

Research on the Coupling and Coordination Relationship between Urbanization Development and Insurance Industry Development in Guangzhou City

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Abstract: This study aims to explore the coupling and coordination relationship between urbanization and insurance industry development in Guangzhou City from 2012 to 2021. By analyzing relevant indices, the study provides recommendations for the future advancement of urbanization and insurance industry development in Guangzhou. Thirteen indicators, including the urban population proportion, per capita built-up area, insurance density, and life insurance ratio, were selected for analysis. Based on these indicators, a systematic coupling model was established to describe the coupling degree and coordination degree of the system. The findings reveal a close linkage between urbanization and insurance industry development in Guangzhou: (1) At the city level, the coupling and coordination relationship between urbanization and insurance industry development has transitioned from a stalemate stage to a harmonization stage, demonstrating an overall positive development trend. (2) At different regional levels, the coupling and coordination of urbanization and insurance industry exhibit distinct geographical characteristics, with significant differences between the northern and southern parts of the city. This discrepancy can be attributed to the relatively lagging development of the insurance industry in these regions. However, in the central region, there is relatively better coupling and coordination between urbanization and the insurance industry. The significance of this study lies in the effective utilization of the coordinated development relationship between urbanization and the insurance industry, which contributes to the improvement of the social security system and promotes the reform and development of new insurance models. It also provides a safeguard for the social risks that may arise during the process of new urbanization construction.

Keywords: Urbanization, Insurance industry, Coordinated development

1. Introduction

1.1 Research Background

Since the reform and opening-up, the urbanization rate in China has been rapidly increasing. In 2014, China proposed a new model of urbanization, and Guangzhou, as the capital city of Guangdong Province, is not only a central city of the country but also a comprehensive gateway city. Its urbanization rate has reached 86.46%. Meanwhile, the insurance industry in Guangzhou has also experienced rapid development. The premium income has grown from 47.464 billion yuan in 2013 to 132.769 billion yuan in 2022, an increase of 2.8 times. Insurance density and insurance depth have also increased by 2.3 times and 1.5 times, respectively. As urbanization and the insurance industry develop rapidly, their relationship has become increasingly close. On the one hand, the aggregation effects brought by the new urbanization development, such as urban-rural integration, the concentration of township and private enterprises in central towns, and the transformation of industrial ecology, provide opportunities and driving force for the development of the insurance industry. On the other hand, the development of the insurance industry provides financial support for the new urbanization and improves the social security system, safeguarding against various risks that may arise in urbanization development. Therefore, it is of great practical significance to play a coordinating and synchronous role between the two in promoting the new urbanization process sustainably and effectively.

1.2 Research Significance

"New-type urbanization" refers to the coordinated development, integration of urban and rural areas, eco-friendly livability, and mutually beneficial development of large, medium, and small cities, small towns, and new rural communities^[1] (Zheng Hangsheng, 2013). "People-oriented" urbanization, which focuses on protecting the interests of farmers, aims to achieve a transition from "rural" to "urban" in terms of industrial support, social security, and lifestyle. This paper analyzes the coupling and coordination between urbanization and insurance industry development to explore the positive aspects of their coordinated development, which is of theoretical and practical significance. Theoretically, it provides a new way of thinking to promote the harmonious development of urbanization construction and the insurance industry, offering a new perspective for the construction of new-type urbanization and innovation in the insurance industry. It helps to shift the focus to the harmonious development between urbanization and insurance industry development and promote the improvement of the institutional system for new-type urbanization construction. Practically, it is of great significance in promoting the industrial upgrading of the insurance industry. By comprehensively evaluating the coupling and coordination degree between urbanization and insurance industry development, this research can reflect the positive and negative aspects of their current collaborative development. It can drive insurance industry practitioners to upgrade and innovate, and provide helpful strategies to address the issues encountered in the process of new-type urbanization construction.

1.3 Literature Review

1.3.1 Domestic Research Status

With the continuous advancement of the new urbanization, the transformation and development of industrial ecology, new risks different from the past are bound to emerge. This provides new development opportunities for the insurance industry, and therefore, the coordinated development of urbanization and the insurance industry is receiving increasing attention. Currently, research on the relationship between urbanization development and the insurance industry in China mainly focuses on two aspects:

Firstly, the role of the insurance industry in urbanization development. Han Han (2015)^[2] believes that the role of insurance in urbanization construction is reflected in: firstly, providing a source of funding for urbanization construction; secondly, through the development of financial institutions, creating a broad living space for people, facilitating transactions, accelerating capital flow, and providing a wider range of capital appreciation models and investment channels; thirdly, providing risk protection to ensure social stability. The problems with the support of the insurance industry for rural urbanization are reflected in: firstly, the low coverage rate of commercial insurance, the imperfect rural insurance industry, and the main focus of financial institutions in large cities, which are relatively lacking in rural areas, resulting in a mismatch in the dual financial structure of urban and rural areas; secondly, the obvious insufficient supply of external financing leading to a clear gap between supply and demand for funds; thirdly, excessive emphasis on traditional development and financing methods, making it difficult to meet the various requirements of financial services in rural urbanization construction. Huang Zumei (2015)^[3] proposes the following specific paths for the insurance industry to serve urbanization: first, by enriching agricultural insurance types to ensure the effective supply of crops; second, by implementing compulsory environmental pollution liability insurance to facilitate environmentally friendly urbanization; third, by actively penetrating the pension and health industries, making commercial insurance a beneficial complement to social insurance; fourth, by actively participating in urban infrastructure construction with insurance funds to promote urban-rural integration.

Secondly, the interaction between insurance and urbanization. Wu Dongling (2019)^[4] believes that insurance plays a dual role of market-oriented risk transfer mechanism and social mutual assistance mechanism. Utilizing insurance funds provides stable financial support for urbanization and construction, enhancing the coordination and stability of the financial system's operation. By leveraging the advantages of insurance companies in institutional networks, professional technology, etc., constructing market-oriented new models can enhance society's ability to withstand risks. However, the new urbanization has brought both historical opportunities and new challenges to the development of the insurance industry. Xu Xian and Ding Mohai (2016)^[5] used the 3SLS method to explore the mutual promotion and interactive mechanisms between insurance development and urbanization. Jiang Xiaoyan and Wu Xiangli (2022)^[6] used the coupling coordination degree and Dagum Gini coefficient to

discover that the coordination level between population urbanization and the insurance industry and the city's scale level are positively correlated, with significant differences among different city scales.

From the above, it can be seen that the existing literature mainly focuses on qualitative analysis of the interaction mechanism between urbanization and the insurance industry, lacking quantitative research with specific cases. This research takes "urbanization" and "insurance industry" as the research objects, constructs a comprehensive evaluation index system of "urbanization-insurance," and quantitatively analyzes the synergistic effects between urbanization and the insurance industry in Guangzhou. The aim is to provide ideas for the further development of urban construction and the insurance industry.

1.3.2 Foreign Research Status

Due to differences in historical cultural traditions, economic development models, and political systems between countries, the factors influencing urbanization development also vary between domestic and foreign contexts. There is limited literature on the relationship between urbanization and the development of the insurance industry in foreign research. Currently, the main focus is on the following three aspects:

Firstly, the linkage between commercial insurance and new urbanization. Pan, Liang and Zhong (2023)^[7] used VAR models and found a long-term equilibrium relationship between the performance of commercial insurance and new urbanization. Commercial insurance reforms compensate for various risk losses in the process of urbanization, but the self-development and self-improvement capabilities of commercial insurance are relatively weak.

Secondly, the impact of urbanization on life insurance and insurance consumption. Wang, Barrese, and Zhang (2016)^[8] collected relevant sample data from China and found a positive correlation between urbanization and per capita insurance premiums. They also found a positive correlation between regional education levels and insurance consumption, supporting the notion that risk awareness is a factor driving insurance demand. Xiaojun and Zhu(2017)^[9] used the Campbell model and concluded that people-oriented urbanization can promote the accumulation of human capital, and the growth of the life insurance industry in the process of urbanization follows an S-shaped curve.

Thirdly, the impact of financial agglomeration on urbanization. Liu and Qiao (2014)^[10] conducted regression tests using the PVAR model and found that financial agglomeration effectively promotes the development of industrial urbanization and spatial urbanization but has little impact on promoting human urbanization.

From the above, it can be seen that the existing foreign literature mainly focuses on the impact and relationship between commercial insurance, the financial industry, and urbanization or the impact of urbanization on the life insurance industry. They are concentrated on the influence of a specific aspect of the insurance industry on urbanization or the influence of the financial sector on urbanization. The impact of urbanization on the insurance industry is limited to the study of insurance consumption and expenditure, and there is a lack of research on the overall connection between the insurance industry and urbanization. Therefore, constructing a comprehensive evaluation index system for the "urbanization-insurance industry" relationship is necessary to provide assistance for future development.

2. Research methods and indicator system

2.1 Construction of Coupling Coordination Model

Urbanization and the insurance industry can be seen as an organic whole composed of various factors that interact and influence each other. They can be viewed as a cyclic system, and a "urbanization-insurance industry" system is established between them. By drawing on the coupling model in physics, the coupling coordination relationship between urbanization and the insurance industry can be clearly revealed, and the coupling coordination degree of the two subsystems can be quantitatively measured. This provides a basis for evaluating the development trend of the coupling coordination relationship and offers insights into promoting harmonious development between them.

Firstly, the utility function is determined. The utility function, also known as the utility coefficient method, is a multi-objective planning approach. It involves setting satisfactory upper limits and unacceptable lower limits for each evaluation indicator, calculating the actual satisfaction level of each

indicator, determining the scores for each indicator, and then using a weighted average method for comprehensive evaluation. This evaluates the overall situation of the research subject. Assuming X_{ij} is the value of the j th indicator in the i th year (i.e., sequence parameter), and α_{ij} and β_{ij} are the upper and lower limits of the j th indicator in the i th year, respectively. The calculation formula for the standardized efficacy coefficient X_{ij} is:

$$X_{ij} = \begin{cases} (X_{ij} - \beta_{ij}) / (\alpha_{ij} - \beta_{ij}) \\ (\alpha_{ij} - X_{ij}) / (\alpha_{ij} - \beta_{ij}) \end{cases} \quad (1)$$

The next step is to calculate the degree of coupling, which requires determining the weights of each indicator. To achieve this, an entropy-based evaluation method is adopted. This method effectively addresses the issue of information overlap among multiple indicators and helps eliminate subjective evaluation bias. The specific calculation process of the entropy-based method is as follows:

(1) Indicator weight:

$$R_{ij} = x_{ij} / \sum_{j=1}^n x_{ij} \quad (2)$$

(2) Entropy value:

$$e_j = -\frac{1}{\ln n} \sum_{j=1}^n R_{ij} \ln R_{ij} \quad (3)$$

(3) Differentiation coefficient:

$$h_j = 1 - e_j \quad (4)$$

(4) Calculation of indicator weights:

$$w_j = h_j / \sum_{j=1}^n h_j \quad (5)$$

Finally, by considering the comprehensive contributions of each indicator, a linear weighting method is used to integrate their contributions. Drawing upon the concept and models of capacity coupling in physics, the coupling degree (C) is employed to represent the degree of association between the urbanization and insurance subsystems. The comprehensive development indicator values of the urbanization and insurance subsystems are denoted as (U_1) and (U_2) respectively. The corresponding weights for the indicator values are represented by (γ_{ij}), allowing the establishment of a coupling evaluation model that reflects the comprehensive efficiency of the urbanization and insurance subsystems. The model can be expressed as:

$$C = \frac{\sqrt{U_1 \times U_2}}{U_1 + U_2} \quad (6)$$

$$U_i = \sum_{j=1}^n \gamma_{ij} X_{ij}, \sum_{j=1}^n \gamma_{ij} = 1 \quad (7)$$

According to the evolution process of urbanization and insurance industry development, the coupling degree is divided into four stages as follows: $0 < C \leq 0.3$ represents the low-level coupling stage, $0.3 < C \leq 0.5$ represents the deadlock stage, $0.5 < C \leq 0.8$ represents the adjustment stage, and $0.8 < C < 1$ represents the high-level coupling stage.

In addition, a coupling coordination model is introduced for validation because in the specific calculation process, the development levels of the urbanization and insurance subsystems differ due to various influencing factors. For example, there may be a phenomenon where both subsystems have low development levels but exhibit high coupling degree, which is different from the connotation of high development levels, degrees, and coupling degree. To prevent this phenomenon, this study intends to utilize the coupling coordination model to accurately reflect the degree of coordinated development between the urbanization and insurance subsystems. A coupling coordination model can be expressed as:

$$D = \sqrt{C \times T} \quad (8)$$

$$T = aU_1 + bU_2 \tag{9}$$

In the above formula, D represents the coupling coordination degree of the "urbanization-insurance" system, T represents the comprehensive evaluation index of the "urbanization-insurance" system, and a and b are uncertain coefficients. Considering that urbanization and insurance both hold significant positions in social and economic development, they can be regarded as equally important, and it is assumed that a and b are both 0.5. The coupling coordination degree is commonly divided into four stages: $0 < D \leq 0.3$ represents the low coordination stage, $0.3 < D \leq 0.5$ represents the moderate coordination stage, $0.5 < D \leq 0.8$ represents the high coordination stage, and $0.8 < D < 1$ represents the extremely coordinated stage.

2.2 Evaluation Index System Design

Based on the connotation and characteristics of urbanization and insurance industry development, and with reference to relevant literature, a comprehensive evaluation index system for the "urbanization-insurance" system has been constructed. This system consists of two subsystems, three levels, and thirteen indicators (as shown in Table 1), aiming to provide a comprehensive and accurate measurement of the development levels of urbanization and the insurance industry.

The comprehensive index method is a statistical approach that utilizes various statistical methods to reflect the overall quantitative characteristics and quantitative relationships of the socio-economic conditions. This method examines various aspects of social urbanization, providing a comprehensive reflection of the progress and level of urbanization. Therefore, in this paper, the comprehensive index method is adopted to measure urbanization from four aspects: population urbanization, economic urbanization, land urbanization, and social urbanization.

Table 1: Evaluation Index System for the "Urbanization-Insurance" System

Subsystem	First-order index	Secondary index	Units
Urbanization subsystem	Urbanization of population	Proportion of urban population(U ₁₁)	%
	Economic urbanization	GDP per capita(U ₁₂)	Yuan
		Proportion of output value of secondary and tertiary industries(U ₁₃)	%
	Land urbanization	Per capita built-up area(U ₁₄)	m ² /person
		Per capita public green space(U ₁₅)	m ² /person
	Social urbanization	Per capita living space(U ₁₆)	m ² /person
		Health professionals per 1,000 people(U ₁₇)	person/10 ³ person
Insurance subsystem	Developmental level	Premium income(U ₂₁)	Billion yuan
		Insurance density(U ₂₂)	yuan/person
		Insurance penetration(U ₂₃)	%
	Development structure	Life yield ratio(U ₂₄)	%
		Property insurance market concentration(U ₂₅)	%
		Life insurance market concentration(U ₂₆)	%

Population urbanization refers to the transition from agricultural population to urban population and the shift from agricultural population to non-agricultural population. Indicators such as per capita GDP and the proportion of secondary and tertiary industry output reflect the improvement of urban residents' living standards and the transformation and upgrading of the agricultural industry. Indicators such as per capita construction land and per capita green space reflect the speed of urbanization construction. Indicators such as average living area per capita and per capita medical and technical personnel reflect changes in population lifestyles.

Indicators such as insurance premium income, insurance density, and insurance depth often reflect the level of development of insurance companies in a country or region. Therefore, this paper also measures the development of the insurance industry from these three perspectives. When insurance premium income is high, it indicates a larger scale and greater economic impact. A higher insurance density indicates a change in residents' disaster prevention awareness and consumption concepts. With the development of the insurance industry, its role in the national economy is becoming increasingly

prominent.

3. Empirical Analysis and Results

3.1 The Mechanism of Interaction and Development between Urbanization and the Insurance Industry

There exists an interactive development transmission system between urbanization and the insurance industry.

Firstly, urbanization promotes the development of the insurance industry. Firstly, urbanization development is reflected in the transition of rural population to urban population and the increase in the urban population ratio. Urbanization development can drive steady socioeconomic progress, facilitate the accumulation of national wealth, overall increase in per capita income, higher per capita GDP, and promote consumption. Along with urbanization, the educational structure should be adjusted accordingly. The new type of urbanization is people-oriented and education-driven. Therefore, urbanization development contributes to the enhancement of population quality, promotes the upgrade and transformation of thinking patterns, strengthens national insurance awareness, further promotes the upgrading of consumption concepts, and facilitates the transformation of consumption structure. Secondly, steady economic development supports a stable bond market. Investors are more willing to purchase long-term bonds, which can better promote and enrich the development of the bond market, providing diverse investment and financing channels for the insurance industry and promoting industrial upgrading and development. Thirdly, as the new type of urbanization continues to deepen and urban-rural integration advances, rural population shifts to urban areas, increasing employment demands and the labor force in the secondary and tertiary industries. This promotes the development of the secondary and tertiary industries, expands the middle-income group, and broadens the consumer base for insurance. Fourthly, with the deepening of urban-rural integration and technological innovation, farmers can utilize advanced technology to drive the transformation and upgrading of the agricultural industry, providing new service directions for the insurance industry, enriching the insurance protection system, and expanding the service scope of the insurance industry.

Secondly, the insurance industry also promotes urbanization development. Firstly, the ongoing promotion of the new type of urbanization brings new development directions for agricultural insurance in aspects such as land circulation, agricultural industrialization, and farmers' risk awareness. This enables insurance institutions to reform and innovate the coverage scope of agricultural insurance, making the underwriting system more reasonable. The improvement and development of agricultural insurance stabilizes the agricultural economy, reduces agricultural production risks, promotes the high-quality and efficient development of agriculture, and contributes to the upgrade and development of the agricultural industry, thereby facilitating the construction of the new type of urbanization. Secondly, commercial insurance introduced by the insurance industry improves the gaps in the social security system and optimizes and enhances the social security system. Thirdly, by utilizing the mechanism of commercial insurance, through understanding the life and property insurance products of major insurance institutions and the market concentration of life and property insurance, residents' preferences for insurance can be determined. Weaknesses and deficiencies of insurance products can be identified, and various risks that may arise in the urbanization process can be better evaluated and protected, thus alleviating government pressure. Fourthly, the further development of the insurance industry optimizes the investment and financing system, leverages its financial advantages, and fills the funding gap in the process of urbanization development.

Thus, a transmission system between the two can be established, namely the transmission system of urbanization and insurance linkage development as shown in Figure 1. This system consists of five aspects: urbanization subsystem, insurance subsystem, influencing factors, interactions, and transmission pathways. Urbanization has a positive impact on "consumption concepts, consumer groups, investment and financing systems, and service areas," which benefits the insurance industry. The insurance industry, through "agricultural insurance direction, commercial insurance direction, social security system, and financial advantages," promotes urbanization development. The two interact and influence each other, forming an interactive system that includes two transmission directions.

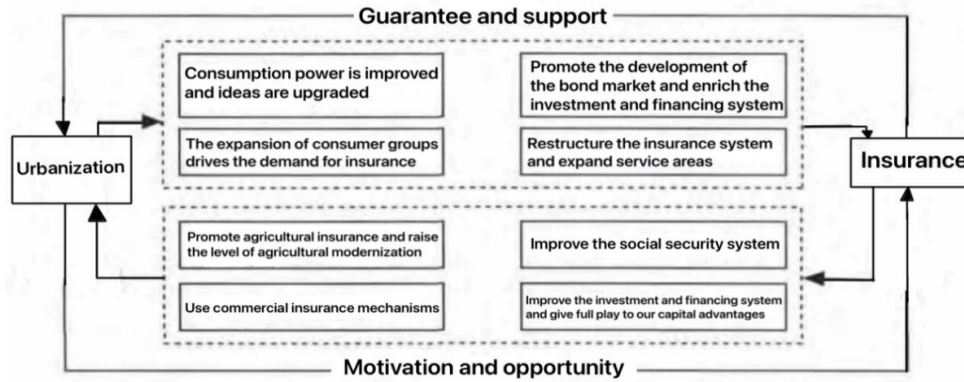


Figure 1: Interactive development transmission system of urbanization and insurance industry

3.2 Data Sources and Weight Determination

Based on panel data from 11 districts in Guangzhou City from 2012 to 2021, the data used in this study are mainly sourced from the "Guangzhou Statistical Yearbook," the China Banking and Insurance Regulatory Commission, and the statistical yearbooks of each district. The choice of 2012 as the starting point for the research is primarily because, by the end of 2012, the urbanization rate in Guangdong Province had ranked first in the country. The urbanization rate in the Pearl River Delta region had already entered a mature stage, and at the same time, Guangzhou's economy was rapidly developing, resulting in a closer interaction between the two. In order to depict the dynamic relationship between the same indicators within each district more clearly, the upper and lower limits of each indicator in each district were set as the maximum and minimum values of the same indicator in the same year.

Among the 13 indicators in the "urbanization—insurance industry" system, the indicators of the ratio of life insurance to property insurance, market concentration of property insurance, and market concentration of life insurance are negative indicators, which are calculated using the negative efficiency formula, while the other indicators are calculated using the positive efficiency formula. Based on the data processed through the efficiency function, the entropy method is used to calculate the weights of each indicator in the "urbanization—insurance industry" system for each year, as shown in Table 2. In order to reveal the spatiotemporal evolution characteristics of the coupling and coordinated development between urbanization and the insurance industry, the analysis will be conducted at both the citywide and district levels.

Table 2: "Urbanization—Insurance Industry Development" - Specific Gravity of System Indexes

year		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Urbanization	U ₁₁	0.099	0.099	0.099	0.099	0.099	0.100	0.100	0.100	0.100	0.100
	U ₁₂	0.131	0.141	0.141	0.079	0.072	0.078	0.080	0.082	0.093	0.099
	U ₁₃	0.099	0.100	0.100	0.100	0.100	0.099	0.099	0.100	0.100	0.100
	U ₁₄	0.105	0.105	0.103	0.101	0.100	0.097	0.095	0.095	0.097	0.096
	U ₁₅	0.092	0.092	0.094	0.096	0.096	0.101	0.103	0.106	0.108	0.108
	U ₁₆	0.085	0.090	0.109	0.099	0.103	0.101	0.101	0.103	0.103	0.102
	U ₁₇	0.075	0.078	0.087	0.092	0.100	0.101	0.108	0.112	0.119	0.123
Insurance	U ₂₁	0.041	0.046	0.059	0.069	0.114	0.111	0.114	0.140	0.147	0.154
	U ₂₂	0.050	0.055	0.067	0.076	0.118	0.110	0.110	0.132	0.136	0.141
	U ₂₃	0.064	0.063	0.075	0.085	0.122	0.109	0.115	0.124	0.124	0.115
	U ₂₄	0.123	0.124	0.124	0.109	0.060	0.079	0.095	0.093	0.090	0.098
	U ₂₅	0.083	0.089	0.094	0.099	0.099	0.102	0.103	0.105	0.110	0.111
	U ₂₆	0.095	0.098	0.098	0.103	0.101	0.100	0.096	0.101	0.103	0.100

3.3 Empirical Results

3.3.1 Coupling and Coordination at the City Level

Based on this, the entropy method is used to determine the proportion of each indicator and

establish a coupling coordination model to analyze the synergy between urbanization and insurance development in various regions of Guangzhou City from 2012 to 2021. Time series analysis is performed on the obtained regional data to calculate the average coupling degree (C) and average coordination degree (D) of Guangzhou City each year, revealing the changing characteristics of the synergy between urbanization and insurance development during the sample period, as shown in Table 3.

Starting from 2012, the overall development of the insurance industry in Guangzhou City has shown a year-on-year increasing trend, which is closely related to the rapid socio-economic development, improvement in residents' living standards, and continuous adjustments in insurance industry development policies. At the same time, the comprehensive index of urbanization has also steadily increased year by year. In the development process of these two areas, before 2015, the degree of urbanization was higher than the development of insurance, while the development of insurance was relatively slow and lagging behind. After 2015, the development of the insurance industry has exceeded the level of urbanization, but the growth rate of the insurance industry has slowed down in the process of urbanization. Overall, both the coupling degree and coordination degree of these two subsystems, urbanization and insurance industry development, show an increasing trend. The coupling degree has entered a phase of adjustment, while the coordination degree has gradually transitioned from moderate coordination to high coordination.

From a citywide perspective, it can be seen that the two systems of urbanization and the insurance industry are gradually fitting together and forming a virtuous cycle. Population migration, urban-rural economic development, improvement in residents' living standards, and changes in lifestyle have led to an upgrade in residents' financial concepts and risk awareness, as well as a change in their perception of the insurance industry. At the same time, the promoting effects of the insurance industry on various aspects of urban-rural integration and coordinated development are also increasingly evident. Overall, they are gradually demonstrating a situation of coordinated development and harmonious coexistence.

Table 3: The average coupling degree and coordination degree of Guangzhou City over the years

year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
U ₁	0.353	0.362	0.378	0.384	0.406	0.422	0.439	0.453	0.469	0.481
U ₂	0.337	0.349	0.368	0.381	0.412	0.429	0.447	0.461	0.473	0.495
C	0.431	0.437	0.456	0.462	0.477	0.489	0.501	0.509	0.514	0.518
D	0.427	0.431	0.448	0.453	0.461	0.474	0.481	0.493	0.507	0.519

3.3.2 Coupling and Coordination at the District Level

There is an imbalance in the development among the administrative districts of Guangzhou City. Therefore, it is necessary to study the coupling and coordination of urbanization and insurance industry development at a regional level. In this study, the annual coupling degree and coordination degree of each district in Guangzhou City are classified into three categories: South, Central, and North, as shown in Figure 2. By drawing a straight line between "Liwan District" and "Zengcheng District," the upper part of the line is classified as the North, the lower part as the South, and the six districts intersected by the line as the Central region. Based on this, the coupling and coordination of urbanization and insurance industry development in China are analyzed at the regional scale.

On average, the coupling and coordination degree of urbanization and insurance industry development exhibit a characteristic pattern: the Central region is stronger than the South and North regions, and the South region is stronger than the North region. Overall, the coupling and coordination degree in these three regions fluctuate continuously. In 2017, the Central region transitioned from moderate coordination to high coordination, while the South and North regions maintained moderate coordination. However, the gap between moderate and high coordination has been gradually narrowing. This indicates that there is still a considerable distance from the ideal situation of coordinated and harmonious development between urbanization and the insurance industry. Although the imbalance between the South and North is higher than that in the Central region, the overall situation is relatively good. Therefore, the article provides an explanation from two perspectives.

First, the differences in regional economic development lead to variations in the coordinated development of urbanization and the insurance industry in different regions. During the early stage of the People's Republic of China, when Guangzhou City was primarily focused on industrial production, the concept of the north-south axis crossing the CBD of Tianhe District was already in its embryonic form. In 1984, the national planning layout for Guangzhou City mainly focused on the old city center, Tianhe District, and Huangpu District, laying a solid foundation for the future economic development

of the Central region in Guangzhou. Therefore, at the beginning of the sample period, the Central region had the advantage of priority development due to policies, historical factors, and regional advantages, making it the forefront of socio-economic development in Guangzhou. In contrast, the South and North regions, located in the suburbs, had slower economic development, resulting in a slower pace of urbanization and insurance industry development compared to the Central region. However, the South region, particularly the Nansha District, achieved high-quality development as the China (Guangdong) Pilot Free Trade Zone was established in 2015. This, in turn, stimulated economic development in the southern region, leading to slightly stronger urbanization and insurance industry development compared to the North region. Due to the limitations imposed by their economic foundation and starting time, there are significant differences in the development among the regions, primarily reflected in their coupling and coordination. The main reasons for these differences are as follows: firstly, from the perspective of the urbanization subsystem, the Central region contributes more to economic urbanization and social urbanization, while the South and North regions have a greater influence on population urbanization and economic urbanization. Secondly, in the insurance industry subsystem, due to their relatively mature stage, the South and North regions pay more attention to the development of the insurance industry, particularly the rationality of its structure. Economic urbanization and social urbanization can better promote urbanization construction, and the industry structure of the insurance industry also serves as an important basis for urbanization construction. Therefore, compared to the South and North regions, the Central region shows much better coordination.

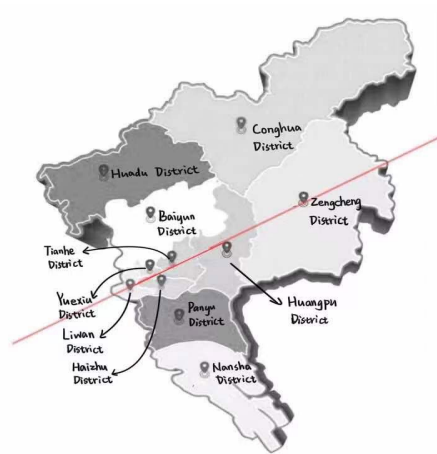


Figure 2: Urban area map of Guangzhou

Table 4: Average coupling degree and coordination degree of subregion over the years

Year	South				Middle				North			
	U ₁	U ₂	C	D	U ₁	U ₂	C	D	U ₁	U ₂	C	D
2012	0.298	0.251	0.358	0.313	0.326	0.318	0.457	0.376	0.257	0.212	0.312	0.304
2013	0.316	0.297	0.379	0.317	0.331	0.324	0.463	0.381	0.264	0.227	0.318	0.309
2014	0.323	0.304	0.392	0.326	0.337	0.334	0.483	0.394	0.271	0.263	0.327	0.315
2015	0.327	0.311	0.401	0.375	0.345	0.357	0.488	0.436	0.295	0.274	0.337	0.317
2016	0.335	0.319	0.423	0.389	0.362	0.376	0.494	0.457	0.319	0.287	0.351	0.332
2017	0.341	0.324	0.436	0.392	0.368	0.382	0.501	0.496	0.326	0.284	0.359	0.337
2018	0.366	0.338	0.441	0.436	0.374	0.387	0.522	0.532	0.334	0.296	0.364	0.353
2019	0.397	0.356	0.449	0.447	0.409	0.423	0.543	0.547	0.357	0.321	0.384	0.381
2020	0.459	0.362	0.457	0.453	0.461	0.475	0.557	0.558	0.411	0.349	0.429	0.384
2021	0.472	0.379	0.458	0.459	0.492	0.502	0.589	0.613	0.428	0.375	0.437	0.423

Secondly, there are significant regional differences in the development of urbanization and the insurance industry, which are the results of the imbalance between different regions, as shown in Table 4. During the sample period, the coupling degree of urbanization and insurance development in the South and North regions remained in a "stalemate" phase, slightly lagging behind the transition from the "stalemate" phase to the "coordination" phase in the Central region. However, all three major regions have a certain gap from the optimal state, and the reasons for this gap are also different. Before 2015, the comprehensive index of urbanization in the Central region was higher than the comprehensive index of insurance development. This indicates that the relatively delayed development

of the insurance industry is an important factor leading to the low level of coupling and coordination between urbanization and insurance development. Since 2016, this transition has begun, and with the rapid development of urbanization in the Central region, it has created a favorable external environment for the insurance industry, which has also shown a trend of high-speed development. However, in the South and North regions, the comprehensive index of urbanization has consistently been higher than the index of insurance development, indicating a lag in the development of the insurance industry and its inability to create a better external environment for urbanization development. This is an important reason for the lower level of coupling and coordination between the two.

4. Policy Recommendations

In conclusion, in order to promote the coordinated and deep development of urbanization and the insurance industry in Guangzhou, the government can formulate corresponding policies to further improve and develop the insurance industry and better promote the development of new urbanization. The following three policy recommendations can be considered:

Firstly, in the Central region, a social medical insurance system combining social insurance and commercial insurance, with commercial insurance as the main component, can be established. A reasonable insurance structure will help promote new urbanization and steadily advance the process of small-town urbanization, bringing new opportunities for the development of the insurance industry.

Secondly, the South and North regions can learn from the development model of the Central region, combined with their own regional conditions, deepen reform and innovation, and enhance the quality and level of insurance services. To accelerate innovation, the government can regularly release general guidelines on the direction of urbanization development, and insurance companies can innovate and explore insurance products and models that better meet the needs of new urbanization development. This will contribute to enhancing the level of coordination and development between urbanization and the insurance industry.

Thirdly, all regions can improve the efficiency of government public services and promote the government's procurement of insurance products and services, thereby further promoting the all-round development of the insurance industry and expanding new products and services. For example, the government can purchase compulsory insurance and catastrophe insurance systems to strengthen social risk management, reduce the possibility of risks during urbanization construction, innovate and reform urban social management, and strengthen the prevention of potential social risks in the process of new urbanization.

5. Conclusion

There is a close interaction between urbanization and the development of the insurance industry. In the process of advancing urbanization and the development of the insurance industry, fully leveraging the synergistic advantages between the two plays a positive role in improving the social security system, promoting the reform and development of the insurance industry's new models, and providing security against social risks arising from the process of new urbanization. Based on the analysis of the interactive development transmission system and mechanism between urbanization and the insurance industry, this study borrowed the system coupling coordination model from physics and constructed and applied an "urbanization-insurance industry" system evaluation index system. Taking the 11 districts of Guangzhou as an example, empirical research on the coupling and coordination effects between urbanization and the insurance industry from 2012 to 2021 was conducted at both the city and regional levels. The main conclusions drawn from summarizing the collected data are as follows:

Firstly, at the city level, the coupling and coordination between urbanization and the development of the insurance industry show an increasing trend overall. The coupling degree is transitioning from a state of stagnation to a state of adjustment, and the coordination degree is gradually approaching an ideal state of synergy. In order to promote mutual promotion, mutual influence, and coordinated development between the two, it is recommended to strengthen urban-rural integration and overall planning, promote the updating and transformation of people's consumption habits and concepts, and improve people's quality of life. Reasonable arrangements should be made for the flow of population between urban and rural areas, and the deepening development of urban and rural areas should be carried out in an orderly manner, with emphasis on policy and institutional arrangements such as social security. Additionally, through risk management mechanisms and the complementary development of commercial insurance and social insurance, a complete new insurance service system can be

constructed to enhance society's ability to resist risks during development and alleviate the risk challenges in urbanization.

Secondly, at the district level, there are significant regional differences in the coupling and coordination between urbanization and the development of the insurance industry. The central region performs better than the northern and southern regions, with the southern region slightly outperforming the northern region. The main reasons for this regional difference are: first, the roles played by urbanization and the insurance industry in each region are different; second, the urbanization process and the insurance industry in the northern and southern regions have not achieved good coordination and development. This is due to the lagging economic development in the earlier stages, resulting in a decline in the development of the insurance industry. In contrast, the imbalance in the central region is reflected in the initial lag in the development of the insurance industry, but since 2017, there has been a gradually improving cycle relationship between urbanization and the development of the insurance industry. Therefore, corresponding adjustments should be made based on local conditions for the development of the central, southern, and northern regions. Emphasis should be placed on enhancing the relatively slow-growing side to achieve balanced development, providing external support to the other side. For the central region, it should continue to develop along the path of a good cycle relationship while exploring better options to upgrade and transform the cycle system, providing strong support for the coordinated development of urbanization and the insurance industry.

In general, during the process of sustained economic and social development, the coupling and coordination between urbanization and the insurance industry have gradually shown a trend of well-circulated development, confirming the conclusion that their coupling and coordination will tend to be in a state of well-circulated and coordinated development.

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