Yanglu	0.38	0.33	0.29	0.24	0.19	0.15	0.10	0.06	0.01	-0.03	-0.08
Wushan	Longjing	0.38	0.34	0.30	0.27	0.23	0.19	0.16	0.12	0.08	0.05	0.01

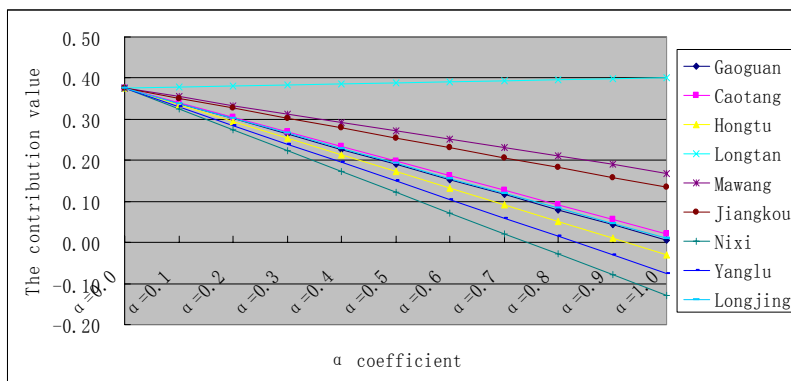


Figure 1 The Fig of the contribution value of the water supply project