Research article

Unlocking Urbanization: The symbiotic relationship between inclusive finance and urban development in China

Qiyun Li [b], Long Chen [a,c,d,e,f,*], Tianxu Hao [g]

[a] *School of Management, Hebei GEO University, Shijiazhuang, 050031, Hebei Province, China*
[b] *SKK Business School, Sungkyunkwan University, 03063, Seoul, South Korea*
[c] *School of Economics, Peking University, Beijing, 100871, China*
[d] *Post-Doctoral Scientific Research Workstation of Hebei Bank, Shijiazhuang, 050011, Hebei Province, China*
[e] *Research Base for Scientific-Technological Innovation and Regional Economic Sustainable Development of Hebei Province, Hebei GEO University, Shijiazhuang, 050031, China*
[f] *Science and Technology Innovation Team, Hebei GEO University, Shijiazhuang, 050031, China*
[g] *College of Business Administration, Wonkwang University, 54538, Iksan, Jeollabuk do, South Korea*

A R T I C L E   I N F O

A B S T R A C T

The emergence and development of inclusive finance has made it possible for more economic entities to have easy access to a wider selection of financial services. This shift has significantly addressed the financial challenges inherent in the process of urbanization, making it a driver of the process of urban development. Therefore, this paper provides empirical evidence on the relationship between financial inclusion development and urbanization construction in China using provincial data and a panel-VAR model. The results show that: (1) There is a significant co-integration relationship among inclusive finance, urbanization, government support, and real estate development. (2) Inclusive finance has a long-term positive impact effect on urbanization. (3) Population urbanization has a positive impact on inclusive finance, but income urbanization has a negative impact on inclusive finance. To effectively promote the development of inclusive finance and urbanization, the following measures are of utmost importance: Firstly, while accelerating urbanization construction, it is necessary to expand and enhance the coverage of financial services. This will ensure that multiple regions can benefit from financial services. Secondly, to meet the diverse needs of different regions, more targeted financial products should be developed, making full use of the advantages of inclusive finance. Lastly, the government should strengthen its supervision of financial institutions and reduce the risks associated with inclusive finance, thereby ensuring a positive interaction between inclusive finance and urbanization development.

1. Introduction

Urbanization is not only a process of continuously gathering population in cities and towns, but also an inevitable stage in economic, social, political, and environmental industrial restructuring and product development [1]. In the process of urbanization development, infrastructure construction, public service improvement, rural labor transfer, and support for urban industrial

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* Corresponding author. School of Management, Hebei GEO University, Shijiazhuang, 050031, Hebei Province, China.
E-mail address: chenlong85@pku.edu.cn (L. Chen).

development all require large amounts of financial support, which is not enough to rely on government investment alone [2]. The urbanization process has promoted the diversity of production, enterprise labor division, and, consequently, has fostered the development of financial services. Zhang and Dilanchiev [3], Fan [4], Lee et al. [5], Chen et al. [6] pointed out that with the further deepening of urbanization construction, more extensive financial needs will inevitably emerge.

In 2005, when the United Nations promoted the concept of equal access to modern financial services for all, the concept of "inclusive finance" was first introduced [7]. Inclusive finance refers to a system that provides financial services to all segments and groups of society with financial needs comprehensively and effectively under affordable cost conditions [8]. Since China introduced the concept of inclusive finance in 2013, the financial industry has made significant progress in building its infrastructure, and its formal system has been gradually improved. On the one hand, with the continuous expansion of the service scope of China's financial industry, those disadvantaged groups (such as migrant workers, small and micro enterprises, and other groups) who were financially excluded in the past can truly enjoy the fruits of financial development [9]. This has dramatically solved the financial problems faced in the construction of China's urbanization and promoted the development of urbanization [10,11]. On the other hand, urbanization construction adheres to the people-oriented core and has always played an important role in promoting the development of China's economy and society. After China's economic growth slowed down and entered the "new normal," urbanization development, as one of the essential means to expand domestic demand, has gradually become a new driving force for China's economic growth.

According to China's National Bureau of Statistics, China's Gross Domestic Product (GDP) grew at an average annual rate of 6.6% from 2013 to 2021, contributing an average of more than 30% to world economic growth and ranking first in the world, as China's economy once again enters the fast lane [12]. China is the most representative country among the emerging markets with rapid economic development [13]. China's national development strategy also relies not only on the traditional model remaining unchanged, but also actively promotes the upgrading of industrial structure [14] and optimizes the allocation of resources [15]. In addition, it promotes the free flow of factors such as labor, capital, and technology between urban and rural areas [16], between regions [17], and internationally [18], but none of these can be separated from the development of urbanization. Compared to developed countries, China still exhibits certain disparities in urbanization development, such as significant regional differences [19]. Therefore, China possesses significant development potential in the field of urbanization construction.

This study adopts China as the research object and empirically examines the interrelationship between inclusive financial development and urbanization construction in each province of China by employing the panel-VAR model and impulse effect analysis method. For this purpose, we considered a sample of 31 Chinese provinces. We aim to explore the mechanism of the role between inclusive finance and urbanization from multiple dimensions to help developing countries fully realize the importance of inclusive finance to drive urbanization.

In contradistinction to prior studies, this study primarily contributes to three key aspects. Firstly, from a theoretical perspective, we extensively elucidate the correlation between inclusive finance and urbanization, analyzing the mechanisms of influence between the two. Secondly, we employ a panel-VAR model using Chinese provinces as the research sample, investigating the dynamic relationship between inclusive finance and urbanization development. Thirdly, this paper constructs a diversified indicator system for inclusive finance and urbanization development. Ge et al. [20], Ahmad and Satrovic [21] and Singh et al. [22] have primarily focused on exploring the effects of financial breadth and depth (the size and efficiency of finance) on urbanization development, as well as the impacts of financial breadth (inclusive finance) on economic growth. However, there exists a notable gap in the literature regarding the influence of financial breadth (inclusive finance) specifically on urbanization development. To address this gap in existing research, we have developed an indicator evaluation system that aligns more closely with the characteristics of China's inclusive finance and urbanization development.

The organization of this study is as follows. After a review of the existing literature in Section 2, the data collection and model setting are described in detail in Section 3. Section 4 contains the results section of the study. Further analysis of the results of this study and comparative analysis with existing studies are presented in section 5. The last section concludes this study.

2. Literature review

Urbanization is a comprehensive process that involves changes in people's geographical residence, lifestyle, culture, and more. Economists view urbanization as the transformation of rural economies into urban economics [23] and consider it a product of economic growth [24]. Research on urbanization construction primarily focuses on its driving mechanisms [25,26], scale changes [27, 28], industrial structure [29,30], and population size [31,32]. In terms of measuring urbanization, traditional approaches rely on single indicators, such as population-based metrics [33] and geographic indicators [34], which may not accurately reflect the true complexity of urbanization. In recent years, scholars have developed multidimensional approaches, considering dimensions like economics [35] and population [36], as well as income levels [37], assigning different weights to assess urbanization construction.

Research on financial development in developing countries primarily focuses on policy evaluation [38], economic growth [39,40], environmental changes [41,42]. Inclusive finance enhances the accessibility and availability of financial services, particularly for low-income groups. However, most studies on financial development in developing countries have primarily focused on financial development itself [43–45] and lacked research on its impact on regional development. The financial system can provide significant funding support for urban transportation construction [46], urban real estate development [47,48], and urban infrastructure development [49] during the urbanization process, making financial factors the primary drivers of urbanization development [50]. Developed countries like those in Europe and America have already achieved high levels of urbanization [51], leading to fewer recent studies specifically addressing the role of finance in supporting urbanization construction. In terms of modeling, studies have used VAR models [52] and questionnaire surveys [53], but it remains challenging to simultaneously study the dynamic changes between finance

and urbanization from both temporal and individual dimensions.

In 2020, China conducted its seventh national population census, with a total population reaching 1.41 billion, accounting for approximately 18% of the global population [54]. China's economy serves as a critical engine for global economic growth, and its economic development significantly impacts the world economy. The orderly development of finance and urbanization has crucial implications for China's sustainable development. China's urbanization construction will change the lives and work styles of billions of people and impact the adjustment of China's industrial structure [55]. In the process of urbanization construction, substantial capital investment is required to achieve optimal allocation of resources [56]. Inclusive finance, with its inclusiveness, can effectively provide funds for urbanization development, offering strong support for urbanization construction. Developing countries are currently in a period of booming urbanization and many scholars [19,39,42] have studied financial support for urbanization. However, most of these studies primarily focus on financial intermediaries and overall financial volumes, neglecting the consideration of financial width (which can be reflected by inclusive finance). After the concept of inclusive finance was introduced, it gained widespread attention among scholars due to its significant role in economic growth and social development. Consequently, most scholars concentrated on topics such as the development of inclusive finance, the relationship between inclusive finance development and economic growth [57], and its impact on urbanization construction, residents' income levels, and social equality [10,58]. Some researchers also studied the relationship between inclusive finance and poverty rates [59] and the reduction of urban-rural income disparities [60,61], achieving notable research outcomes.

It can be observed that existing research has two main shortcomings. Firstly, most studies have examined the development level of inclusive finance and its theoretical impact on urbanization from a macroeconomic perspective, neglecting the importance of regional differences and quantitative analysis. Secondly, in terms of constructing an indicator system, previous research predominantly relied on the perspective of financial service supply, lacking consideration for comprehensive indicators in developing countries. Additionally, we have considered other influencing factors on inclusive finance and urbanization development from multiple dimensions. Finally, in terms of model selection, existing studies primarily considered optimization paths and interactive mechanisms between inclusive finance and urbanization development but failed to address the time-varying dynamic impact between the two. Therefore, our research considers this dynamic impact over time, fully accounting for individual and time effects, effectively addressing the issue of individual heterogeneity.

Based on this, we focused on China as our research subject and analyzed the theoretical literature regarding inclusive finance and urbanization construction. We combined domestic and international indicator evaluation systems to select evaluation criteria for inclusive finance and urbanization from multiple dimensions. We constructed a panel-VAR model and conducted empirical analysis using impulse response functions to examine the mutual impact of inclusive finance and urbanization development. We have also proposed policy recommendations for emerging countries, with China as a representative, in the context of urbanization construction.

3. Methodology

3.1. Data source and variables

This study focuses on inclusive finance and urbanization development processes, with a particular emphasis on the period from 2011 to 2015 as the research timeframe. The reasons for selecting this stage are as follows: Firstly, before 2011, China's inclusive finance was undergoing rapid changes, and its development was in an uncertain state. Secondly, according to a 2016 People's Daily

Table 1
Inclusive finance index system.

Object layers	Indices	Calculation formula
Inclusive finance Coverage (W_1)	Number of financial institution outlets in 10,000 square kilometers (P_{11})	Number of financial institution outlets/10,000 square kilometers
	Number of financial institution outlets for 10,000 people (P_{12})	Number of financial institution outlets /10,000 people
	Number of financial institution personnel in 10,000 square kilometers (P_{13})	Number of financial institution personnel/10,000 square kilometers
	Number of financial institution personnel in 10,000 people (P_{14})	Number of financial institution personnel/10,000 people
Inclusive finance Usability (W_2)	Deposit utilization status (P_{21})	Deposit per capita/GDP per capita
	Loan utilization status (P_{22})	Loans per capita/GDP per capita
	Internet payment usage status (P_{23})	Peking University released Digital Inclusive Finance Index
	The density of insurance (P_{24})	Insurance premium revenue /population
	Depth of insurance (P_{25})	Insurance premium revenue/GDP
	Utilization of securities financing (P_{26})	Securities market fundraising/GDP
Inclusive finance Quality (W_3)	Quality of services for micro and small enterprises (P_{31})	Microfinance company loan balance /total loans
	Quality of services for the three farmers (P_{32})	Farmers' loan balance/total loans
	Quality of services for real estate development (P_{33})	Domestic loans for real estate development enterprises/ total loans

report, by the end of 2015, China's urbanization rate had reached 56.1%, with the urban permanent population rising to 770 million [62]. This indicates that China's urbanization development had entered the mid-to-late stage. Thirdly, in 2016, the Chinese government implemented new policies aimed at targeted regional coordination development [63]. Considering the sample's effectiveness and observability, this study chose the initial and core interaction stages of inclusive finance and urbanization development from 2011 to 2015 as the research period. The data selection and calculation for each indicator are detailed as follows.

3.1.1. Inclusive finance

Inclusive finance reflects the breadth of finance, the availability, and inclusiveness of financial services and is generally expressed by the Inclusive finance Index (IFI). Based on the inclusive finance measurement indicators proposed by Beck et al. [64], Chakravarty and Pal [65], Sarma and Pais [58] and Xiao and Hong [66] and considering the description of inclusive finance in World Bank Group [67], we constructed an inclusive finance index system in three dimensions: coverage, usability, and quality, as shown in Table 1.

3.1.1.1. Dimensionless processing of data. Since there are differences in the scale of each indicator, the raw data need to be dimensionless before calculating the inclusive finance index, i.e., normalized. Therefore, this study uses the polar difference method to process the raw data. As shown in equation (1) :

$$T_{ij} = \frac{P_{ij} - m_{ij}}{M_{ij} - m_{ij}}, T_{ij} \in [0, 1] \tag{1}$$

Where, P_{ij} is the raw data of the jth indicator under the ith dimension, M_{ij} is the maximum value of the indicator, and m_{ij} is the minimum value of the indicator.

3.1.1.2. Determination of indicator weights. The critical point of the calculation of the financial inclusion index is the determination of the weight of each indicator and dimension. There are two main categories of subjective and objective methods. Where the subjective method has been used less frequently in recent studies due to human influence and significant variation in calculation results, but among the objective methods, the coefficient of variation method is widely used to calculate the inclusive finance index because of its simplicity and scientific strength, this method is still chosen to calculate the weights in this study. The calculation steps of that method are shown in equations (2)–(7).

Step 1. Calculate the coefficient of variation of each indicator in the *i* dimension:

$$CV_{ij} = \frac{\sigma_{T_{ij}}}{\mu_{T_{ij}}} \tag{2}$$

where, CV_{ij} is the coefficient of variation of the jth indicator under the ith dimension, $\sigma_{T_{ij}}$ is the standard deviation of the indicator, and $\mu_{T_{ij}}$ is the mean of the indicator.

Step 2. Calculate the weights of each indicator in the ith dimension:

$$\omega_{ij} = \frac{CV_{ij}}{\sum_j CV_{ij}} \tag{3}$$

where, ω_{ij} is the weight of the jth indicator under the ith dimension.

Step 3. Calculate the values of each dimension (based on calculated indicator weights and dimensionless processed raw data (T_{ij})):

$$W_i = 1 - \frac{\sqrt{\sum_j \omega_{ij}^2 (1 - T_{ij})^2}}{\sqrt{\sum_j \omega_{ij}^2}} \tag{4}$$

Step 4. Calculate the coefficient of variation for dimension i:

$$CV_i = \frac{\sigma_{W_i}}{\mu_{W_i}} \tag{5}$$

Step 5. Calculate the weights of dimension i:

$$\omega_i = \frac{CV_i}{\sum_i CV_i} \tag{6}$$

where, ω_i is the weight of the ith dimension.

Step 6. Calculate the inclusive finance index based on the calculated dimensional weights:

$$IFI = 1 - \frac{\sqrt{\sum_i \omega_i^2 (1 - W_i)^2}}{\sqrt{\sum_i \omega_i^2}} \tag{7}$$

where, W_i and IFI are both positive indicators, which are relative numbers located within [0,1], the high and low indicators can only reflect the differences in the development of inclusive finance in each region and cannot represent its absolute nature.

3.1.1.3. IFI calculation results. According to the above index system and calculation method, this study collects relevant data from China Statistical Yearbook,[1] China Financial Yearbook,[2] Regional Financial Operation Report,[3] Peking University Digital Financial Inclusion Index,[4] and the WIND database.[5] It calculates the inclusive finance index of 31 provinces and cities in China for five years. The specific results are shown in Table 2.

3.1.2. Urbanization level

The level of urbanization can reflect the process of urbanization. In general studies, urbanization is mainly studied in terms of both quantity (population) and quality (income) of urbanization. Therefore, we adopted the population and income urbanization rates to measure each province's urbanization level. The detailed index system is shown in Table 3.

The population urbanization rate (PUR) can quantitatively reflect the level of urbanization in each region and is a positive indicator. With the development of urbanization, more and more people from rural areas are moving to cities, driving the growth of the urban population, among which some have acquired household registration, and some have not. Therefore, to better reflect the change in urban population, we examine the level of urbanization from the perspective of the proportion of the urban resident population to the total population.

The income urbanization rate (IUR) can qualitatively reflect the level of urbanization in each region and is a positive indicator. Similarly, as the degree of urbanization deepens, its promotion and demand for non-agricultural industries will gradually increase, which will inevitably increase the proportion of non-agricultural output value in each region. Therefore, we examine the development level of urbanization from the perspective of the proportion of non-agricultural output value to the total output value.

3.1.3. Other influencing factors

Government support (GS) is inseparable from the development of urbanization. Therefore, we selected the share of each local government's fiscal expenditure in each province's GDP to reflect the government's influence on urbanization development.

Real Estate Development (RE) plays a fundamental role in the urbanization process and is a key strategy for provinces to address the housing challenge. Therefore, this paper selects the proportion of real estate investment in each province's GDP to reflect the development of the real estate industry in different provinces. Other influencing factors are defined as shown in Table 4.

3.2. Model setting

This study employs provincial-level data from China. To control for the geographical, economic, and temporal trends in the sample data, we conduct our research using a panel-VAR model. This model incorporates different individual effects and time-varying variables, requiring relatively little in terms of event length. Therefore, it can effectively capture the variations among provinces, enabling a better analysis of the mutual influences and dynamic interactions among various indicators. The model is shown in equation (8):

$$y_{it} = \alpha_{0t} + \alpha_{lt} y_{it-l} + f_i + u_{it} \tag{8}$$

Where, $y_{it} = \{LN\,PUR_{it}, LN\,IUR_{it}, LN\,IFI_{it}, LNGS, LN\,RE_{it}\}$.

$y_{it-1} = \{LN\,PUR_{it-l}, LN\,IUR_{it-l}, LN\,IFI_{it-l}, LN\,GS_{it-l}, LN\,RE_{it-l}\}$

Where, where i is the provinces and cities, t is the year, l is the order of the lag, α_{0t} is the time effect variable for each sample, f_i is the individual effect variable for each sample, and u_{it} is the error term that obeys independent identical distribution. *LNPUR, LNIUR, LNIFI, LNGS,* and *LNRE* denote the logarithm of population urbanization rate, income urbanization rate, inclusive finance index, government support, and real estate development, respectively.

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[1] Database source link: https://www.stats.gov.cn/sj/ndsj/.
[2] Database source link: http://camlmac.pbc.gov.cn/yanjiuju/3911332/3911372/3911414/index.html.
[3] Database source link: http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126049/5127700/5127467/index.html.
[4] Database source link: https://idf.pku.edu.cn/.
[5] Database source link: https://www.wind.com.cn/mobile/EDB/zh.html.

Table 2
Inclusive finance Index (IFI) by provinces.

Province	2011	2012	2013	2014	2015
Beijing	0.55	0.53	0.50	0.50	0.46
Tianjin	0.22	0.23	0.24	0.24	0.35
Hebei	0.08	0.08	0.07	0.07	0.11
Shanxi	0.11	0.11	0.11	0.10	0.14
Inner Mongolia	0.05	0.07	0.06	0.06	0.08
Liaoning	0.11	0.11	0.10	0.11	0.15
Jilin	0.05	0.06	0.06	0.06	0.09
Heilongjiang	0.05	0.06	0.05	0.06	0.08
Shanghai	0.42	0.44	0.43	0.46	0.69
Jiangsu	0.14	0.15	0.14	0.14	0.21
Zhejiang	0.17	0.17	0.16	0.17	0.23
Anhui	0.09	0.08	0.08	0.08	0.12
Fujian	0.09	0.09	0.10	0.10	0.13
Jiangxi	0.06	0.07	0.07	0.06	0.10
Shandong	0.10	0.10	0.10	0.10	0.13
Henan	0.07	0.08	0.08	0.07	0.10
Hubei	0.08	0.07	0.07	0.06	0.09
Hunan	0.06	0.06	0.05	0.05	0.07
Guangdong	0.13	0.13	0.12	0.12	0.18
Guangxi	0.05	0.05	0.05	0.05	0.07
Hainan	0.10	0.09	0.08	0.08	0.12
Chongqing	0.11	0.11	0.11	0.11	0.14
Sichuan	0.08	0.09	0.08	0.09	0.12
Guizhou	0.04	0.06	0.05	0.06	0.07
Yunnan	0.05	0.05	0.06	0.06	0.07
Tibet	0.05	0.03	0.04	0.04	0.07
Shaanxi	0.08	0.08	0.08	0.08	0.11
Gansu	0.07	0.07	0.08	0.07	0.09
Qinghai	0.07	0.08	0.08	0.07	0.09
Ningxia	0.09	0.08	0.08	0.08	0.12
Xinjiang	0.07	0.08	0.08	0.07	0.08

Table 3
Urbanization index system.

Object layers	Indices	Calculation formula
Quantity perspective	Population urbanization rate (PUR)	Urban resident population by province /total population by province
Quality perspective	Income urbanization rate (IUR)	Non − agricultural industry output by province/GDP by province

Table 4
Other influencing factors.

Object layers	Indices	Calculation formula
Government support	Government support (GS)	Fiscal spending by province/GDP by province
Real estate development	Real estate development (RE)	Amount of real estate investment by province /GDP by province

4. Empirical analysis results

4.1. Data test and model lag order selection

As data stationarity is a prerequisite for applying the Panel-VAR model, this study first adopts two-panel unit root inspection methods, IPS and ADF, to inspect the sample data. The specific test results are shown in Table 5.

The results in Table 5 show that only the population urbanization rate sequence containing a time trend is stationary, while the sequences of other variables are non-stationary. Therefore, it is necessary to conduct a cointegration test on the sample data to further examine whether there exists a long-term stable relationship among the non-time series variables in the panel data. We use the method of Pedroni [68] for cointegration tests in this study, and the results of its seven statistics are shown in Table 6.

Considering the relatively short data period in this paper (T = 5 ≤ 20), according to Pedroni's theory, the Panel ADF-Statistic (significant at the 1% level) and the Group ADF-Statistic (significant at the 1% level) are more representative. As seen from the results in Table 6, there is a clear cointegration relationship among the five variables. This implies that the analyzed time series are not

Table 5
Results of unit root test for panel data.

Inspection category	Variable	IPS Inspection		Fisher-ADF	
		T	p-value	T	p-value
Not included Time Trend	LNPUR	−0.6759	0.2496	89.8513	0.0119
	LNIUR	1.0203	0.8462	53.2719	0.7774
	LNIFI	3.3932	0.9997	35.0994	0.9977
	LNGS	−9.8245	0.0000	38.6387	0.9913
	LNRE	−0.5493	0.2914	61.0927	0.5087
Included Time Trends	LNPUR	−16.1588	0.0000	174.1110	0.0000
	LNIUR	0.3289	0.6289	39.0525	0.9900
	LNIFI	−3.6512	0.0001	45.2879	0.9453
	LNGS	−2.9295	0.0017	67.3154	0.3002
	LNRE	0.3264	0.6279	45.9234	0.9370

Table 6
Results of the cointegration test.

Statistical quantity	Statistic (P)	Statistical quantity	Statistic (P)
Panel v-Statistic	−7.625	Group rho-Statistic	8.435
	(1.000)		(1.000)
Panel rho-Statistic	4.752	Group PP-Statistic	−14.572***
	(1.000)		(0.000)
Panel PP-Statistic	−26.065***	Group ADF-Statistic	−9.698***
	(0.000)		(0.000)
Panel ADF-Statistic	−24.238***		
	(0.000)		

Note: *P*-values are in parentheses; "*," "**," and "***" represent statistical tests with significant levels of 10%, 5%, and 1%.

just random fluctuations but rather exhibit a long-term equilibrium dynamic relationship among them, providing reliability in capturing the sustained relationships between the variables.

In addition, the Panel-VAR model with a lag of order 1 was selected in this study based on the principle of minimal AIC, BIC, and HQIC indicators, as shown in Table 7.

4.2. Estimation of Panel-VAR model

This study analyses the Panel-VAR model for five variables using stata14 statistical software. The empirical results are shown in Table 8.

It can be observed that although inclusive finance has a positive impact on both aspects of urbanization, it is not significant. This indicates that inclusive finance plays a promoting role in urbanization but does not exert a strong influence. Real estate development only has a significant positive impact on population urbanization at the 10% level, indicating that real estate development provides a housing foundation for rural populations entering cities. Government fiscal expenditure has a non-significant negative impact on population urbanization. Government investment has a complex impact on urbanization. Specifically, large-scale population urbanization is difficult to have a direct and effective impact solely relying on government investment. However, it has a non-significant positive effect on income urbanization, suggesting that government investment to some extent increases the income of urban residents but with relatively modest effects. Population urbanization, income urbanization, government support, and real estate development all have non-significant positive effects on inclusive finance. This indicates that inclusive finance provides certain financial services for urbanization construction and meets the financial needs of residents. However, due to the relatively low and uneven development level of inclusive finance in China, this impact is limited in directly promoting the improvement of inclusive finance. Inclusive finance, government support, and real estate development are fundamental factors in urbanization development, each playing distinct and interrelated roles with varying effects and influences.

Since explaining the parameter estimates of individual variables alone will have some limitations, we followed up with Cholesky decomposition, GMM estimation, and Monte Carlo simulation to construct and apply impulse response functions, shown in Fig. 1.

The first row of the figure reflects the response of population urbanization to shocks to itself and each of the other variables. Of

Table 7
Selection of model lag order.

Lag	AIC	BIC	HQIC
1	−18.353*	−13.451*	−16.374*
2	−17.847	−10.814	−15.086
3	28.139	38.778	31.607

Table 8
Results of the Panel-VAR model.

Independent Variables	Dependent variables				
	LNPUR	LNIUR	LNIFI	LNGS	LNRE
LNPUR (L1)	0.490*** (3.70)	−0.034 (−0.74)	0.055 (0.05)	−0.108 (−0.30)	−0.939 (−0.67)
LNIUR (L1)	0.605 (0.91)	0.675** (2.10)	2.246 (0.34)	0.338 (0.16)	2.080 (0.56)
LNIFI (L1)	0.016 (0.42)	0.005 (0.43)	0.571* (1.72)	−0.012 (−0.11)	0.064 (0.14)
LNGS (L1)	−0.024 (−0.48)	0.002 (0.12)	0.393 (0.80)	0.747*** (4.23)	−0.046 (−0.08)
LNRE (L1)	0.028* (1.69)	0.002 (0.88)	0.087 (0.75)	0.018 (0.66)	0.766** (2.00)

Note: *Z*-values are in parentheses; "*," "**," and "***" represent statistical tests with significant levels of 10%, 5%, and 1%.
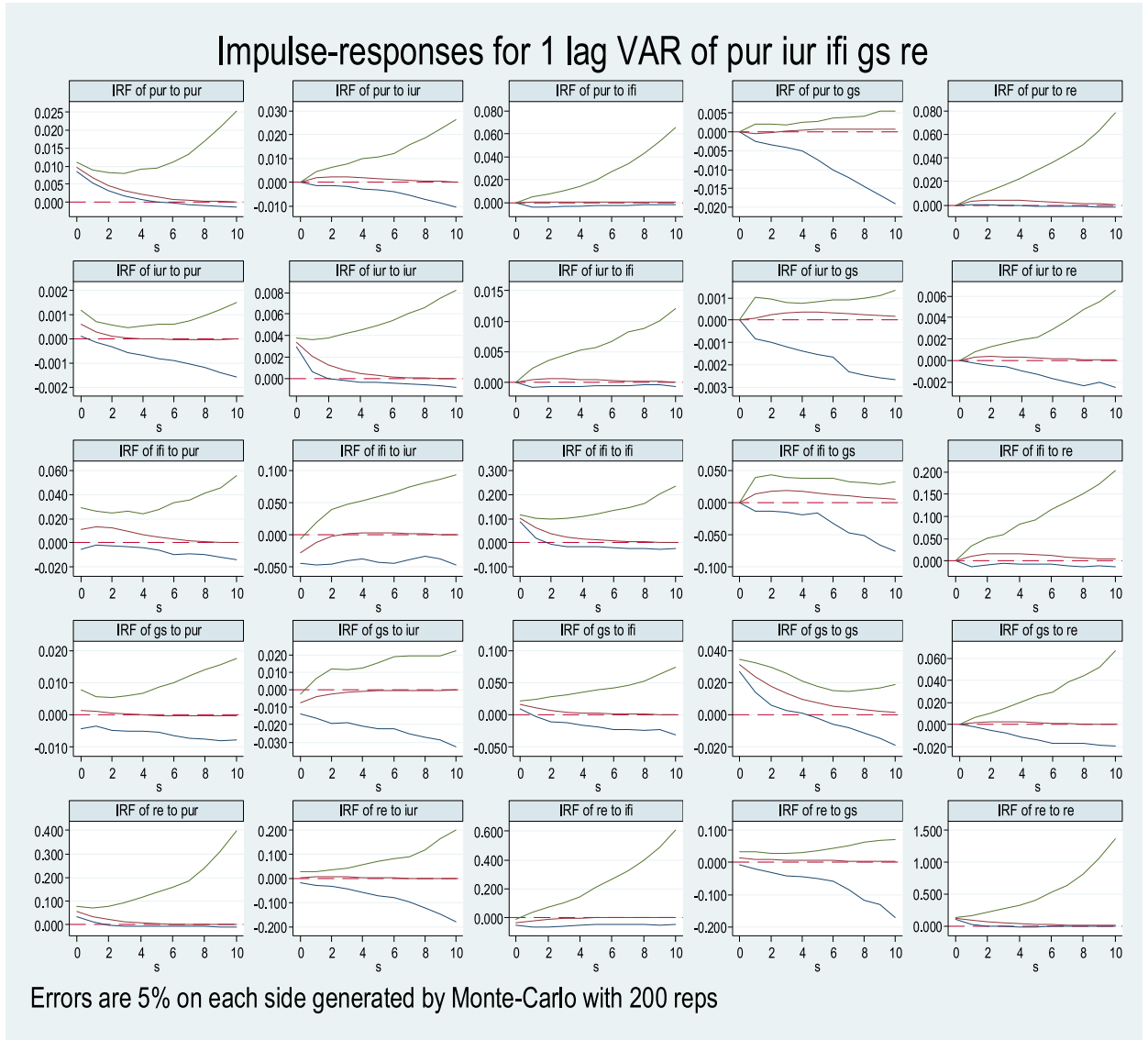

Fig. 1. Impulse response.

these, population urbanization has a positive and diminishing response to its shocks over time. Surprises to income urbanization, inclusive finance, government support, and real estate development show a positive response from 0. However, the answer to shocks such as inclusive finance and government support has been feeble. Thus, the development of inclusive finance has not significantly contributed to the population's urbanization. This analysis finds that the development of inclusive finance can provide more convenient financial support for urbanization construction on the one hand and promote the development of urbanization. However, on the

other hand, the development of inclusive finance has also increased the convenience of financial services for everyone, narrowed the gap between urban and rural areas, and curbed the trend of rural-urban migration, so from the perspective of population urbanization, inclusive finance has not played a more significant role.

The second row of the figure reflects the response of income urbanization to shocks to itself and each of the other variables. Of these, income urbanization shows a positive impulse response to its own and population urbanization shocks, and the effect diminishes over time. The wonders of income urbanization on inclusive finance, government support, and real estate development all exhibit a positive impulse response with an initial period of 0, followed by an increase and then a decrease. This analysis reveals that the development of inclusive finance can provide an increasingly better financial environment for economic growth and promote the development of secondary and tertiary industries in urbanization. Therefore, inclusive finance can improve income urbanization.

The third row of the figure reflects the response of inclusive finance to shocks to itself and various other variables. This analysis reveals that inclusive finance has a positive and gradually diminishing impulse response to its own and population urbanization shocks. The shock to government support and real estate development exhibits a positive impulse response with an initial period of 0. The shock to income urbanization shows a negative and rapidly weakening impulse response, which reaches a negative maximum at the beginning of the period and then decays quickly, decreasing to 0 in period 2. This analysis shows that with government support and real estate development, the level of population urbanization will become higher and higher, and along with the growth of the urban population, the demand for inclusive finance for social and economic development will become higher and higher. Therefore, this will promote the further development of inclusive finance. In contrast, income urbanization exhibits a short-term, discontinuous negative effect on inclusive finance, probably due to the dualistic economic structure of China at this stage. The long-term backwardness of the primary industry, the unreasonable industrial system, and the fact that the secondary and tertiary sectors are still at the location of labour-intensive development are also not conducive to the development of inclusive finance in China.

The fourth row of the figure reflects the response of government support to shocks to itself and each of the other variables. This analysis reveals that government support has a positive impulse response to itself, population urbanization, and the impact of inclusive finance development, and the response gradually diminishes. The shock to income urbanization shows a negative and weakening progressively impulse response, decreasing to 0 in period 6. The shock to real estate development shows a positive pulse response with an initial value of 0. This analysis shows that with the increase in urban population, a large amount of financial support from the government is inevitably required, which indirectly drives the growth in government expenditure. And the development of income urbanization reflects the development of industry and service industry itself, which can solve part of the financial needs in social and economic development, so it also inhibits government support.

The fifth row of the figure reflects the response of real estate development to shocks to itself and various other variables. Of these, real estate development has a positive and gradually decreasing impulse response to its population urbanization and government support shocks. The shock to income urbanization has an initial positive response of 0. The shock to inclusive finance has a negative

Table 9
Results of variance decomposition (%).

	s	LNPUR	LNIUR	LNIFI	LNGS	LNRE
LNPUR	1	1.000	0.000	0.000	0.000	0.000
LNIUR	1	0.033	0.967	0.000	0.000	0.000
LNIFI	1	0.010	0.072	0.918	0.000	0.000
LNPUR	2	0.906	0.022	0.000	0.001	0.071
LNIUR	2	0.028	0.952	0.014	0.001	0.005
LNIFI	2	0.019	0.060	0.902	0.012	0.007
LNPUR	3	0.803	0.043	0.002	0.001	0.152
LNIUR	3	0.026	0.927	0.033	0.003	0.011
LNIFI	3	0.025	0.053	0.874	0.029	0.019
LNPUR	4	0.726	0.056	0.004	0.001	0.213
LNIUR	4	0.024	0.903	0.048	0.008	0.016
LNIFI	4	0.028	0.049	0.845	0.044	0.033
LNPUR	5	0.676	0.063	0.007	0.001	0.253
LNIUR	5	0.023	0.884	0.059	0.014	0.020
LNIFI	5	0.030	0.048	0.822	0.057	0.044
LNPUR	6	0.645	0.066	0.009	0.003	0.277
LNIUR	6	0.023	0.871	0.065	0.020	0.022
LNIFI	6	0.030	0.047	0.805	0.066	0.052
LNPUR	7	0.626	0.067	0.011	0.005	0.292
LNIUR	7	0.023	0.861	0.068	0.024	0.023
LNIFI	7	0.030	0.046	0.794	0.073	0.057
LNPUR	8	0.614	0.068	0.012	0.007	0.300
LNIUR	8	0.022	0.855	0.070	0.028	0.024
LNIFI	8	0.030	0.046	0.787	0.077	0.061
LNPUR	9	0.607	0.068	0.013	0.008	0.304
LNIUR	9	0.022	0.851	0.071	0.031	0.024
LNIFI	9	0.030	0.045	0.782	0.080	0.063
LNPUR	10	0.603	0.067	0.013	0.010	0.306
LNIUR	10	0.022	0.849	0.072	0.032	0.025
LNIFI	10	0.029	0.045	0.779	0.082	0.064

and gradually weakening answer. On the one hand, the increase in urban population, the rise of government support, and the development of secondary and tertiary industries will undoubtedly increase the demand for real estate and promote real estate development. On the other hand, with the development of inclusive finance, the breadth of financial services is expanding, making more and more industries gain, dispersing the financial support for real estate, so that inclusive finance only shows a negative impact on real estate development.

To further analyse the long-term interaction between inclusive finance and urbanization, this study immediately adopts the variance decomposition method to decompose the analysis of each shock. The calculation results are shown in Table 9.

Table 9 reflects the results of the variance decomposition of the population urbanization, income urbanization, and inclusive finance indicators for periods 1–10.

Firstly, looking at the variance decomposition results of the population urbanization indicator, it shows a decreasing trend in its contribution, but it remains above 60%. Income urbanization's contribution to population urbanization starts from 0 and gradually increases, especially reaching its maximum of 6.80% in the 8th period, followed by a relatively stable trend. In the case of inclusive finance, its contribution to population urbanization is 0 in the first two periods and gradually increases. It reaches its maximum of 1.30% in the 9th period. Government support for population urbanization exhibits a slow and gradual growth trend starting from 0 initially. On the other hand, real estate development's contribution to population urbanization starts from 0 but shows a rapid increase, reaching 30.64% in the 10th period. It is evident that population urbanization is still significantly influenced by itself. Furthermore, in the long term, real estate development and income urbanization gradually increase their contributions to population urbanization, totalling 37.3%, becoming the primary influencing factors. However, the impacts of inclusive finance and government support are relatively small.

Secondly, looking at the variance decomposition results of income urbanization, the contribution of population urbanization shows a decreasing trend. It reaches its minimum of 2.20% in the 8th period and remains stable thereafter. Income urbanization's own contribution displays a gradual decrease but remains above 80%, holding an absolute advantage. In the case of inclusive finance, government support, and real estate development, their contributions to income urbanization all start from 0 and gradually increase, reaching 7.20%, 3.20%, and 2.50%, respectively, in the 10th period. This indicates that income urbanization is still predominantly influenced by itself. However, among the other indicators, inclusive finance gradually exerts a more prominent influence on income urbanization.

Finally, examining the variance decomposition results of inclusive finance, the contribution of population urbanization shows a gradually increasing trend, reaching its maximum of 3.00% in the 5th period and remaining relatively stable thereafter. The contribution of income urbanization exhibits a decreasing trend, declining to 4.50% in the 10th period. Inclusive finance has an overwhelmingly dominant contribution to itself, with a decreasing trend in its contribution, but its lowest value is 77.90%, maintaining a significant advantage. Government support and real estate development both start with a contribution of 0 in the initial period and gradually increase afterward. This further emphasizes that inclusive finance is primarily influenced by itself, while over time, the impact of government support factors gradually strengthens.

5. Discussion

This study utilized panel data from 31 Chinese provinces for the period 2011–2015. It employed a panel-VAR model and examined the mutual relationship between inclusive finance development and urbanization construction in various Chinese provinces using impulse response analysis. The research findings are as follows:

Firstly, the impact of inclusive finance on population urbanization and income urbanization is not very high, but there exists a long-term stable bidirectional influence between them.

Specifically, inclusive finance has a positive impact on both population urbanization and income urbanization, which aligns with the results of previous studies [69,70]. Population urbanization also has a positive impact on inclusive finance, but income urbanization has a negative impact on inclusive finance, which differs from the findings of Liu et al. [71]. This discrepancy could be attributed to differences in the study periods and regional economic development. This study selected a period when inclusive finance development was relatively stable and urbanization was rapidly advancing, allowing for a more precise exploration of the interaction between inclusive finance and urbanization construction.

Furthermore, the research revealed that real estate development has a strong positive impact on population urbanization, consistent with the results of Zhu et al. [72]. This underscores the critical role of real estate development in the urbanization process, ensuring housing needs for urban residents.

Both government investment and real estate development have a long-term positive impact on the development of inclusive finance. In summary, increasing the development of inclusive finance not only promotes the urbanization process but also meets the higher demand for inclusive finance as urbanization deepens, facilitating the rapid development of inclusive finance.

In comparison with previous literature, this study primarily focuses on the mutual relationship between inclusive finance development and urbanization construction in China, whereas prior research mainly concentrated on inclusive finance and economic development, as well as inclusive finance and urban-rural income disparities [73,74]. Secondly, this study used panel data from 31 Chinese provinces and conducted targeted research on regional differences. Lastly, this research significantly enriches the study of inclusive finance and regional development, offering new research perspectives for future researchers.

6. Conclusion

6.1. Conclusion and recommendations

With the proposal and rapid development of inclusive finance, more and more scholars have conducted research on inclusive finance. This study explores for the first time the interrelationship between the development of inclusive finance and urbanization construction in China and empirically analyses the interrelationship between inclusive finance and urbanization construction through a combination of the Panel-VAR model and impulse response analysis method, and the results support the validity of the current study to a great extent. According to the findings of this study, the development level of inclusive finance in China is generally low and there is a serious imbalance, both of which seriously restrict the development of urbanization and economic and social development in China. In response, local governments should actively promote financial sector reform and vigorously promote the development level of inclusive finance. In the process of urbanization, all regions should consider the establishment and improvement of the inclusive financial system and promote the synergistic development of the two. Strengthen the basic investment and further increase the support for inclusive finance. This requires a good national top-level design to further rationalize the development relationship between the two. It is through the simultaneous development of urbanization and financial inclusion that the mutually reinforcing effect can be maximized. At the same time, more attention should be paid to the inner construction of inclusive finance and urbanization. Combining contemporary technologies such as the Internet and the Internet of Things, we expand the scope of traditional inclusive finance and urbanization to ensure the continued healthy and stable development of both in the future.

6.2. Theoretical contributions

This paper extends the research on the synergies between urbanization construction and finance and enriches the existing literature on the comprehensive study of urbanization development in emerging markets. Secondly, this study provides a relevant realistic basis for developing countries in terms of urbanization development. Finally, based on the mesoscopic level, the evaluation index system is constructed by combining macro and micro factors, and the dynamic factors between them are further considered.

6.3. Research limitations

Although this study set out to enrich the current research on the interrelationship between inclusive finance and urbanization construction, it still has some limitations. First, the selection of the study population uses provincial data at the national level and has not been combined with micro-level studies at the same time. Second, in terms of the construction of the indicator system, since there is no unified standard for the construction of the indicator system of inclusive finance and urbanization, especially for developing countries, the comprehensive indicators are not very comprehensive, therefore, we have constructed the indicator system by the national conditions of China as far as possible, and the special situations faced by other developing countries in the process of urbanization are not all reflected in this paper. Consequently, the above deficiencies will be a relevant part of the future research that we will conduct.

Data availability

Data will be available upon request.

CRediT authorship contribution statement

Qiyun Li: Writing – original draft, Software, Methodology. **Long Chen:** Writing – review & editing, Supervision, Project administration. **Tianxu Hao:** Visualization, Investigation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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