

Article

Examining the Impact of Infrastructure Financialization on Uneven Regional Development: Evidence from China

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Abstract: Infrastructure financialization is an important economic phenomenon in urbanization and urban financialization. The existing studies are mainly focused on qualitative and theoretical analysis around the world. To quantitatively evaluate the impact of infrastructure financialization on uneven regional development, this study firstly measures the characteristics of uneven regional development in China, then we use the Tobit model to analyze the impact of infrastructure financialization based on panel data from 2006 to 2019. The results find that infrastructure financialization plays a significant role in uneven regional development in China. Low infrastructure financialization constrains the economic growth and urbanization of underdeveloped regions. This study not only contributes to the knowledge body of global financialization theory, but also provides a scientific basis for the optimization of infrastructure development both in China and the Global South.

Keywords: infrastructure financialization; tobit model; uneven regional development; financial geography; urbanization; China



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1. Introduction

Infrastructure is an important driving force for urbanization and economic growth, as well as a critical guarantee for people's well-being [1]. However, infrastructure construction costs are often too great for local governments to afford [2]. The shortage of funds for infrastructure development is a common challenge faced by governments around the world [3]. To address the challenge of urban and rural infrastructure investment and financing, governments of various countries have carried out a long-term exploration of financialization, forming a dynamic, variegated, and complex financialization phenomenon [4]. Infrastructure financialization can be understood as a process in which the proportion of financial capital in the fund source of infrastructure construction keeps increasing, and the role and influence of financial institutions, instruments, and professionals in infrastructure construction keep expanding. However, financialization is a double-edged sword. On the one hand, financialization promotes infrastructure construction; on the other hand, there is the risk of excessive financialization, which leads to debt crises for local governments [5,6]. Therefore, it is necessary to evaluate infrastructure financialization scientifically and systematically and establish a mechanism for sustainable infrastructure development.

Infrastructure financialization not only has a significant direct effect on urbanization and urban spatial expansion, but also an important impact on government debt and social welfare [7–9]. In addition, the impact of infrastructure financialization is heterogeneous across scales and regions [7]. This study focuses on infrastructure financialization's impact on uneven regional development (URD). The misallocation and liquidity of financial capital across regions have led to the delayed development of infrastructure in underdeveloped

regions, widening the gap between urban and rural areas. Widening imbalances may lead to more serious political and social problems and even impede national development. As a critical factor influencing URD, existing studies of infrastructure financialization lack empirical analysis to justify the hypothesis.

In recent decades, China's economy has experienced an amazing achievement, but there is also serious URD, including the imbalance between the east, middle, and west, and between the north and south [10–14]. There are 31 provinces (excluding Hong Kong, Macao, and Taiwan) in mainland China, which are generally divided into eastern, central, western, and northeastern regions, decreasing from east to west in terms of economic development level. China's eastern provinces are on the coast, have easy access to shipping, were the first to implement the reform and opening-up policy, are more globalized, and have been leading the economy. In 2021, the GDP of the eastern, central, western, and northeastern regions are 59.2 trillion yuan, 25.0 trillion yuan, 24.0 trillion yuan, and 5.6 trillion yuan respectively, accounting for 52%, 22%, 21%, and 5% respectively. What is the overall situation of China's URD? What is the impact of infrastructure financialization on URD? What is the degree of impact? To address these questions, this study identifies and analyzes the characteristics of URD in China, then uses the Tobit model to evaluate the impact of infrastructure financialization on URD with provincial panel data from 2006 to 2019. The marginal contribution of this study is multifold. On the one hand, this study enriches the global knowledge body of financialization and financial geography; on the other hand, this study provides a scientific basis for the decision-making and optimizing of the regional development policies for the government. Moreover, although this study is based on data from China, the findings of the study are informative for the Global South.

This study aims to examine the impact of infrastructure financialization on uneven regional development through the quantitative method. This paper begins with a brief review of financialization and uneven regional development. Following this, the research design and data are presented. We discuss the empirical results in the fourth section. We conclude by summarizing and discussing the key points made in this study, and by suggesting some policy directions for the optimization of infrastructure financialization in China and other developing countries.

2. Theoretical Background

In the face of the fast-developing financial market, financial capital continues to spread outward from the economic field in the process of pursuing profit maximization, which is called "financialization" [15]. As a highly complex and dynamically evolving phenomenon, financialization generally refers to the process by which financial motivation, markets, actors, and institutions play an increasingly larger role in domestic and international economics [16–19]. Despite its origins in the economic field, financialization also has distinctive features in the field of urbanization and urban development, and has gradually attracted the attention of geographers [20,21]. The financialization of city areas covers many fields such as nature, land, real estate, infrastructure, healthcare, and energy [22]. Among these factors, the financialization of land and real estate has attracted more attention from scholars due to the significant trends and high dependence on the financial market [23,24]. Compared with the financialization of land and real estate, there have been relatively few studies on infrastructure financialization, especially theoretical summaries and model construction results based on Chinese experiences and the perspective of geographical disciplines. On the one hand, the existing research on infrastructure financialization has mainly focused on economics, management, and other disciplines, and lacks research from the perspective of economic geography [25,26]. On the other hand, the existing theoretical system and research on the financialization of cities are mainly based on the western urbanization background. Research in the context of developing countries (global south) is still in its infancy [27]. Infrastructure financialization has multiple dynamic effects. The extent of financialization in China and its role in urbanization remains controversial [28]. However, urban financialization in China is a significant and irreversible trend. An important feature

of urban financialization in China is the key role played by local government financing platforms and mega urban projects [29,30]. The imperfect financial market not only has an important impact on local government debt, but also a direct effect on urbanization and spatially unbalanced development. Global financial capital has significant spatial heterogeneity and agglomeration. Most financial capital, including financial funds, institutions, and practitioners, is concentrated in a few financial centers.

URD is a common phenomenon in urbanization and economic growth [31]. Except for some countries with small areas and no regional development differences, almost all countries have URD problems, especially China [12–14]. Some economists believe the inter-regional income gap is the main cause of URD [32,33]. Among them, the difference in the capital endowment is the most important factor affecting the income gap [34,35]. The theory of new institutional economics emphasizes the importance of institutions to economic growth, and confirms that institutions play a significant role in economic growth in China [36]. In the context of economic opening, globalization, and trade liberalization have significantly increased China's inter-regional income gap [37].

With the multiplier and driving effects, infrastructure can promote economic growth, stimulate capital investment, improve residents' living standards, eradicate poverty, and reduce URD. Therefore, it is recommended to build infrastructure moderately ahead of time. Démurger (2001) used the economic growth model to conduct an empirical study on the relationship between China's infrastructure investment and economic growth [38]. Fedderke, Perkins, and Luiz (2006) confirmed the promotion effect of infrastructure construction on economic growth by measuring South Africa's infrastructure and economic growth [39]. However, infrastructure also has negative effects, such as generating local government debt risk due to the huge investment in infrastructure and government financing and subsidies, which some scholars call the "infrastructure trap" [40,41].

The effect of infrastructure financialization on URD is reflected in several aspects. On the one hand, financialization can attract funds from developed regions to accelerate local development and narrow the gap in regional development for underdeveloped regions with backward economies and a lack of infrastructure construction funds. On the other hand, the profit-seeking and agglomeration of financial capital will promote investments in infrastructure projects in developed regions, which will widen regional development differences. In addition, infrastructure investments have a spread or backwash effect in economic activity, which possesses a strong spatial correlation, having the greatest impact on the neighboring region [42]. From a theoretical point of view, those effects co-exist, which requires empirical analysis and case verification. Through evaluation indicators and quantitative measurements, the impact of infrastructure financialization in the process of urban and regional development is assessed, thereby monitoring potential problems due to financialization and deepening the theoretical understanding of financialization.

3. Materials and Methods

This study chose China as a typical case to examine the impact of infrastructure financialization on uneven regional development. On the one hand, China's infrastructure experiences significant financialization in the urbanization process in order to address the financing challenge. On the other hand, it is based on the consideration of data availability. In addition, the existing studies on urban financialization basically focused on theoretical analysis and case studies. This study constructed the indicator systems for uneven regional development and infrastructure financialization respectively based on the provincial panel data in China, and quantitatively assesses the impact of infrastructure financialization on uneven regional development by the Tobit model. The methods and findings would be of interest also for other nations.

3.1. Constructing the Evaluation Index System

3.1.1. URD Indicators

The quantitative measurement of URD is complex as there is currently no specific and generally accepted index system. The selection of indicators is affected by various factors, which are highly correlated with measurement methods and objectives. Any factor will affect the results of the analysis. From the selection of indicators, research on URD is mainly divided into the following two types. The first is to study regional economic growth gaps. For example, Zhou (2002) used GDP per capita as an overall indicator to measure regional economic differences and analyzed the varying characteristics of economic differences between provinces in China from 1990 to 2000 based on the standard deviation and standard deviation coefficient of GDP per capita among provinces. The second type is the gap in living standards between study areas. Among them, per-capita consumption and per-capita income indicators are widely used. For example, Xu (2006) used China's per-capita income and consumption since 2000 to prove that regional disparities in China are still widening. This paper chooses per-capita GDP as a measure of URD. Compared with other indicators, per-capita GDP includes services, which is an important indicator to measure the level of regional economic development.

In general, URD measured by economics can be reflected in three aspects, namely the absolute gap, relative gap, and comprehensive gap.

(1) Absolute gap

The absolute gap refers to the absolute deviation between the overall unit variable value and standard deviation, including range, mean deviation, and standard deviation. Range is chosen in this paper. Range refers to the difference between the maximum and minimum values of the overall unit variable value. The calculation formula is as follows.

$$R = X_{max} - X_{min}$$

where X_{max} represents the maximum value of per-capita GDP and X_{min} represents the minimum value of per-capita GDP.

(2) Relative gap

The relative gap refers to the ratio between the overall unit variable value and the contrast value, namely, the relative ratio, including relative difference, relative range, and unbalance difference. This paper selects the relative range for research. The relative range refers to the ratio of the maximum to the minimum values between similar indicators. The calculation formula is as follows.

$$D = \frac{X_{max}}{X_{min}} \times 100\%$$

where X_{max} represents the maximum value of per-capita GDP and X_{min} represents the minimum value of per-capita GDP.

(3) Comprehensive gap

The comprehensive gap refers to the comprehensive ratio of the gap between the overall unit variable values, which reflects the overall trend of the difference. In a regional economy, there is the Gini coefficient, Theil index, and weighted coefficient of variation. The weighted coefficient of variation removes the disadvantages of the first two, which is a reasonable and effective calculation method. Therefore, this paper selects the weighted coefficient of variation for research. The formula is as follows:

$$V_w = \frac{1}{\bar{x}} \sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \times \frac{P_i}{P}}$$

where V_w is the weighted coefficient of variation, \bar{x} is the mean value of per-capita GDP, and $\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \times \frac{P_i}{P}}$ is the standard deviation of per-capita GDP.

This paper uses the three indicators of range, relative range, and the weighted coefficient of variation to explain the overall characteristics of China's URD from the aspects of the absolute gap, relative gap, and comprehensive gap. The comprehensive gap was selected for empirical analysis, which can reflect the overall development trend.

3.1.2. Indicator of Infrastructure Financialization

The financial correlation rate indicator to measure economic financialization is the ratio of total financial assets to gross national product. Drawing on the financial correlation rate, we constructed the infrastructure financialization rate (IFR) indicator, that is, the ratio of the total amount of financial funds to the total investment in infrastructure investment. The calculation formula is as follows:

$$IFR = F_r / W_r$$

where F_r refers to the total amount of financial capital in infrastructure investment in a certain period and W_r refers to the total investment in infrastructure in a certain period.

3.2. Model and Variables

3.2.1. Tobit Model

The Tobit model is also known as a censored regression model or limited dependent variable. The classic Tobit model hails from the Probit model by James Tobin who analyzed the expenditure of household durable goods [43,44]. The Tobit model's original purpose was to address the limitations of explanatory variables and extreme value problems. In continuous development, explained variable value constraints or selection behaviors are attributed to the Tobit model. It achieves consistent results by exploiting maximum relief estimates. The Tobit model has been widely used in the field of social science research [45–49]. Considering the range of the explained variable (comprehensive gap) is 0–1, this paper adopts the Tobit model with a limited dependent variable. Stata software was used to analyze panel data for the comprehensive gap among the four regions from 2006 to 2019. With infrastructure financialization levels as explanatory variables, and urbanization rate, government intervention degree, and highway mileage as control variables, the IFR's impact on URD is estimated as follows:

$$URD = \alpha \sum \beta_i X_i + \text{control} + \varepsilon$$

where URD represents the comprehensive difference index of URD among the four regions, α is the intercept item, β_i is the parameter to be estimated, X_i represents the influencing factor of the comprehensive difference, control represents the control variable, and ε represents the residual item.

3.2.2. Variables Selection

For data availability and high correlation, the following indicators are selected to examine the impact on regional development so as to ensure the authenticity and reliability of the indicator values.

The details of the variables are as follows:

(1) Explained variable.

The comprehensive gap (weighted coefficient of variation) of per-capita GDP is selected to characterize URD.

(2) Explanatory variables.

This paper selects the infrastructure financialization level as the core explanatory variable to comprehensively analyze the IFR's impact on URD.

(3) Control variable.

Urbanization level, government intervention degree, and public service level are cited as contributing factors to URD. Urbanization level is a symbol that reflects the coordinated development of a country or region in terms of productivity development, technological

progress, and industrial structure, which is generally expressed by urbanization rate, that is, the proportion of the total urban population to the total population. Government intervention affects economic growth and further regional development in various regions through growth drivers. Based on the existing literature, public service is considered a controllable variable. Among them, highway mileage in the transportation domain is selected to measure public service.

3.3. Data Source and Processing

The data used in this article are panel data from 2006 to 2019, all from the China Statistical Yearbook from 2006 to 2019. According to the variables' descriptive statistics, there are no outliers in the current data. The data values all fluctuate within the normal standard deviation range of the mean value. In contrast, the comprehensive gap and IFR of URD among China's 31 provinces and cities fluctuated more. The index kurtosis of the comprehensive gap is -0.291 and the skewness is 1.084 . The indicator kurtosis of the IFR is 2.007 and the skewness is 1.176 . A basic understanding of the data is obtained through the descriptive analysis of the characteristics of concentration and volatility, which lays the foundation for subsequent in-depth analysis (Table 1).

Table 1. Descriptive statistics of variables.

Variables	Mean Value \pm Standard Deviation	Variance	Median	Standard Error	Mean Value 95% CI(LL)	Mean Value 95% CI(UL)	IQR	Kurtosis	Skewness
Comprehensive gap	0.509 \pm 0.079	0.006	0.460	0.021	0.467	0.550	0.127	-0.291	1.084
Infrastructure financialization level	0.378 \pm 0.028	0.001	0.375	0.008	0.363	0.393	0.034	2.007	1.176
Highway mileage	426.500 \pm 49.187	2419.369	429.685	13.146	400.735	452.265	88.745	-1.135	-0.165
Government intervention	0.226 \pm 0.023	0.001	0.235	0.006	0.214	0.238	0.030	-0.398	-0.829
Urbanization level	0.537 \pm 0.060	0.004	0.538	0.016	0.505	0.568	0.112	-1.265	-0.034

4. Results

4.1. URD Characteristics in China

Since the 1990s, the Chinese government has begun to pay attention to the issue of URD and attempted to solve the problem of URD in the process of urbanization by implementing industrial policies, regional development policies, and rural revitalization strategies, as well as using state finances and taxation to directly support backward regions.

According to the available data, this paper selects the per-capita GDP of 31 province-level regions in China (excluding Hong Kong, Macao, and Taiwan) from 2006 to 2019 as indicators to measure URD. This paper describes the URD of 31 province-level regions in China from 2006 to 2019 from the perspectives of range (absolute gap), relative range (relative gap), and the weighted coefficient of variation (comprehensive gap), as shown in Table 2.

Table 2. Uneven regional development measured by China's per capita GDP.

Year	Range	Relative Range	Weighted Coefficient of Variation
2006	48,893	275.9756	0.6672
2007	56,173	263.2354	0.6439
2008	59,457	239.2918	0.5926
2009	61,549	230.4786	0.5722
2010	66,514	213.3193	0.5332
2011	70,222	192.7114	0.4867
2012	73,811	184.9131	0.4614
2013	78,480	179.8717	0.4482
2014	81,631	174.0689	0.4420
2015	87,746	177.2708	0.4489
2016	95,995	180.2385	0.4580
2017	107,069	182.3794	0.4568
2018	118,784	184.5443	0.4568
2019	127,069	184.5134	0.4511

As shown in Table 2, the range of China’s 31 provinces, municipalities, and autonomous regions increased year by year, and the relative range and weighted coefficient of variation fluctuated from 2006 to 2019. The following figures are more intuitive for observation and analysis (see Figures 1–3).

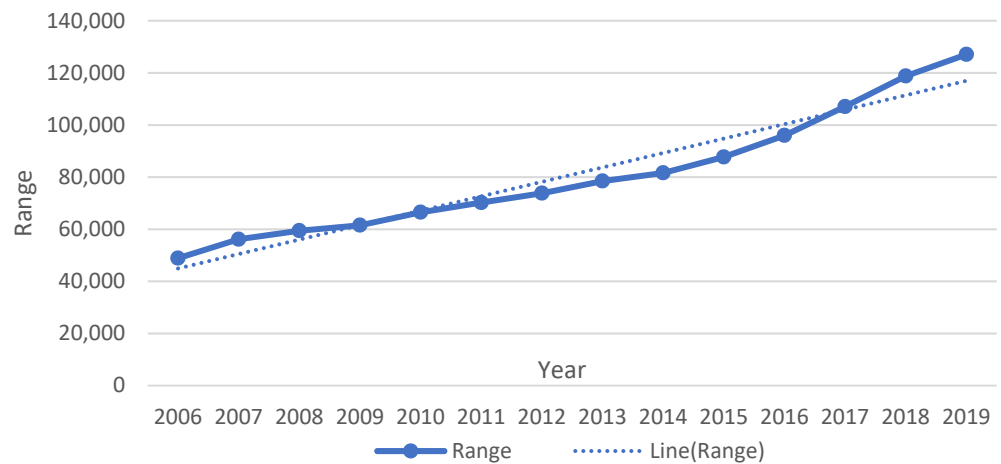


Figure 1. The absolute gap (range) of China’s per-capita GDP from 2006 to 2019.

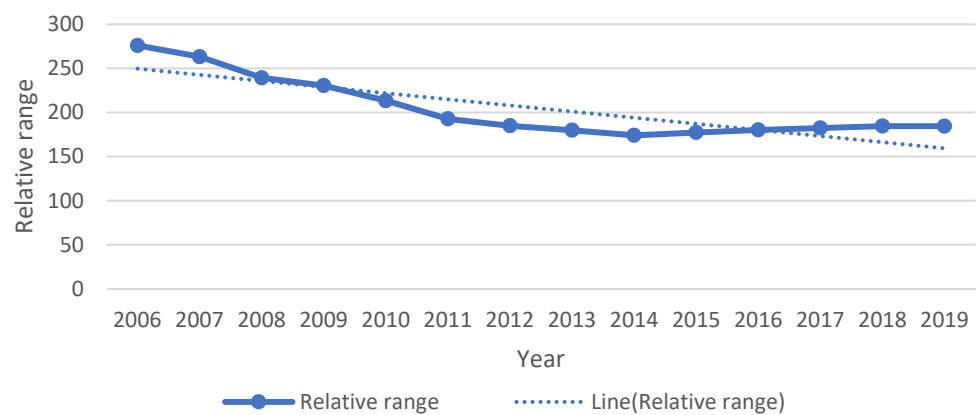


Figure 2. A comprehensive gap of China’s per-capita GDP from 2006 to 2019.

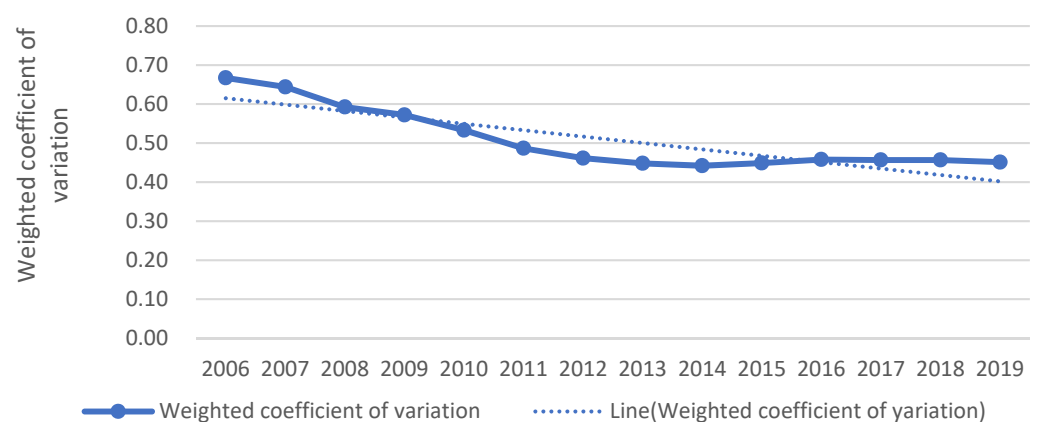


Figure 3. The comprehensive gap in China’s per-capita GDP from 2006 to 2019.

The range of per-capita GDP of China’s 31 provinces, municipalities, and autonomous regions is constantly rising, with different ranges. In 2006–2007, the rate of increase continued to climb. In 2007–2009, the rate of increase continued to slow. From 2009–2017,

the rate of increase continued to grow. In 2017–2019, the rate of increase continued to slow down. In general, the absolute gap in China has continued to increase in the past decade. However, there has been a slowing trend of growth in recent years, which is likely to continue in the future.

Compared with the absolute gap, the relative gap and the comprehensive gap are more complex. From 2006 to 2019, China’s per-capita GDP relative range generally showed a downward trend (Figure 2). With 2014 as the dividing line, the relative range of China’s per-capita GDP showed a volatile downward trend in 2006–2014 and an upward trend in 2014–2016. Since 2016, the relative gap between regions in China has slowly declined. Overall, the level of URD in China has been gradually controlled and declined in recent years.

As can be seen from Figure 3, China’s URD from 2006 to 2019 generally presents the following characteristics. With 2014 as the dividing line, China’s regional development showed a fluctuating downward trend in 2006–2014 and a slow rise in 2014–2016. In 2016–2019, regional development showed a continuous downward trend. In recent years, China’s URD has been slowly shrinking in general, which shows that policies such as “One Belt One Road” have gradually come into play since 2014.

From the perspectives of range (absolute gap), relative range (relative gap), and the weighted coefficient of variation (comprehensive gap), the URD of China’s provinces and cities in the past ten years has been described in general. First, the absolute gap of China’s URD increased year by year from 2006 to 2019, whereas the relative gap and comprehensive gap continued to decline. Secondly, although the absolute gap in China’s regional development is increasing, the growth rate is gradually slowing down. It is predicted that the absolute gap of regional development may shrink in the future. Finally, the relative range (relative gap) and the weighted coefficient of variation (comprehensive gap) show similar characteristics. The changing trends of the two are basically the same, and both take 2014 as the turning point. After 2014, the relative gap and comprehensive gap showed a trend of rising first and then falling.

4.2. Regression Analysis

First, the model is subjected to an overall validity analysis. According to Table 3, the original hypothesis of this model test is that the model quality is the same in both cases with or without explanatory variables (IFR, highway mileage, urbanization level, and government intervention). The *p*-value is less than 0.05, indicating that the original hypothesis is rejected. Therefore, the explanatory variables have validity. In other words, this model building makes sense. If AIC or BIC values are used to compare multiple models, the smaller the AIC or BIC value, the better the model builds.

Table 3. Tobit regression model likelihood ratio test.

Model	−2 Logarithmic Likelihood	Chi-Square Value	Df	<i>p</i>	AIC Value	BIC Value
Intercept only	−32.443					
Final model	−72.427	39.984	4	0.000	−62.427	−59.231

From Table 4, the explanatory variables of the Tobit regression analysis include IFR, highway mileage, urbanization rate, and government intervention, and the explained variables include the comprehensive gap. The model formula is as follows: comprehensive gap = 0.967 + 0.481 × IFR − 0.005 × highway mileage + 3.325 × urbanization level − 1.998 × government intervention. Through specific analysis, the final results are as follows.

Table 4. Summary of Tobit regression analysis results (n = 14).

Item	Regression Coefficient	Standard Error	z Value	p Value	95% Confidence Interval (CI)
Intercept	0.967	0.103	9.422	0.000	0.766~1.168
Infrastructure financialization rate	0.481	0.186	2.592	0.010	0.117~0.845
Highway mileage	−0.005	0.002	−2.110	0.035	−0.009~−0.000
Urbanization level	3.325	1.647	2.019	0.043	0.098~ 6.552
Government intervention	−1.998	0.661	−3.022	0.003	−3.293~−0.702
Log (Sigma)	−4.006	0.189	−21.196	0.000	−4.376~−3.635

Note: Dependent variable is a comprehensive gap. McFadden R2: −1.232.

The regression coefficient value of IFR is 0.481 and shows a significant level of 0.01 ($z = 2.592, p = 0.010 < 0.01$), which means the IFR had a significant positive effect on the comprehensive gap.

The regression coefficient value of highway mileage is −0.005 and shows a significance level of 0.05 ($z = -2.110, p = 0.035 < 0.05$), which means highway mileage has a negative impact on the comprehensive gap.

The regression coefficient value of the urbanization rate is 3.325 and shows a significance level of 0.05 ($z = 2.019, p = 0.043 < 0.05$), which means the urbanization rate has a significant positive impact on the comprehensive gap.

The regression coefficient value of government intervention is −1.998 and shows a significance level of 0.01 ($z = -3.022, p = 0.003 < 0.01$), which means government intervention has a significant negative impact on the comprehensive gap.

The IFR has a significant positive impact on the comprehensive gap of URD. The urbanization rate has a positive effect, which is not as large as the infrastructure financialization's impact. Highway mileage and government intervention have a negative impact on the comprehensive gap.

5. Conclusions and Discussion

Infrastructure financialization is an important part of urban financialization. However, compared to the financialization of real estate and land in urbanization, infrastructure financialization has been paid little attention, especially the lack of quantitative empirical studies. Based on the panel data of provinces in China, this study conducts an empirical analysis of the relationship between infrastructure financialization and URD through the Tobit model. The results validate the existence and continued exaggeration of serious regional imbalances in China. Furthermore, the empirical results verify the significant impact of infrastructure financialization on URD. The underdeveloped financialization affects infrastructure construction, which in turn constrains economic growth and urbanization. This research supports and enriches existing theories on the function of financialization in urbanization using Chinese cases and data.

Over the past few decades, Chinese local governments have adopted various financial instruments and financial policies to promote local and regional development, which have had far-reaching effects [50,51]. Due to financialization itself and the constraints of local institutions and environments, it is necessary to conduct in-depth research while considering globalization and the local context of China. However, the findings suggest that government intervention has a negative impact on uneven regional development. Therefore, the policy instruments should be used carefully in infrastructure financialization, and the government's accountability in infrastructure financialization should be strictly defined and clarified.

On the one hand, due to the poor stability and transparency of policy instruments, it is difficult to predict investment and policy efficiency. The market mechanism should fully play its role in infrastructure financialization [52,53]. First, the government should

shift from limited funds in competitive fields to infrastructure construction and introduce appropriate competition mechanisms. Second, reforming government institutions must be properly set up. A government financial institution that is too large or has too many institutions will generate redundant or even unfavorable intervention activities for infrastructure financialization.

On the other hand, it is necessary to implement tailored policies of financial regulation according to the detailed analysis of URD across regions. The government should formulate financialization policies according to each region's economic development status so as to effectively promote the allocation of resources in each region. Due to specific financial operating conditions, different regions must implement different financial policies. The history of China's economic development has confirmed that indiscriminate financial policies will lead to a large flow of capital and resources to the eastern seaboard, which will exacerbate regional development.

In addition, excessive financialization must be avoided. There is an obvious "government-led" phenomenon in financialization under China's context, which leads to the fact that financialization may become a tool for local governments to manipulate local finance [6,28]. Over-reliance on financial instruments and financial assets creates the risk of a government debt crisis [54].

Furthermore, underfunding of infrastructure and the resulting lag in construction is a common challenge in the Global South [55]. This not only constrains economic development, but also seriously affects the public livelihoods and social welfare in developing countries [56–58]. Although this study is based on data from China, a typical emerging market, the China-based study is a sufficiently representative and highly theoretical contribution to be of reference value to other developing countries.

As mentioned above, the impact of infrastructure financialization on urban and regional development is variegated and complex, including regional development, urban sprawl, local government debt risk, and social benefits. This paper discusses the impact of infrastructure financialization on URD. Due to the limitation of time and space, this study does not analyze and discuss the impact on other sectors. Subsequent research on the impact of infrastructure financialization on urban scale expansion can further analyze the spatial evolution process and interaction on the basis of this study.

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