

Spatio-temporal Evolution and Influencing Factors of Housing Affordability for Urban Residents in China: A Postprint

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Abstract

Using methods such as the Theil index, coefficient, Moran' s I, and spatial regression models, this study analyzes the spatiotemporal evolution patterns of the income-to-housing price ratio across 346 municipal units in mainland China from 2012 to 2017, and explores its influencing factors. The results show that: from 2012 to 2017, the ranking of income-to-housing price ratios across Chinese municipal units generally exhibited the pattern of eastern region > central region > northeastern region > western region, with both relative and absolute differences showing an increasing trend over time, and residents' housing affordability steadily improving. From 2012 to 2017, the spatial agglomeration of income-to-housing price ratios across Chinese municipal units significantly strengthened, with the inequality of spatial distribution showing a gradually increasing trend. Economic level, urbanization level, real estate investment level, and city size are the main factors influencing housing affordability in Chinese municipal units; among them, economic level and urbanization level have significant positive impacts on residents' housing affordability, while real estate investment level and city size have negative impacts. From 2012 to 2017, China' s northeastern, eastern, central, and western regions were influenced by different factors to varying degrees.

Full Text

Preamble

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1 Introduction

1.1 Study Area and Data Sources

This study examines 346 municipal units in mainland China from 2012 to 2017. Data were obtained from the *China City Statistical Yearbook*, *China Statistical Yearbook for Regional Economy*, and *China Real Estate Statistical Yearbook* for the period 2012-2017. The income-to-housing price ratio was calculated based on per capita disposable income of urban residents and average commercial housing prices.

The coefficient and Theil index were employed to measure the temporal evolution of the income-to-housing price ratio. Spatial autocorrelation was analyzed using Moran's I, and a spatial regression model was constructed to identify influencing factors.

1.2.3 Spatial Autocorrelation Analysis

Moran's I was used to examine spatial clustering patterns of the income-to-housing price ratio:

$$\text{Moran's I} = \frac{\sum_i \sum_j W_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{\sum_i (Y_i - \bar{Y})^2}$$

where $S^2 = \sum_i (Y_i - \bar{Y})^2$, $\bar{Y} = \frac{1}{n} \sum_i Y_i$, Y_i and Y_j represent the income-to-housing price ratio in regions i and j , n is the number of municipal units, and W_{ij} is the spatial weight matrix with values between 0 and 1. The Moran's I index ranges from -1 to 1, where values near 1 indicate strong positive spatial autocorrelation, values near -1 indicate strong negative spatial autocorrelation, and values near 0 indicate random spatial distribution.

1.2.4 Spatial Regression Model

A spatial econometric model (SEM) was constructed to analyze influencing factors of the income-to-housing price ratio. The model specification is:

$$Y = \rho WY + X\beta + \varepsilon$$

where Y is the dependent variable (income-to-housing price ratio), X represents independent variables, W is the spatial weight matrix, ρ is the spatial autoregressive coefficient, and ε is the error term.

The study period 2012-2017 was divided into phases: 2012-2014 (early stage) and 2015-2017 (later stage). Municipal units were categorized by city size based on permanent population: small (0-0.5 million), medium (0.5-1 million), large (1-3 million), mega (3-5 million), and super (5 million).

2 Spatial Pattern Analysis

The spatial distribution of income-to-housing price ratios across China's municipal units reveals distinct regional patterns. The eastern region consistently shows the highest ratios, followed by the central and northeastern regions, with the western region exhibiting the lowest ratios. Both relative and absolute differences among regions have increased over time, indicating deteriorating housing affordability.

[Figure 1: see original paper] shows the ranking changes of income-to-housing price ratios from 2012 to 2017, while [Figure 2: see original paper] displays the average value trends. [Figure 3: see original paper] illustrates the Theil index breakdown, demonstrating increasing spatial polarization.

The spatial autocorrelation analysis reveals significant clustering. The Moran's I index has gradually increased, indicating strengthening spatial agglomeration. High-high (HH) clusters are predominantly located in eastern China, low-low (LL) clusters in western China, and mixed clusters in central and northeastern regions. The number of municipal units with reasonable income-to-housing price ratios (within a sustainable range) increased significantly, accounting for 66.8% of all units in 2017.

[Figure 6: see original paper] presents the Moran's I index trend line, and [Figure 7: see original paper] maps the spatial association patterns for 2012 and 2017, clearly showing the persistence and intensification of spatial clustering.

4 Influencing Factors Analysis

4.1 Variable Definition

defines the influencing factors examined in this study:

- **X1:** Per capita GDP (economic development level)
- **X2:** Urbanization rate (urbanization level)

- **X3**: Industrial structure (proportion of secondary industry)
- **X4**: Industrial structure (proportion of tertiary industry)
- **X5**: Per capita real estate investment
- **X6**: Per capita fiscal revenue
- **X7**: City size (population)

4.2 Regression Results

Spatial regression analysis was conducted separately for four regions: Northeast (KD), East (KB), Central (!B), and West (&B). and present the parameter estimates.

Key findings:

1. **Per capita GDP (X1)** shows significant positive effects on the income-to-housing price ratio across all regions throughout 2012-2017, indicating that economic growth exacerbates housing affordability challenges.
2. **Urbanization rate (X2)** exhibits regionally and temporally differentiated effects: positive impacts in Northeast China during 2014-2017, but negative impacts in Eastern China during 2016-2017.
3. **Industrialization level (X3, X4)** demonstrates significant negative effects on the ratio in Western China from 2014-2017, suggesting that industrial development improves housing affordability in less-developed regions.
4. **Real estate investment level (X5)** shows significant negative impacts in Northeast and Eastern China, indicating that increased supply alleviates price pressures.
5. **Per capita fiscal revenue (X6)** has significant negative effects in Eastern China throughout the study period.
6. **City size (X7)** consistently shows significant negative impacts across all regions from 2012-2017, with larger cities exhibiting better housing affordability relative to income levels.

The spatial regression model results confirm that both economic fundamentals and spatial factors significantly influence the income-to-housing price ratio. The spatial lag term is statistically significant, confirming the importance of spatial dependence in housing affordability analysis.

5 Conclusions

This study reveals significant spatiotemporal evolution characteristics of China's urban housing affordability from 2012 to 2017. The income-to-housing price ratio shows clear regional differentiation, with Eastern China facing the most severe affordability challenges. Spatial polarization has intensified, with significant clustering effects.

The analysis of influencing factors demonstrates that per capita GDP, urbanization rate, industrialization level, real estate investment, fiscal revenue, and city size are the primary determinants. However, their effects vary significantly across regions and time periods. Economic growth consistently worsens affordability, while industrial development and real estate investment can mitigate price pressures, particularly in less-developed western regions.

Policy implications suggest the need for regionally differentiated housing policies that account for local economic conditions, spatial spillover effects, and city size characteristics. Strengthening industrial development and regulating real estate investment are crucial for improving housing affordability, especially in rapidly urbanizing areas.

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