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How Does Land Development Promote China's Urban Economic Growth? The Mediating Effect of Public Infrastructure

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Abstract: Although substantial studies emphasized the close relationship among land development, public infrastructure, and urban economic growth, the mediating effect of public infrastructure remains unexplored. Using panel data of 253 prefecture-level Chinese cities from 1999 to 2012, we empirically conduct a mediating effect analysis to examine how land development promotes urban economic growth. It is found that land development has a positive impact on public infrastructure, whereas the construction of public infrastructure is positively related with urban economic growth. Therefore, land development exerts a positive influence on urban economic growth through one important mediator: public infrastructure. It is also found that the mediating effect of public infrastructure is partial. The estimation results are robust to various specifications and sensitivity analysis.

Keywords: land development; land revenue; public Infrastructure; urban economic growth; mediating effect

1. Introduction

China's land policy has experienced dramatic changes in the past decades. Local governments are authorized with monopolistic power in land acquisition and deposition in land developing. Since the reform of the tax sharing system in 1994, central fiscal revenue surged whereas local government revenue decreased rapidly. The unbalanced administrative rights and financial power made local officials have little option but to take on the role of land developers in China's primary land market [1]. Developing and managing land has become a major business for many local governments [2,3]. From 1999 to 2012, the area of urban construction land increased by 119%, from 2.08×10^4 km^2 to 4.57×10^4 km^2. Existing studies reveal that land development has two kinds of impacts on urban growth [4,5]. The first one is the expansion of urban construction land and the second one is the substantial increase in land revenue. The interrelationship between urban spatial expansion and economic growth has been well discussed [6–8]. By comparison, our research focuses on land revenue which local officials acquired during the land development. According to the different obtaining ways, we divide land revenue into land conveyance revenue and land finance revenue.

With China's booming real estate market, urban housing and land price has grown rapidly [9]. Land gradually became the greatest immobile asset controlled by local government [1,10]. Local officials' land revenue, especially land conveyance revenue, skyrocketed [11,12]. From 2009 to 2013, the total land conveyance revenue reached 12.94 billion yuan. Most land revenues are spent on the construction of urban public infrastructure [13,14]. For example, during the period 2008–2012, a total of 2.59 trillion yuan of land conveyance revenue was spent on public infrastructure. Such

huge spending greatly improved the level of China's urban infrastructure. The total length of city road was increased from 2.6 million km in 2000 to 3.27 million km in 2012. In addition, the massive construction of infrastructure greatly promoted economic growth [15–17]. Therefore, it can be inferred that infrastructure has played a mediating role. It is not surprising that the new phenomenon of "local government-driven land-based development", which can simply be summarized as land development, land revenue, public infrastructure, urban economic growth, was very prevalent for local government in the past decades.

So far, the important role of land development in China's urban growth has been stressed by many studies from different perspectives. Nevertheless, how land development promotes China's urban economic growth remains unexplored, and the mechanism and pathway from land development and land revenue to urban economic growth was overlooked. From the point view of land revenue, this paper aims to answer the above question by conducting a thorough empirical analysis on the mediating effect of public infrastructure. The adoption of mediating effect analysis allows us to obtain robust estimation results and verifies the validity of public infrastructure as a mediator. It is found that land development has a positive impact on public infrastructure, whereas the construction of public infrastructure is positively related with urban economic growth. Therefore, land development exerts a positive influence on urban economic growth through one important mediator: public infrastructure. It is also found that the mediating effect of public infrastructure is partial. The estimation results are robust to various specifications and sensitivity analysis.

The paper is structured as follows. Section 2 briefly reviews studies of land development, public infrastructure and urban growth. In Section 3, we demonstrate the analytical framework and propose three hypotheses in relation with the mediating effect of public infrastructure. Section 4 describes methodology and data used in this paper. Section 5 reports and discuss the estimation results, and conduct some sensitive analysis. Section 6 concludes the paper and provides some policy suggestions.

2. Literature Review

The relationship between land development and urban economic growth has been well discussed [18]. The prevailing view took land use change as the outcome of urban economic growth [7,13,19]. Economic growth has generated enormous demand for urban construction land converted from agricultural land [20,21]. As an important production factor, some studies empirically verified the positive impact of urban land expansion on economic growth [6]. The supply of urban construction land has been proven to be a growth engine in China [1,22,23]. He *et al.* [8] investigated the interrelationship between urban spatial expansion and economic growth. They found that urban construction land expansion was not only the consequence of economic growth but also its direct and indirect driver. For the consequence of substantial increasing in land revenue, Liu *et al.* [24] confirmed that leasing land for industrial and commercial use is beneficial to local budget revenue growth by generating a stream of future revenues, land leasing significantly contributes to local GDP growth in the current and following years. The substantial increase in land revenue caused by land leasing greatly stimulated urban economic growth [1].

To attract both domestic and foreign investment, substantial revenues accumulated from land development have been used to invest in urban public infrastructure [25–27]. Zheng *et al.* [28] investigated the self- reinforcing mechanism of China's financing and investment channel for urban infrastructure. They found that, on one hand, the municipal governments who have rich land revenue are able to invest heavily on urban public infrastructure; On the other hand, investment on urban public infrastructure will increase land prices through improving economic productivity and quality of life. The role of infrastructure in stimulating economic growth has been well documented theoretically and empirically. In the theoretical literature, infrastructure is modeled as an important source which could generate external economies. As an intermediate input, it can have spillover externalities, such as enhancing local amenities and attracting external investment [15–17]. However, empirical findings on this issue are inconsistent and contrary to each other. For example, Fedderke *et al.* [29] failed to

find any strong linkage between infrastructure investment and output in South Africa by utilizing VAR technique. But, for the same country, Fedderke *et al.* [30] found strong effects of infrastructure on output per worker as well as on TFP. As for East Asian countries, Young [31] and Hsieh [32] also found different conclusions.

In summary, existing studies paid more attention to the direct impact of land development on urban growth, but overlooked how land development influences urban economic growth. Although substantial studies emphasized the close relationship among land development, public infrastructure, and urban economic growth, to the best of our knowledge, the role of public infrastructure in land development or urban growth has not been systemically investigated. Our analysis contributes to existing studies in this aspect by empirically examining the mediating effect of public infrastructure.

3. Analytical Framework and Hypotheses Development

3.1. Analytical Framework

As one of the main consequences of land development, land revenue, which was the local officials' biggest extra-budgetary revenue, has skyrocketed during the past decades [6,33]. Substantial empirical studies have directly verified the positive impact of land revenue on economic growth. But except the directly positive impact, land revenue also has an indirect impact on economic growth. Previous research and statistical data analysis shows that most of local land revenue has been used for urban public infrastructures [34,35]. The non-budgetary revenues generated from urban land leasing hold the promise to empower local governments' fiscal capacity and flexibility in financing various urban public infrastructures, such as transportation, water, and gas supplies and green spaces, aiming to enhance local amenities and attract external investment. Thus, urban public infrastructure, as a mediator, has proven its positive effects on urban economic growth (Figure 1).

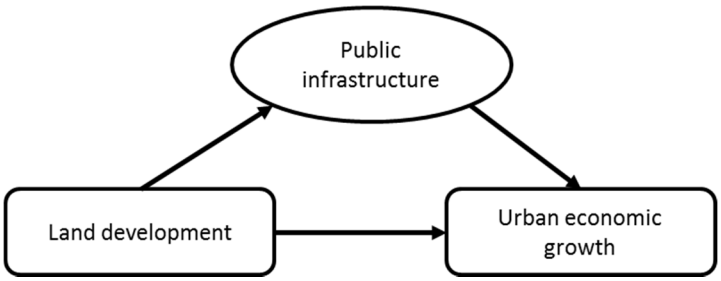

Figure 1. Analytical framework of the mediating effect of public infrastructure.

3.2. Hypothesis of Land Development, Land Revenue, and Public Infrastructure

Since the early 1990s, local officials have turned land development into a money-making business and acquired a significant amount of land revenues [1,3]. Land conveyance revenue, which was historically set mainly by negotiation but is increasingly set by auction (pai mai), public tender (zhao biao), and quotation (gua pai) subject to competitive bidding land supply system, increased by more than 55 times, from 51.43 billion yuan in 1999 to 2.85 trillion yuan in 2012 (Figure 2). The proportion of total land conveyance revenue to local governments' fiscal revenue was more than 30% nationwide after 2004. For land finance revenue, which includes land mortgage revenue and quasi-municipal bonds (chengtouzai) based on the credit of land. In 2013, the net land mortgage revenues reached 1.77 trillion yuan and the total mortgage revenues reached 7.76 billion yuan from 2009 to 2013 (Figure 3).

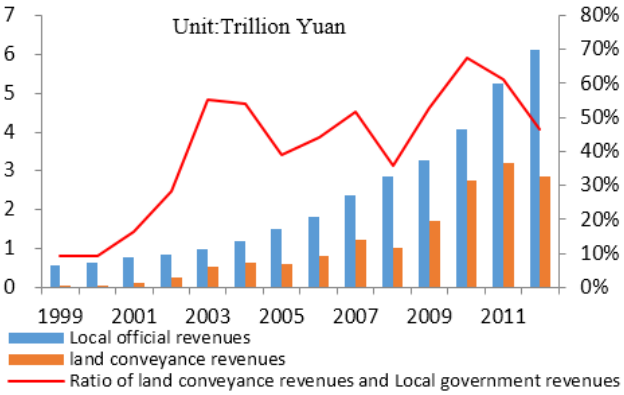

Figure 2. Growth rate and proportion of land conveyance revenue. Sources: China City Statistical Yearbook [36], China Statistical Yearbook of Land and Resources [37] and author's calculations.

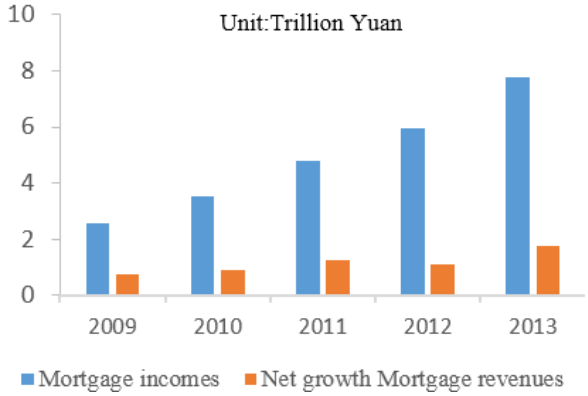

Figure 3. 84 major cities' land mortgage revenue. Source: China Land and Resources bulletin [38].

Substantial land revenue accumulated from land development has been used to finance the provision and improvement of urban public infrastructure, such as transportation, water and gas supplies, and green spaces, *etc.* [25], so as to attract both domestic and foreign investment [26,27]. Before 2007, the expenditure of land revenue in China was under little scrutiny and local officials can freely use them for any purpose. With the state-owned land conveyance revenue and expenditure management approach becoming effective, the expenditure of land conveyance revenue was limited in land acquisition and relocation compensation, land development, urban infrastructure construction, *etc.* in 2007. About 58.97% (369.22 billion yuan) of land conveyance revenue was spent on urban public infrastructure after deducting the cost of land compensation in 2012 (Table 1). Liu and Jiang [39] investigated the investment sources of local officials' infrastructure in several southeast coastal counties in 2005. They found that only 10% investment came from fiscal revenue, while the remaining 90% was related to land development, among which 30% came from land conveyance revenue, 60% came from land mortgage revenue.

Table 1. Net incomes of land leasing and its expenditure.

	2008	2009	2010	2011	2012
Net revenue of land leasing	456.31	686.88	221.60	942.32	626.14
Urban infrastructure expenditure	336.23	377.41	855.34	655.80	369.22
Other expenditure	121.93	169.38	264.41	237.57	210.47
Ratio of urban infrastructure expenditure	73.69%	54.95%	70.02%	69.59%	58.97%

Unit: Billion Yuan; Source: China Land and Resources bulletin [38].

We proposed Hypothesis 1 as follows:

Hypothesis 1: The construction of urban infrastructure is positively related with urban land development.

3.3. Hypothesis of Public Infrastructure and Urban Economic Growth

Existing studies indicated that as investment expenditure, the construction of public infrastructure can stimulate economic growth directly, while also enhancing local amenities and attracting external investment [15–17]. Thus public infrastructure has a spillover effect and provision of public infrastructure is one of the effective means by which governments can promote economic growth [40,41].

We proposed Hypothesis 2 as follows:

Hypothesis 2: The construction of urban public infrastructure has a positive impact on urban economic growth.

Although most land revenue has been invested in urban public infrastructure, there is also a certain amount dedicated to education and compensation expropriation. Table 2 indicates that this amount reaches proximately 30% to 50% of the total land revenue. The education and compensation expropriation also has an impact on economic growth. While on the other hand, analysis shows that the urban construction land expansion is also a result for land developing activities [33]. Urban construction land as a production factor, can stimulate economic growth directly and in the same time can be successfully used as a tool to attract foreign investments and to sustain infrastructure investments, indirectly triggering economic growth [4,8]. Thus, the improvement of infrastructure as a mediator is only a partial reason for economic growth. Land development promotes urban economic growth through comprehensive channels besides this mediator.

Table 2. Sources and descriptive statistics of variables.

Variables	Sources	Mean	S.D.	Min.	Max.
ln *GDP*	China City Statistical Yearbook [36]	6.118	1.117	−4.605	9.804
ln *PI*	Author calculation	−2.479	0.545	−6.023	−0.622
ln *Lc*	China Statistical Yearbook of Land and Resources [37]	0.141	2.071	−4.605	6.478
ln *Lfc*	China Urban Construction Statistics Yearbook [42]	1.945	2.192	−4.605	7.350
ln *Li*	Author calculation	2.248	2.002	−4.605	7.496
ln *Lac*	China City Statistical Yearbook [36]	0.797	1.469	−4.605	4.551
ln *pFDI*	China City Statistical Yearbook [36]	2.887	2.160	−4.605	8.073
ln *Psi*	China City Statistical Yearbook [36]	3.832	0.260	2.197	4.511

Taking Hypothesis 1 and Hypothesis 2 together, we proposed Hypothesis 3 as follows:

Hypothesis 3: Public infrastructure mediates the impact of land development and urban economic growth. Moreover, the mediating effect of public infrastructure is partial.

4. Methodology and Data

4.1. Mediating Effects Analysis Method

Mediating effect models are frequently used in the research of social science. Mediating indicates that the effect of an independent variable (x) on a dependent variable (y) is transmitted through a third variable (m), and m is called "mediator". Using the mediating effects model, we can identify the mediator's effect and verify how land development influence urban economic growth.

According to Baron and Kenny's causal steps approach [43], in order to examine how land development influences urban economic growth, we estimate three regression models to examine the mediating effects. Model 1 examines the impact of land revenues on urban economic growth, Model 2 examines the impact of land revenues on urban public infrastructure, and Model 3 examines the impact of land revenues on urban economic growth under the control of public infrastructure.

If all of the three effects are significant, the mediating effects of public infrastructure are proven to exist, which means the urban public infrastructure is a mediator. Furthermore, if the land revenues' coefficient in Model 3 is significant and the coefficient is smaller than that in Model 1, urban public infrastructure is identified as a partial mediator, otherwise, urban public infrastructure is identified as a completed mediator.

4.2. Model Specification

According to the mediating effects analysis method, we established three models to exam three hypotheses proposed in Section 3.

4.2.1. Model 1: Economic Growth Model

We introduced the government's land revenue into an economic growth model to exam the impact of land revenue on urban economic growth. Based on the Cobb-Douglas production function, after controlling for human capital, foreign direct investment (FDI), and the output of secondary industry, we introduced land revenue into urban economic growth estimation model (See Equation (1)):

$$GDP_{it} = \alpha_0 + \alpha_1 Li_{it} + \alpha_2 X_{it} + f_i + \varepsilon_{1,\,it} \tag{1}$$

where GDP_{it} is the Gross Domestic Product of city i in year t; Li_{it} is the land revenue of city i in year t, which includes local government land conveyance revenue (Lc), land finance revenue (Lfc) and total land revenue; X_{it} is a vector of control variables, including human capital (Lac), FDI per capita ($pFDI$) and the proportion of secondary industry output (Psi).

4.2.2. Model 2: Urban Public Infrastructure Model

We introduced the government's land revenues into an urban public infrastructure model to exam the effect of land revenue on urban public infrastructure (See Equation (2)):

$$PI_{it} = \beta_0 + \beta_1 Li_{it} + \beta_2 X_{it} + f_i + \varepsilon_{2,\,it} \tag{2}$$

where PI_{it} are the public infrastructure level of city i in year t and the definition of Li_{it} is the same as Model 1. X_{it} is also a vector of control variables, the variables should the same as Model 1 according to mediating effects analysis method.

4.2.3. Model 3: Urban Economic Growth Model under the Control of Public Infrastructure

Under the control of public infrastructure, we also established an urban economic growth model to examine the direct effect of land revenue on economic growth (See Equation (3)):

$$GDP_{it} = \gamma_0 + \gamma_1 Li_{it} + \gamma_2 PI_{it} + \gamma_3 X_{it} + f_i + \varepsilon_{3,\,it} \tag{3}$$

where the definition of GDP_{it}, Li_{it} and the control variables (X_{it}) are the same as Model 1, the definition of PI_{it} are the same as Model 2.

4.3. Data and Variable Measurements

Our empirical study aims at investigating how land development influences urban economic growth and verifies the mediating effect of public infrastructure. We use a panel of time-series cross-section data and restrict our analysis to a time period beginning in 1999, the first year in which reliable land conveyance revenue data is available, and ending in 2012. Given that the data of some prefecture-level cities are missing or hard to find, we exclude these cities and restrict our attention to the 253 cities (including four municipalities). The main economic data comes from the China City Statistical Yearbook, the land revenue data comes from China Statistical Yearbook of Land and

Resources, and the public infrastructure data comes from China Urban Construction Statistics Yearbook (See Table 2).

So far, there is no systematic statistic data of urban public infrastructure in the existing yearbook. In order to measure urban public infrastructure, we establish a public infrastructure evaluation index system, which contains four second class indicators and nine third class indicators. Table 3 reports the weight of each indicator, which is calculated with expert scoring. Then, after standardizing the original data, we measure urban public infrastructure of 253 cities from 1999 to 2012.

Table 3. Urban public infrastructure index system and the weight.

Urban infrastructure level	Living Facilities (25%)	Length of heating pipeline (8.33%)
		Length of water supply pipeline (8.33%)
		Length of gas pipeline (8.33%)
	Road Facilities (25%)	Public transport vehicles of per million people (12.5%)
		Road area of per people (12.5%)
	Ecological Facilities (25%)	Green area of per people (12.5%)
		Green area coverage rate (12.5%)
	Sanitation Facilities (25%)	Length of sewage drainage pipeline (12.5%)
		Number of sewage treatment station (12.5%)

Since systematic statistic data on land finance revenue are lacking in the existing yearbook, following Zheng *et al.* [28], we use the sum of domestic loans and bonds of urban infrastructure investment funding as the amount of urban land finance revenue. Land revenues are the sum of land conveyance incomes and land finance revenue.

In addition, we make logarithmic transformation to both the dependent and independent variables.

5. Estimation Results and Sensitive Analysis

5.1. Estimation Results

Table 4 reports the estimation results of all models. Because Hausman test indicates rejecting the hypothesis of no correlation at a 5% significance level, we estimated all specifications of these equations using fixed-effect panel data regression.

Column Model 1 in Table 4 shows that land revenue has a direct positive impact on urban economy. Increasing land revenue by 1% will result in a 0.23% increase in urban GDP. The result is consistent with most direct study of the relationship between land revenue and economic growth [44]. Column Model 2 reports that land revenue has a positive impact on public infrastructure. The coefficient of Model 2 shows that if we increase land revenue by 1%, urban public infrastructure level will increase by 0.06%. It is consistent with the finding of Zheng *et al.* [28] and verified Hypothesis 1. The construction of urban infrastructure is positively related with urban land revenue, which is gained by the local officials during the land development.

From Column Model 3, we can find that urban public infrastructure has a positive impact on urban economic growth. Increasing urban public infrastructure level by 1% will result in a 0.27% increase in urban GDP. This result consistent with the finding of most empirical studies on the relationship between public infrastructure and economic growth, such as Bronzini *et al.* [41]. It also verified Hypothesis 1.The construction of urban public infrastructure has a positive impact on urban economic growth.

Table 4. Estimation result of mediating effects.

Dependent Variable	Model 1			Model 2			Model 3		
	GDP			Urban Infrastructure Level			GDP		
ln *PI*							0.420 *** (0.033)	0.294 *** (0.028)	0.274 *** (0.028)
ln *Lc*	0.045 *** (0.007)			0.026 *** (0.004)			0.034 *** (0.007)		
ln *Lfc*		0.214 *** (0.009)			0.041 *** (0.006)			0.202 *** (0.009)	
ln *Li*			0.231 *** (0.010)			0.059 *** (0.006)			0.215 *** (0.010)
ln *Lac*	0.341 *** (0.010)	0.257 *** (0.009)	0.240 *** (0.010)	0.100 *** (0.006)	0.089 *** (0.006)	0.078 *** (0.006)	0.299 *** (0.010)	0.231 *** (0.009)	0.218 *** (0.010)
ln *pFDI*	0.142 *** (0.007)	0.083 *** (0.006)	0.084 *** (0.006)	0.091 *** (0.004)	0.088 *** (0.004)	0.085 *** (0.004)	0.104 *** (0.007)	0.057 *** (0.007)	0.061 *** (0.007)
ln *Psi*	0.366 *** (0.049)	0.297 *** (0.041)	0.291 *** (0.041)	0.213 *** (0.027)	0.235 *** (0.025)	0.228 *** (0.025)	0.276 *** (0.048)	0.228 *** (0.041)	0.229 *** (0.041)
_Cons	4.0721 *** (0.183)	4.162 *** (0.152)	4.089 *** (0.153)	−3.626 *** (0.101)	−3.769 *** (0.093)	−3.776 *** (0.092)	5.596 *** (0.215)	5.272 *** (0.183)	5.123 *** (0.200)
R-sq:	0.668	0.716	0.706	0.5740	0.567	0.573	0.695	0.715	0.716
Number of obs.	2882	3334	3347	2882	3334	3347	2882	3334	3347

Note: Standard errors are reported in parentheses; *** denotes significance higher than 0.01.

According to coefficients in column Model 3, we know that urban public infrastructure is a partial mediator since the coefficient in Model 3 is significant at a 1% level and is smaller than the coefficient in Model 1. Therefore, Hypothesis 3 is verified. This result means that the effect of local government's land revenues on urban economic growth is not only transmitted through public infrastructure. Public infrastructure is not the only mediator and other factors or channels may also impact economic growth.

Then we replaced land conveyance revenue and land finance revenue to the Model 1 to Model 3 respectively to investigate their influence on urban economic growth and to examine the mediating effect of public infrastructure. Table 4 reports the estimation results. It is shown that the mediating effect exists. Both land conveyance revenue and land finance revenue have a positive impact on public infrastructure, the construction of public infrastructure is positively related with urban economic growth, and urban public infrastructure level is an effective mediator.

5.2. Sensitive Analysis

In this section, we conduct some sensitive analysis to check the robustness of estimation results of Models 1–3.

Firstly, we divided the total sample into three sub-samples: east, middle, and west. The east sub-sample contains 113 cities, the middle sub-sample contains 72 cities, and the west sub-sample contains 68 cities. According to the result of Hausman test of specification, all models are estimated with fixed-effect panel data regression. Table 5 reports the estimation results of the sensitive analysis. Note that three hypotheses we proposed still hold in the east, middle, and west sub-samples. As a result, public infrastructure is an effective mediator in all of the three areas. In addition, land revenues have greatly promoted urban economic growth in each area. In particular, increasing land revenue by 1% will result in a 0.20%, 0.09%, and 0.20% increase in urban GDP in the east, middle, and west areas, respectively.

Table 5. Estimation results of mediating effects in different regions.

Sub-Sample	Dependent Variable	GDP	Public Infrastructure	GDP
East sub-sample	ln *PI*			0.4114 *** (0.042)
	ln *Li*	0.197 *** (0.013)	0.0480 *** (0.007)	0.1769 ***(0.012)
	ln *Lac*	0.307 *** (0.013)	0.0982 *** (0.007)	0.2665 *** (0.013)
	ln *pFDI*	0.108 *** (0.009)	0.0850 *** (0.006)	0.0731 *** (0.010)
	ln *Psi*	0.310 *** (0.058)	−0.0237 (0.035)	0.3200 *** (0.057)
	_Cons	4.129 *** (0.212)	−2.756 *** (0.126)	5.2631 *** (0.236)
	R-sq:	0.805	0.638	0.819
	Number of obs.	1535	1535	1535
Middle sub-sample	ln *PI*			0.0707 * (0.047)
	ln *Li*	0.0891 *** (0.019)	0.029 ** (0.013)	0.087 *** (0.019)
	ln *Lac*	0.3626 *** (0.015)	0.046 *** (0.010)	0.3593 *** (0.015)
	ln *pFDI*	−0.0493 **(0.011)	0.071 *** (0.008)	−0.0543 ***0.012)
	ln *Psi*	0.1473 *** (0.060)	0.358 *** (0.041)	0.1220 * (0.063)
	_Cons	5.0916 *** (0.228)	−4.162 *** (0.156)	5.3858 *** (0.301)
	R-sq:	0.650	0.477	0.656
	Number of obs.	977	977	977
West sub-sample	ln *PI*			0.122 *** (0.052)
	ln *Li*	0.203 *** (0.023)	0.111 *** (0.016)	0.189 *** (0.024)
	ln *Lac*	0.170 *** (0.020)	0.076 *** (0.014)	0.161 *** (0.021)
	ln *pFDI*	0.031 ** (0.012)	0.057 *** (0.008)	0.024 *** (0.013)
	ln *Psi*	0.424 *** (0.079)	0.464 *** (0.053)	0.368 *** (0.082)
	_Cons	3.594 *** (0.303)	−4.782 *** (0.204)	4.176 *** (0.391)
	R-sq:	0.526	0.508	0.531
	Number of obs.	835	835	835

Note: Standard error are reported in parentheses. ***, ** and * denotes significance higher than 0.01, 0.05 and 0.1, respectively.

Secondly, to control for time-specific effect, we divided the whole time period into two periods: period 1999–2004, and period 2005–2012. We estimate Models 1–3, respectively in these two periods and reports the results in the following Table 6. It is clear that the signs and significance of each variable are similar to that of the whole-period. Taken together, we conclude that our estimation results obtained by fixed-effect panel data regression are robust to various specification tests as well as change of sample size and period.

Table 6. Estimation results of mediating effects in different time periods.

Dependent Variable	Model 1		Model 2		Model 3	
	GDP		Urban Infrastructure Level		GDP	
Time Period	**1999–2004**	**2005–2012**	**1999–2004**	**2005–2012**	**1999–2004**	**2005–2012**
ln *PI*					0.234 *** (0.039)	0.304 *** (0.040)
ln *Li*	0.203 *** (0.013)	0.258 *** (0.015)	0.051 *** (0.009)	0.065 *** (0.008)	0.192 *** (0.013)	0.238 *** (0.015)
ln *Lac*	0.248 *** (0.013)	0.230 *** (0.013)	0.085 *** (0.009)	0.074 *** (0.007)	0.228 *** (0.013)	0.208 *** (0.014)
ln *pFDI*	0.095 *** (0.008)	0.073 *** (0.009)	0.080 *** (0.006)	0.088 *** (0.005)	0.076 *** (0.009)	0.047 *** (0.009)
ln *Psi*	0.306 *** (0.059)	0.283 *** (0.056)	0.173 *** (0.041)	0.268 *** (0.031)	0.265 *** (0.059)	0.202 *** (0.056)
_Cons	4.041 *** (0.218)	4.083 *** (0.211)	−3.606 *** (0.151)	−3.921 *** (0.117)	4.888 *** (0.257)	5.275 *** (0.260)
R-sq:	0.685	0.651	0.46	0.552	0.695	0.663
Number of obs.	1329	2018	1329	2018	1329	2018

Note: Standard errors are reported in parentheses. *** denotes significance higher than 0.01.

6. Conclusions

In recent decades, developing and managing land has become a major business for Chinese local officials. Although substantial studies emphasized the close relationship among land development, public infrastructure, and urban economic growth, the mediating effect of public infrastructure remains unexplored. Using panel data of 253 prefecture-level Chinese cities from 1999 to 2012, we empirically conducted a mediating effect analysis to examine how land development promotes urban economic growth. It is found that land development has a positive impact on public infrastructure, whereas the construction of public infrastructure is positively related with urban economic growth. Therefore, land development exerts a positive influence on urban economic growth through one important mediator: public infrastructure.

Our paper can be viewed as the first attempt to empirically investigate the mechanism and path way from land development to urban economic growth, through public infrastructure. As discussed in Zheng *et al.* [28], the interrelationship among land development, land revenues, and urban economic growth is complicated. The self-reinforced mechanism between land revenues and urban public infrastructure and the cumulative causation effect among land development, land revenues and urban economic growth may exist. Though the relationship between land development and urban economic growth have been widely discussed, how the mechanism that urban economic growth effect land revenues are rarely studied. Therefore, it is worthwhile to extend our empirical analysis to investigate land revenues and urban public infrastructure's self-reinforced mechanism and the cumulative causation effect among land development, land revenues, and urban economic growth.

Although the paper verified the prevailing phenomenon that land development promotes urban economic growth greatly through mediate effectors of public infrastructure in the past decade, there is a critical issue for us to rethink: is this kind of land-dependent development mode sustainable in the future? Since the financial crisis, China's land price and land revenue have experienced a downward trend. In addition, it is emphasized in China's new urbanization plan (2014–2020) that central government will strictly control the scale of urban land development. Therefore, urban construction land will not grow as fast as it has in the past decades. The "local government-driven land-based development" mode will not be sustainable in the future. In this regard, it is highly suggested that local government should transform their extensive growth model from now on.

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