SPATIAL-TEMPORAL EVOLUTION AND INFLUENCING FACTORS OF URBAN RENTAL HOUSING MARKET: AN ANALYSIS OF REGIONAL DIFFERENTIATION IN CHINA

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by

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At the end of a busy thesis writing, I suddenly realised that there were still acknowledgement to be written. It was a bit nervous and surprise, so after thinking about it, I decided that I wanted to finish it seriously and bring my PhD career to a close.

Being 30 years old before starting my PhD is inevitably a bit overwhelming. There are so many chores in life that to be able to settle down and finish it has been the most glorious experience of my life. In the past few years, I have experienced the Covid-19, got married, and had a baby, and looking back, it looks like a light boat has already crossed all the mountains.

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May your life set sail, heading towards great ideals.

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LIST OF SYMBOLS

W_{ij}	Degree of dependence or the closeness of connection between region *i* and region *j*
N	Number of objects
X_i	Observed value.
$\overline{X}$	Mean value of the X_i
W(i, j)	Spatial connectivity matrix between i and j
$z_{i,t}$	The *z* standardized rental housing proportion in *i* city in *t* year
$L_{i,t}$	Position of *i* city *t* year
$d(L_{i,t},L_{i,t+1})$	Moving distance of *i* city in *t* and *t+1* years
$w_{i,j}$	Spatial weight matrix
Γi	Relative length
ε_i	Curvature
SF	Spatio-temporal flux
SC	Spatio-temporal cohesion
F_1	Number of transitions for Type1
F_2	Number of transitions for Type2
F_{3A}	Number of transitions for Type3A
C_v	Coefficient of variation;
n	Number of cities;
h_i	Rental price index for i city;
$\overline{h}$	Mean value of the h_i
T_W	Intra-regional difference;
T_B	Inter-regional difference

n_d	Number of cities in Eastern region
n_z	Number of cities in Central region
n_x	Number of cities in Western region
T_i	Proportion of the rental price index of i cities
T_d	Proportion of the rental price index in Eastern region
T_z	Proportion of the rental price index in Central region
T_x	Proportion of the rental price index in Western region
q	Factor detection value
N_h	Number of samples with data type h in the driver factor
L	Total number of drivers
$\overline{Y}_h$	Mean of attributes within sub-region h
n_h	Number of samples within the sub-region h
Var	Variance
N_{X1}	Sample size of two factors X1
N_{X2}	Sample size of two factors X 2
SSW_{X1}	*S*um of within-layer variance of the layers formed by X1
SSW_{X2}	Sum of within-layer variance of the layers formed by X2
L1	Number of layers of variables X1
L2	Number of layers of variables X2
α	Confidence level
y	Explained variable
ρ	Spatial diffusion or spillover intensity between spatial adjacent objects
X	Explanatory variable
ε	Normally distributed random error term

μ	Residual term
ρ	Spatial effect coefficient
λ	Spatial effect coefficient of the explanatory variables in the adjacent regions
d_{ij}	Spherical distance (kilometer) between region i and region j

LIST OF ABBREVIATIONS

GMV	Gross Market Volume
US	United States of America
UK	United Kingdom
ESDA	Exploratory Spatial Data Analysis
ESTDA	Exploratory Spatio-Temporal Data Analysis
Cv	Coefficient of variation
T	Theil
LISA	Local Indicator of Spatial Associations
GMM	Institut Pengajian Siswazah
CNKI	Universiti Sains Malaysia
CREIS	China Real Estate Index System
Creprice	China Real Estate Price
CPC	Communist Party of China
NPC	National People's Congress
CPPCC	Chinese People's Political Consultative Conference
RTP	Rental Price
SLM	Spatial Lag Model
SEM	Spatial Error Model
SDM	Spatial Dubin Model
OLS	Ordinary Least Squares
VIF	Variance Inflation Factor
RE	Random Effect
LM	Lagrange Multiplier
GDP	Gross Domestic Product
Prent	Proportion of rental housing
Pgdp	Per capita GDP
Tgdp	The proportion of the tertiary industry in GDP
Price	Housing prices
Dpop	Population density

Migrant	The proportion of migrants
Unmarried	The proportion of unmarried population
Pop	The proportion of population over 65
Family	Household size
Save	Residents 'savings deposit balance
School	Number of primary and secondary schools
Hospital	Number of hospitals
Education	Average years of education
Area	Per capita housing area
Minority	The proportion of ethnic minority population

LIST OF APPENDICES

EVOLUSI RUANG-MASA DAN PENGARUH FAKTOR PASARAN PE RUMAHAN SEWA BANDAR: ANALISIS PERBEZAAN WILAYAH DI CHINA

ABSTRAK

Pasaran rumah sewa memainkan peranan penting dalam sektor perumahan, memenuhi pelbagai keperluan sosioekonomi. Di China, urbanisasi pesat, penghijrahan, dan transformasi ekonomi telah memberi kesan mendalam terhadap pembangunan perumahan sewa, yang memerlukan pemahaman yang lebih mendalam tentang evolusi spatial dan temporalnya. Kajian ini menyelidiki trajektori pembangunan pasaran rumah sewa di China dalam tempoh dua dekad yang lalu dan mengenal pasti perbezaan spatial serta faktor utama yang mempengaruhinya. Walaupun kajian terdahulu telah meneliti pasaran hartanah China, tumpuan pada sektor perumahan sewa agak terhad, terutamanya dalam memahami dinamik evolusi spatial dan temporalnya. Penyelidikan ini mengisi jurang tersebut dengan melakukan analisis berskala besar di 335 bandar peringkat prefektur, menggabungkan kajian perbandingan jangka panjang dari tahun 2000 hingga 2020, yang menambah perspektif temporal yang sangat diperlukan dalam kajian perumahan spatial. Kajian ini dibina berdasarkan kerangka teori seperti Teori Penyaringan Perumahan (Housing Filtering Theory), Teori Geografi Ekonomi Baru (New Economic Geography Theory), dan Teori Ekonometrik Ruang (Spatial Econometrics Theory). Literatur mengenai urbanisasi, penghijrahan, dan mekanisme penawaran-permintaan perumahan dikaji semula untuk menetapkan peranan faktor sosioekonomi dalam membentuk perbezaan spatial pasaran rumah sewa. Kajian ini

menggunakan data dari Banci Penduduk China (2000, 2010, dan 2020), indeks harga rumah sewa bandar, dan data panel bandar. Autokorelasi spatial, pekali variasi, dan analisis indeks Theil digunakan untuk menilai corak evolusi spatial dan temporal. GeoDetector dan model ekonometrik spatial digunakan untuk menganalisis faktor-faktor yang mempengaruhi serta mekanisme yang mendorong perubahan ini. Dapatan kajian menunjukkan peralihan yang ketara dalam pasaran rumah sewa China dari "desentralisasi spatial" kepada "pengagregatan spatial", terutamanya di bandar peringkat pertama dan kedua. Bandar dengan populasi yang lebih besar, pertumbuhan ekonomi yang lebih tinggi, dan struktur sosial yang lebih terpolarisasi menunjukkan bahagian pasaran sewa yang lebih besar. Ketidaksamaan serantau ketara, dengan rantau Timur menunjukkan kelebihan ketara dalam pembangunan pasaran, manakala rantau Barat menunjukkan potensi pertumbuhan yang ketara. Penghijrah muncul sebagai faktor dominan dalam perbezaan spatial, dengan interaksi antara saiz populasi penghijrah dan harga rumah menjelaskan sebahagian besar corak spatial yang diperhatikan. Selain itu, dalam tempoh 20 tahun yang lalu, faktor isi rumah dan pasaran semakin membentuk pasaran rumah sewa, manakala kesan faktor ekonomi dan institusi semakin berkurangan. Berdasarkan dapatan ini, kajian ini mencadangkan pendekatan dasar yang berbeza bagi wilayah yang mengalami aliran masuk dan keluar penduduk. Pembuat dasar harus memberi tumpuan kepada penyelarasan pembangunan pasaran rumah sewa serantau, menyesuaikan strategi pembangunan perumahan berdasarkan trend demografi, dan membina ekosistem pasaran perumahan yang seimbang. Selain itu, perancangan bandar dan peraturan pasaran harus diselaraskan dengan tren yang berkembang dalam pasaran rumah sewa untuk memastikan pertumbuhan yang mampan. Kajian ini menyumbang kepada literatur dengan menawarkan analisis spatiotemporal yang komprehensif

mengenai pasaran rumah sewa di China, menyoroti ketidaksamaan serantau, dan mengenal pasti faktor-faktor utama yang mempengaruhi perbezaan spatial. Dapatan ini memberikan pandangan berharga kepada pembuat dasar untuk merangka dasar perumahan khusus wilayah yang mempromosikan pembangunan bandar yang sihat dan menangani cabaran unik yang dibawa oleh penghijrahan dan perubahan ekonomi di wilayah yang berbeza.

SPATIAL-TEMPORAL EVOLUTION AND INFLUENCING FACTORS OF URBAN RENTAL HOUSING MARKET: AN ANALYSIS OF REGIONAL DIFFERENTIATION IN CHINA

ABSTRACT

The rental housing market plays a critical role in the housing sector, catering to a variety of socioeconomic needs. In China, rapid urbanization, migration, and economic transformation have profoundly affected the development of rental housing, necessitating a deeper understanding of its spatial and temporal evolution. This study investigates the development trajectory of China's rental housing market over the past two decades and identifies the spatial differentiation and key influencing factors. While previous studies have explored China's real estate market, there has been limited focus on the rental housing sector, particularly in understanding the spatial and temporal dynamics of its evolution. This research fills this gap by conducting a large-scale analysis across 335 prefecture-level cities, incorporating a long-term comparative study from 2000 to 2020, which adds a much-needed temporal perspective to spatial housing studies. This research builds on theoretical frameworks such as Housing Filtering Theory, New Economic Geography Theory, and Spatial Econometrics Theory. The literature on urbanization, migration, and housing supply-demand mechanisms is reviewed to establish the role of socioeconomic factors in shaping the rental housing market's spatial differentiation. The study employs data from the China Population Census (2000, 2010, and 2020), urban rental housing price indices, and urban panel data. Spatial autocorrelation, coefficient of variation, and Theil index were used to assess

spatial and temporal evolution patterns. GeoDetector and spatial econometric models were applied to examine the influencing factors and mechanisms driving these changes. The findings reveal a significant shift in China's rental housing market from spatial decentralization to spatial agglomeration, particularly in first- and second-tier cities. Cities with larger populations, higher economic growth, and more polarized social structures exhibited higher rental market shares. Regional disparities were evident, with the Eastern region demonstrating a pronounced advantage in market development, while the Western region shows considerable potential for growth. Migrants emerged as a dominant factor in spatial differentiation, with the interaction between migrant population size and housing prices explaining much of the observed spatial patterns. Additionally, over the past 20 years, household and market factors have increasingly shaped the rental market, while the impact of economic and institutional factors has waned. Based on these findings, the study recommends differentiated policy approaches for regions experiencing population inflows and outflows. Policymakers should focus on coordinating regional rental housing market development, adjusting housing development strategies based on demographic trends, and fostering a balanced housing market ecosystem. Additionally, urban planning and market regulations should be aligned with the evolving trends in the rental housing market to ensure sustainable growth. This study contributes to the literature by offering a comprehensive spatiotemporal analysis of the rental housing market in China, highlighting regional disparities, and identifying key factors influencing spatial differentiation. The findings provide valuable insights for policymakers to design region-specific housing policies that promote healthy urban development and address the unique challenges posed by migration and economic shifts in different regions.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Housing is an essential part of people's lives. Realising people's housing rights and interests and improving the existing living conditions play a significant role in constructing a harmonious society. As human productivity and lifestyle shift from rural to cities, industrial integration's capacity has improved, the economic development of cities has spawned a large number of employment opportunities, the population continues to gather in the city, and the housing demand of residents has also increased accordingly. At this time, the housing market's development scale and investment amount are increasing to balance the rapidly growing housing demand. The housing supply is increasing, resulting in the increasingly high price of commercial housing. Most new working and low- and middle- income groups need help to realise their desire to buy houses. In this case, the new working groups and the low- and middle- income groups can only rely on renting to solve the housing problem, resulting in the rental housing market (Hu, 2019). The development of the housing market is one of the core problems in developing the urban and real estate industries. As one of the decisive industries supporting the development of China's national economy, the healthy operation of the real estate industry plays a profound role in the excellent development of the national economy. The rental and trading housing markets are complementary and supportive of one another as vital components of the housing economy, solving the housing problem for different income groups and ensuring the overall and orderly development of the housing market and the smooth progress of the urbanisation process

(Cai, 2022). Resources including industry, education, healthcare, and labour force concentration occur in cities due to growing urbanisation. As the population of cities grows, there is a corresponding increase in demand for housing, which leads to a supply-demand imbalance that drives up housing costs (Dai, 2022). These cities' low- and middle-income groups cannot afford to buy into the trading housing market. For low- and middle- income residents in these cities, the contradictions and problems of basic living needs are becoming increasingly severe (Hu, 2019). Furthermore, it is due to the relatively slow development of the urban rental housing industry, which is plagued by imperfect norms and regulations. Housing owners and renters in public service can enjoy the difference between the government providing all kinds of policies, public expectations of housing prices and traditional concepts of home ownership security. A series of reasons caused the imbalance between the two housing market segments (Wei, 2017). This will lead to the loss of the migrant population, especially low- and middle-income people, which is not conducive to developing labour-intensive industries and urban expansion. The relatively low proportion of the rental housing population in China also reflects that the demand for the rental housing market needs to be explored, and the market's growth prospects are promising (Cai, 2022). The rental housing market, as the last line of defense in solving the housing problems of the population, has a role that cannot be replaced by the trading housing market. As a result, developing and regulating the rental housing market is crucial to redressing the imbalance between urban housing market purchases and rentals as well as to furthering the housing system's reform. Meeting resident demand for housing, enhancing the structure and operation of the housing market, and fostering social and economic development are all very important.

1.2 Background

1.2.1 The Development of the Rental Housing Market Lags Behind

China's real estate market has developed over the past 40 years and accomplished amazing feats since the housing system reform. Regional cooperation in China's economic development is intensifying. As an essential pillar of the national economy, the real estate industry plays a vital role in regional economic linkage, and the development and investment of the real estate industry has also become a new economic growth point. According to statistics, the real estate industry's added value in 2020 was 7.45 trillion yuan, a 7% rise from 2019. In 2020, the real estate industry contributed 7.34% to the national economy, up 1.65 percentage points from 2011. Over the last decade, China's real estate industry's contribution to the economy has been steadily increasing. In the early 1980s, China's real estate industry was still in the initial stage of development. There was a severe urban housing shortage at that time, and the per capita floor area was less than 8 square meters. After years of efforts, the severe housing shortage was solved, and urban residents' housing conditions were significantly improved. The National Bureau of Statistics recently released the China Census Yearbook 2020, which shows that the per capita living area of Chinese households reached 41.76 square meters, a 13-fold increase from 1978. Before 1998, annual domestic sale area of commercial housing was less than 100 million square meters. In 1998, it reached 121.85 million square meters, and in 2020, it reached 176.086 million square meters, 14 times that of 1998. The real estate industry has contributed to people's lives and economic and social development. While the quick development of trading housing market regulations and legislation system has been completed. The rental

housing market is falling behind in terms of regulation, and the policy mechanisms for financing, land, and taxation are incomplete and behind in development, making it the largest deficit in the housing system (Shao, 2020). The development between China's two major housing market segments could be more balanced, which affects good development of housing market, hinders the national economy's better development.

How to ensure the steady development of the housing market, solve the problem of declining housing payment capacity, and backward reform of housing security have become critical components of further improving the housing system and promoting the deepening of the reform of the housing system. A healthy, complete, and vibrant market should be composed of buying, selling, and renting. In recent years, China's housing market has been more focused on sales, and trading house have become a common way of housing consumption. Commercial housing sales volume and sales area far exceed the rental volume and rental area. According to the National Bureau of Statistics, in the past seven years, the rental housing income of real estate development enterprises nationwide has been only about 2% of the trading housing revenue. How will the regulation policy of rental housing change the current situation of unbalanced regional development and build a balanced housing market? The coordinated regional development of the rental housing market has become an urgent problem that needs to be solved. In 2015, the country first proposed the development of the rental housing market and establishing a housing system with both purchase and rent. Since then, China's rental housing market has entered a stage of rapid development (Dai, 2022). Later, it has gradually developed and grown under the promotion of a clear development direction and ever-improving policies. However, the differences in demand between regions also signal different

directions for the development of the rental housing market between regions, and the selection of pilot cities also generally reflects the close correlation between the growth of rental housing demand and population inflows. In 2017, after China's rental housing market principle was developed, local governments and financial institutions introduced some policies and measures to develop the rental housing market. Many large real estate development enterprises began intervening in the rental housing market, and real estate intermediary brokerage companies also began to transform rental housing forms and business models. Thus, China's rental housing market is developing rapidly. However, because the government's concept, policy, laws, and regulations are poorly prepared, weak housing renters of the developed market, China's rental housing market is mainly composed of real estate development enterprises and real estate market intermediary companies according to its understanding of policy and enterprise intrinsic nature free development. As a result, it has just developed, and its contradictions and problems were immediately exposed and soon led to a dilemma (Yi, 2019).

1.2.2 The Large Regional Differences in the Rental Housing Market

Regional differences in China are closely related to regional differences in the social environment, such as society, history, culture, religion, and geographical advantages. In terms of region, China is a vast country with a large population. As regions and cities are located in different geographical areas, there are differences in the level of urbanisation, initial resource endowment, natural environment and other aspects. Leads to uneven development in terms of openness, economy, population, etc., between regions and cities (Sun, 2017). However, more importantly, it is caused by the policy bias of the reform.

The differences in regional economic base mainly cause the imbalance of urban development in different regions. Cities in Eastern, Central, and Western region of China have developed differently based on different resources and industrial structures. As the regional unit of urbanisation and economic development, the cities at and above the prefecture level have experienced different stages of development and have different characteristics and rules. Understanding these stages and characteristics and the differences between different cities can help develop urban development strategies and promote sustainable urbanisation and economic growth. In urban development, strategies should be adopted to promote the city's development according to the development stage, as well as the characteristics and contradictions of the city. This includes policy measures to optimise resource allocation, promote inter-city cooperation, improve infrastructure development and talent admission. Therefore, this study thinks that while studying the rental housing market, regional differences are an important factor to consider. The trading housing market is a typical geographic market, and this has to do with the real estate properties of residential commercial assets.The premise of solving the housing problem is to understand the housing situation of residents in various regions, such as high housing prices, housing affordability, and other problems. Especially for some megacities and large cities in some urban agglomerations, regulation of the housing market should be adapted for local conditions. However, when residents live in a certain geographical environment, the price of residential and commercial housing in different regions is quite different, and the rental housing market also has different degrees in time and degree due to regional influence.

1.2.3 The Spatial Differentiation in the Rental Housing Market is Significant

The continuous development of the national economy has driven the continuous development and integrated innovation of urban industries. Industrial development needs agglomeration, so industrialisation drives urbanisation, and the population gathers from rural to urban on a large scale. The development of the service industry needs more agglomeration than industry, so in the middle and late stages of urbanisation, the population mainly gathers in urban agglomeration. As the global urbanisation process enters the middle and late stages, the urban population growth of different sizes will change from the past to differentiation. The population will migrate from rural, small, and medium-sized cities to urban agglomerations. In contrast, the population growth of small and medium-sized cities will face stagnation or even net migration. Population, capital, technology, information and other factors flow frequently through the increasingly developed transportation and communication network, and the rental housing market also shows prominent characteristics of regional agglomeration. In this context, the spatial differentiation phenomenon between cities is also gradually significant. There have been some studies by scholars that have shown that the development and change of rental housing in China from 2000 to 2010 have significant spatial agglomeration characteristics, and the trend of spatial agglomeration is becoming stronger and stronger, while the distribution of rental housing development hotspots in China has changed in different periods (Zhan et al., 2020). Influenced by the development of regional economic integration, the rental housing market's spatial differentiation has intensified, and the spatial correlation of the regional rental housing market has been enhanced. In the study of the spatial differentiation pattern of the rental housing market in the Yangtze River Economic Belt, a cluster area with high land values

is formed by the Yangtze River Delta urban agglomeration. In contrast, the west Yunnan forms a cluster area of low land prices. This spatial correlation is also evident in the rental housing market, which is closely linked to residential land prices. The high-value area of rental housing development is closer to the urban agglomeration of the Yangtze River Delta and the Pearl River Delta, some regional center cities in the Western region and economically developed cities such as Beijing and Xiamen (Zhan et al., 2020). Many factors like the size of the internal population and the degree of economic development influence the rental housing market. It is also affected by the external environment, such as the supply and demand of related cities and the real estate market activity. Therefore, the differences in the rental housing market not only reflect the unbalanced development of the region but also reveal the internal links of the regional economy (Mo, 2020). Both spatial differentiation and spatial correlation phenomena follow specific economic rules. In this study, the spatio-temporal evolution rule is analysed about the coordinated development of the regional economy. The rule of the temporal and spatial evolution is influenced by many factors, including the level of economic development, population flow and policy regulation. Using GeoDetectors and spatial econometric model, this study further reveals the mechanism and causes of spatial differentiation in the rental housing market. With the acceleration of the urbanisation process and the continuous adjustment of policies, it will continue to show a differentiated development trend. Thus, distinct policies and actions must be developed in accordance with the real circumstances in different regions in order to support the market's healthy development. This study aims to objectively reflect the development level of the rental housing market in China, identify the characteristics and trends of the market's evolution in terms of space and time, analyse the factors that influence

differentiation, grasp the status and trend of development, draw attention to issues facing , and develop regulations of rental housing in the region.

1.3 Problem Statement

The spatial differentiation of the rental housing market, defined as the varied distribution and development patterns of rental housing across different regions, is a crucial aspect of urban housing dynamics. This differentiation not only directly impacts residents' housing choices and overall quality of life but also indirectly influences urban economic development, social stability, and the equitable distribution of resources (Wen, 2022). However, despite its significance, the specific factors contributing to this spatial differentiation and the mechanisms through which they exert their influence remain complex and not fully understood. Recognizing and addressing these knowledge gaps is essential for promoting balanced urban development and ensuring housing access that aligns with diverse regional needs. Existing studies suggest that a range of structural and demographic factors, including policy environments, economic development, demographic compositions, and socioeconomic characteristics of households, collectively contribute to a complex, multi-layered web of influences on the spatial distribution of the rental housing market (Han, 2020; Zhan & Yu, 2020; Du, 2019; Yu & Xu, 2018; Vasanen, 2012; Aziz et al., 2019). For instance, policy support in specific regions can lead to accelerated growth of the rental housing market, while variations in regional economic levels can create significant disparities in housing demand and availability (Seiko, 2007). Additionally, factors such as population age structure, household composition, and income levels also influence rental housing patterns, shaping unique regional profiles (Painter, 2000; Kim & Jeon, 2012; He & Fei, 2018).

According to the literature, various factors affect the rental housing market, which can not be included in this study, and too many variables will cause multicollinearity. Combining the theory of evolution and spatial differentiation and the theory of new economic geography in Chapter 2, combing the analyses, it can be seen that population flow is an activity driven by economic reasons for migrants to obtain a better life, which can be seen that the economic factor is the main factor leading to population migration, so when exploring the influencing factors of spatial differentiation should be included in the research model of the economic factors and demographic factors. According to the theory of housing filtration, in the housing market, high-income groups, as the first consumers to purchase housing, choose to re-purchase new houses when the quality of housing declines or fails to meet the demand, while the eliminated houses will be sold or rented at a lower price to low- and middle-income groups, whose original houses will be used by lower-income groups. Therefore, the income factor should also be included in the research model of factors influencing spatial differentiation in the rental housing market .The price of rental housing is affected by location, transportation and traffic.The price of rental housing is affected by location, transport, and the degree of completeness of supporting facilities, etc. Therefore, the livability factor and the cultural and psychological factor are closely related to the development of the rental housing market, and can also reflect the development level of the local rental housing market.

1.3.1 The explained variables

The development of the rental housing market in the urban research units is represented by the "Rental Housing Proportion" for all households. The calculation formula is:

Rental housing proportion (Prent) = number of rental households / total number of households

1.3.2 The key explanatory variables

The development of the rental market is affected by various factors, such as economic cost, demographic, income, livability and cultural and psychology. Referring to the selection of influencing factors and data availability of existing studies, a total of 23 variables were selected as influencing factors for the development and change of rental housing in China:

i. Economic cost factors: the six variables of city GDP, per capita GDP, the proportion of the tertiary industry in GDP, the proportion of employees in secondary and tertiary industries, housing price and rental price were selected to mainly reflect the impact of urban social and economic development level and the change of rent and purchase cost on the rental housing market development.

City GDP: GDP is the total outcome of all resident productive activity in a nation (or region) over a specific time period., which is used to measure the level of development and economic status of a a nation (or region). In 2022, China's GDP was 121.02 trillion yuan, an increase of 3% over the previous year and an average growth of 5.7% in the past two years. City GDP is the gross domestic product in the city, and the

value of the final product produced in the city within a certain period (such as a year). In 2022, there will be seven cities (Shanghai, Beijing, Shenzhen, Chongqing, Guangzhou, Suzhou, and Chengdu) with a city GDP of over 2 trillion yuan, and the combined seven city GDP accounts for 18.3% of China's GDP. The growth of GDP leads to the improvement of the economic development degree, which makes resident's income higher and higher, thus increasing the demand for housing and also improving the confidence of real estate developers in housing investment, and then increasing the corresponding development investment, which will also cause some fluctuations in the rental housing market.

Per capita GDP: it is calculated by comparing the GDP achieved in a country during the accounting period (usually one year) with the resident population (or household population) of the country to obtain the per capita GDP. Per capita GDP is a measure of the standard of living of peoples and is often combined with purchasing power parity for a more objective measure. Per capita GDP depends on two factors: population size and GDP. The formula is: per capita GDP = total GDP ÷ average annual population. The National Bureau of Statistics issued the Statistical Bulletin of the People's Republic of China on National Economic and Social Development in 2022. According to preliminary calculations, the per capita GDP in 2022 was 85,698 yuan, an increase of 3.0% over the previous year. Per capita GDP better reflects a country's or region's prosperity and economic development level than the total GDP. It is an effective tool for people to understand and grasp the macroeconomic operation status of a country or region. It is often used to measure economic development status in development economics, and it is one of the most important macroeconomic indicators.

The proportion of the tertiary industry in GDP: the added value of the primary, secondary, and tertiary industries is combined together to form the regional gross domestic product. The proportion of the three industries in GDP is the most critical economic index to describe the distribution of industrial structure in a nation (or region). This index fully reflects the changes in the economic development process of a country and before and after the adjustment of industrial structure through policies. A review of the proportion of GDP accounted for by the three industries in China over the years reveals the development trend of China's industrial structure. During the 70 years from 1952 to 2022, the three industrial structures have undergone subversive changes. The secondary and tertiary industries have developed rapidly, and the proportion of the tertiary industry in GDP exceeds that of the secondary industry. This shift is a fair representation of the ongoing improvement of the consumption structure and the outcome of ongoing efforts to advance policies for industrial structure adjustment. After 1978, the proportion of the secondary industry in China's GDP has been stable between 40% and 50% over the years, with little change. The primary industry declined from 28% in 1978 to 7% in 2022, while the tertiary industry rose to 53% from 24% in 1978. Therefore, after the reform and opening up, the secondary industry developed steadily, the tertiary industry developed rapidly, and the primary industry developed slowly. In general, the change in China's industrial structure is mainly reflected in the gradual evolution from agriculture to industry to service industry. From the development experience of developed countries in the world, with the improvement of economic development level, the proportion of the service industry in GDP will continue to rise.

Table 1.1 The trend of the proportion of the three industries in GDP

Year	Primary industry	Secondary industry	Tertiary industry
1952	51%	21%	28%
1978	28%	48%	24%
2022	7%	40%	53%

Sources:The China Statistical Yearbook in 1952/1978/2022

The proportion of employees in the secondary and tertiary industries: it is the percentage of employees in the secondary and tertiary sectors out of all employees. From the perspective of industrial structure, the development of the secondary industry and the tertiary industry will often bring a large number of jobs, and the development of the tertiary industry can also enhance the service capacity of the city and attracting inward migration. Meanwhile, industrial development will also bring a series of economic effects, such as the increase of residents' income and the enhancement of the financing ability of real estate enterprises, which will promote the rise of residential land price, thus having an impact on the rental housing market.

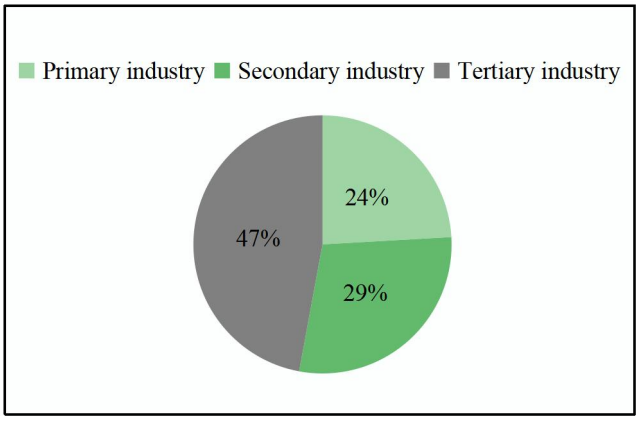

Figure 1.1 The proportion of employees in 2022
Sources:The China Statistical Yearbook in 2022

Housing price: refers to the price of the housing together with the land it occupies, the housing price=land price+building price. Housing price decision has their unique rules. It belongs to a kind of commodity price in the existence of land rent, which is a typical situation where the usefulness of the commodities produced in different grades of land varies. In the case of housing, the usefulness of goods (housing) produced on superior land (good locations) is high, and the usefulness of goods (housing) produced on inferior land (poor locations) is low. Thus, housing prices are governed by the price law of land rent theory when there are differences in the usefulness of goods produced by different classes of land.

Rental price: the amount of currency or physical substance charged for renting real estate or paid for renting real estate is usually referred to as rent and sometimes as the rental price. When houses and land are rented together, it is referred to as the rental price of the house or the rent of the house.

ii. Demographic factors: Eight variables were selected to represent the total population at year-end, population density, population size, urbanisation rate, the proportion of migrant population, the proportion of unmarried population, the proportion of population over 65 and household size, with the first five variables having an impact by influencing the size of demand in the housing rental market, and the last three reflecting the impact of changes in the life cycle and household size.

Total population at year-end: refers to the number of population at 24:00 on December 31 of a particular year, or the number of population at 00:00 on January 1 of next year, that is, the number of population at the beginning of the following year. The

population at the year-end or the beginning of the following year is obtained by regular population registration or sampling survey. It can also be obtained (the number of the population at the year-end + the number of births in this year, the number of deaths in this year + Number of inflows in this year－number of outflows in this year). According to the National Bureau of Statistics, the country's population at the end of 2022 was 1,411.75 million, a decrease of 0.85 million from the end of the previous year.

Population density: the number of people per unit of land area. There are two units of measurement commonly used: persons per square kilometre; and persons per hectare. It is an important indicator of the distribution of population in a country or region. The land area for the calculation of population density refers to the land area and inland waters within the territory, excluding the territorial sea. Because the population density indicator is assumed to be uniformly distributed in a certain geographical area it covers, therefore, the smaller the scope of population density calculation, the more faithfully reflect the situation of population distribution; the larger the scope can only be generalised to reveal the general trend of population distribution.

Population size: the number (or size) of the population of a city (town) referred to in the study of urban geography and the preparation of urban planning. Generally, it refers to the number of population development in a city (town) at present or within a certain period of time, the latter being closely related to the regional economic basis of city (town) development, geographical location and construction conditions, and the characteristics of the present situation. City population size refers to the actual number of people living in a city.

The proportion of migrant population: the proportion of the population whose Hukou is registered outside the district or county to the total population， it is an important figure for measuring the percentage of attractiveness of a place's population. The migrant population specifically refers to those who have been living in the local area for more than half a year but whose Hukou is registered in a city outside the province, or those who have been living in the city for less than half a year but who have been away from the place of Hukou registration for more than half a year. In China, it cannot be denied that cities with large inflow of population or large proportion of migrant population are, without exception, the most active cities in terms of economic development. From the data of the 7th China Population Census, it can be seen that in 2020, the Yangtze River Delta urban agglomeration, Pearl River Delta urban agglomeration, and Beijing-Tianjin-Hebei urban agglomeration are located to the majority of the cities with a larger percentage of migrant populations.

Urbanisation rate: the population constantly gathering in cities, also known as urbanisation. As a result of the process of urbanisation, the proportion of the urban population in the total population of society as a whole has continued to rise. So far, China has achieved an urbanisation rate that is close to that of middle-income countries. When a country's urbanisation rate reaches 30%, urbanisation accelerates until it reaches 70%. In the process of urbanisation, if the per capita housing area in towns and cities does not reach 30 square metres, the national housing demand will be very high. On the one hand, the continuous gathering of population to cities increases the demand for housing; on the other hand, the demolition or renovation of old towns also drives the demand for housing. New urbanisation is mainly based on urban agglomerations, with

emphasis on central cities radiating to surrounding cities and towns. According to the bulletin of the National Bureau of Statistics, the urbanisation rate of China's resident population will increase from 49.95% in 2010 to 65.22% in 2022.

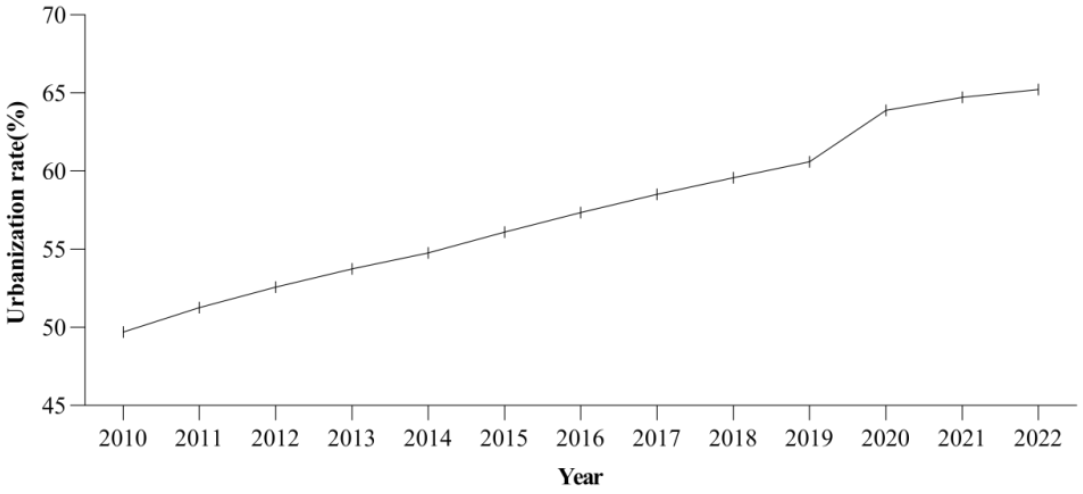

Figure 1.2 Urbanisation rate in 2010-2022 (%)

Sources:The China Yearbook in 2010-2022

The proportion of unmarried population: the proportion of the unmarried population to the total population. According to sample survey data from the China Statistical Yearbook 2022, if the single population refers to the number of unmarried population, then the total number of single persons in the country in 2021 will be 226 million; if the single population refers to the number of unmarried population plus the number of population in divorce status, then the total number of single population in the country in 2021 will be 253 million.

The proportion of population over 65: also known as the coefficient of old age, it refers to the number of people aged 65 and over as a percentage of the total population.

According to the National Bureau of Statistics, in 2022, 14.9% of China's population will be 65 years of age or older. According to the international standard, when the proportion of people over 65 in a country or region exceeds 7%, it enters into aging; when it reaches 14%, it is deep aging; and when it exceeds 20%, it enters into a super-aging society. This means that China may have already entered a deeply ageing society.

Household size: The average number of persons living in a household in society as a whole or in a given area. Changes in the household size, even if the total population remains unchanged, will cause changes in the number of dwelling units and thus in the housing required, which in turn will lead to changes in the demand for housing and thus affect the housing price. Data from the 7th China Population Census show that the average household size in China in 2020 was 2.62 persons, a decrease of 0.48 persons from 3.10 persons in 2010, which has fallen below the bottom line of the number of "3-member households". A household is defined as one that is "related by blood, marriage or adoption". Looking back over the past half-century, the size of China's households has been declining all the way down from the " 3-member family" often talked about before, and is now in transition to the " 2-member family", which is undoubtedly a profound social change. Changes in social and cultural attitudes have led to a tendency for households to become smaller, and intergenerational conflicts have led to more people choosing not to live with their parents, thus reducing the proportion of "multigenerational households". At the same time, the proportion of single-member and two-member households has increased due to factors such as the concepts of non-marriage, late marriage and Dink, as well as the divorce rate. Generally, as the household size becomes smaller, the average household size decreases, the number of

households increases, the total amount of housing needed increases, and housing prices tend to rise.

iii. Income factors: three variables of residents 'savings deposit balance, average salary of employees on duty and per capita disposable income were selected, which mainly reflect the impact of residents' income ability and housing affordability on the development of rental housing market.

Residents 'savings deposit balance: it is the balance of residents' deposits in financial institutions (such as banks or cooperatives) the difference between the total capacity of net deposits and the amount of net temporary deposits, which is the result of the balance of residents' deposits. Therefore, it can be an important basis for measuring residents' behaviour. Composed of monetary and financial products, it reflects the structure of residents' resource allocation behaviour and is an important mirror of residents' resources. As the balance of residents' savings deposits is an important indicator reflecting residents' behaviour in real time, it changes much more frequently than other indicators, so it can accurately judge residents' behaviour and predict the trend of changes in residents' behaviour in a short period of time. It is of great economic significance in that it can reflect not only residents' behaviour but also macroeconomic conditions, and is an important reference indicator for socio-economic development.

Average salary of employees on duty: the average amount of salary received by each employee on duty in the unit. The formula: average salary of employees on duty = total salary of employees on duty / average number of employees on duty. The average salary of employees on duty in urban units indicates the extent of the salary income of

employees on duty in a certain period of time, reflecting the salary level of employees on duty and revealing the cost of labour and the distribution of national income.

Per capita disposable income: it can reflect the purchasing power of a city's residents, and the purchasing power of the locals increases with income levels. Low- and middle-income households in a city have rigid demand for a first house as well as improvement demand such as house exchanges and second houses, while high-income households in a city have a greater likelihood of real estate investment or speculation, so the level of residents' incomes determines, to a certain extent, the amount of capital that can flow into the housing market. As with population, both rental demand, rigid demand and investment demand will cause housing rents to rise by lifting housing prices within-region. The degree of correlation between per capita disposable income of urban residents and the rental housing market varies at different points in time. The level of residents' income affects the consumption structure. The macroeconomic environment and income distribution policies will have an impact on residents' income. According to international practice, the consumption structure at the income level of Engvall coefficient of 40% belongs to the well-off type, and the residents' expenditure on housing accounts for 15% of the total expenditure, when the residents' demand for housing is inelastic. Once the per capita disposable income reaches a certain level, the increase in income makes the demand for housing even stronger. It can be understood that in low-income households, when income increases, the increase is in the basic needs of life, and the demand for housing does not increase. In the case of high-income households, an increase in income does not increase the demand for housing either, because high-income households have high-grade housing. However, speculative

demand for real estate brought about by high incomes increases the volatility of house prices. It is worth noting that among middle-income households, an increase in income leads to higher demand for housing, which in turn leads to higher house prices. The level of residents' income affects house prices in two ways. On the one hand, it raises people's demand for housing, and the demand that once had no purchasing power is transformed into effective demand when the level of residents' income increases, which also increases people's demand for improved housing. On the other hand, it leads to an increase in the cost of real estate, and people start to pay attention to the supporting equipment, green environment and safety aspects of housing after the increase in the level of residents' income, which increases the cost of housing and further pushes up the house price.

iv. Livable factors: three factors were selected to indicate the green coverage rate of built-up area, the number of primary and secondary schools, and the number of hospitals, mainly reflecting the impact of urban livable environment and supporting facilities on the development of rental housing market.

Green coverage rate of the built-up area: percentage of urban built-up area covered by greenery. The greening coverage area refers to the vertical projection area of all vegetation such as trees, shrubs and lawns in a city. Greening coverage is an important indicator reflecting the status of ecological environmental protection in a country or region. It is also an important indicator for the assessment of China's model cities for environmental protection and the creation of civilised cities. With the gradual improvement of residents' quality of life, many renters are not only concerned about the price and location when choosing housing, but also very concerned about their future

living environment. The plot ratio and greening rate have a great influence on the environment, and the greening rate has even become an important standard for measuring the quality of the community.

Number of primary and secondary schools: the primary schools include junior and senior primary schools, while secondary schools include junior and senior secondary schools. Over the past decade, there has been a clear concentration of population in the large cities. Large cities have good educational resources and stronger teachers, attracting more families to the large cities. The increase in primary and secondary school enrolment means an increase in the number of young adults in the city, and an increase in demand for housing, especially in school districts. As society attaches more importance to education, competition for quality educational resources will significantly contribute to the rise in housing prices.

Number of hospitals: In the concept of renting and buying a house, in addition to the necessary conditions such as geographical location, price and property, whether there are medical resources nearby has also become one of the important factors that more and more people consider comprehensively.

v. Cultural and psychological factors: included the average yeas of education, per capita housing area, and the proportion of ethnic minority population.

Average years of education: the average of the total number of years of academic education (including adult academic education, excluding all kinds of academic training) received by a certain population group in a certain period of time and in a certain region. The results of the main data from the 7th China Population Census:

218.36 million people have a university degree. Compared with 2010, The average years of education for those 15 years of age and older increased from 9.08 to 9.91, the number of people with a university degree per 100,000 people increased from 8,930 to 15,467, and the rate of illiteracy decreased from 4.08% to 2.67%. The continued improvement in the education situation reflects the positive results of China's 10 years of vigorous efforts to develop higher education and to eradicate illiteracy among young adults, as well as the continuous improvement in the quality of the population. The average years of education is an important reflection of residents' social class and economic earning power, and as a group social and cultural normative constraint, has the potential to influence the rent-purchase behaviour of people with different levels of education.

Per capita housing area: this study deals with the per capita housing area, which refers to the per capita living area of housing for a households. The living area referring to the actual area of use of the house, i.e., the area of the house set, and the building area referring to the area labelled on the property certificate, including the communal area, and so on. The per capita housing area reflects, to a certain extent, the housing consumption capacity and preference habits of different regions. The National Bureau of Statistics released the China Population Census in 2020, which shows that by 2020, the per capita housing area of Chinese households will reach 41.76 square metres, with an average of 3.2 rooms per household, and an average of 111.18 square metres of housing area per household. This data covers both urban and rural areas, with urban households having a per capita housing area of 36.52 square metres, an increase of nearly six times in 30 years.