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Article

Research on the Hollowing-out Characterization in the Evolution of Chinese Cities: A Multidimensional Comparative Analysis Based on Guangzhou and Langfang

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Abstract: The aim of this study is to explore the evolutionary difference of cities at different levels in the process of China's urbanization, with a focus on the comparison of Guangzhou, a representative "growth-oriented city," and Langfang, which is confronted with the risk of "functional hollowing out." Through the analysis of population dynamics, economic structure, industrial layout, innovation capacity, and public service levels from 2021 to 2024, it was found that Guangzhou, relying on its strong industrial resilience and agglomeration capacity, has established a virtuous cycle of population inflow, improvement of industrial efficiency, and enhancement of public service levels. However, while Langfang enjoyed the crowding-out effect of Beijing, it now encounters the dual risks of permanent resident outflow and low-end industrial lock-in, driven by the strong suction force of core cities. The study also improved the formation mechanism of urban hollowing out, offering suggestions on the governance of small and medium-sized cities to avoid functional hollowing out.

Keywords: Urbanization; Guangzhou; Langfang; Functional Hollowing Out; Population Dynamics; Industrial Resilience; Urban Governance; Growth-oriented Cities

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1. Introduction:

Urban hollowing, as an urban economic and geographic phenomenon, can be defined as a complex process in which there is a decline in economic vitality, an imbalance in population structure, and an atrophy of social function in the core area or the city itself, which occurs after the outflow of elements in the urban development process reaches a certain stage [1, 2]. In the traditional Western model of urbanization, there is often a phenomenon of suburbanization, which occurs when there is a migration of population from the central urban area to the suburban area [3, 4]. However, in the current model of "uneven growth" and "regional coordinated development" in China, the phenomenon of urban hollowing takes on more complex forms, transforming into an overall change involving population structural contraction, industrial lock-in, and the misallocation of public service resources [5]. The recent results of the three population censuses have confirmed the empirical relationship between population structural contraction and the concentration of resources in urban areas [6]. The data on the population structure of Heilongjiang Province in recent years have revealed the coupling relationship between industrial lock-in and population linkage [7]. All these have confirmed the actual effects of urban hollowing, which is an urgent problem that needs to be solved.

The research on the issue of urban hollowing was initiated early in other countries [3, 4]. However, due to the high-speed development in China, the issue of urban hollowing is often eclipsed by the issue of the development trend in rural or underdeveloped towns such as suburbanization [8]. As for the specific comparison and indicator system of the issue of urban hollowing in China, there is still much unstructured content in the forefront of the research [9].

As the core city in the Pearl River Delta region, the city of Guangzhou is a representative city of the "growth-oriented city" type, showing strong resilience in population aggregation, industrial upgrading, and functional extension. By contrast, the city of Langfang, located in the forefront of the coordinated development in the Beijing-Tianjin-Hebei region, despite its high geographic location in relation to the megacity Beijing, shows high potential for urban hollowing due to the tug-of-war between the "siphoning effect" of the city's factors and the constraints in its development. Thus, based on the comparative analysis of the two cities, we aim to reveal and explain the phenomenon of urban hollowing from different aspects and find the underlying contradictions in the allocation of resources in the urbanization process in China. It is evident that the city of Guangzhou has formed a positive cycle of "population inflow-industrial efficiency-service enhancement" due to its well-developed modern service industry system and strong ability in fiscal absorption. By contrast, the city of Langfang is suffering from the dual challenges of "passive reception" and "continuous loss of core elements" in the process of undertaking the decentralization of non-capital functions from Beijing. By analyzing these two representative cities in-depth, we can reveal the underlying contradictions in the allocation of resources in the urbanization process in China and provide guidance for the prevention of functional contraction in small and medium-sized cities in China.

2. Study Description:

The source of our research data comes from the statistical data of China, such as the statistical bulletins of the National Bureau of Statistics of China, Guangzhou City, Langfang City, and other reference data that can be accessed publicly. Besides that, the specific areas that were used for the comparison were the population, economy, corporate innovation, and infrastructure. Unless otherwise specified, the content was based on the latest available data as of 2023.

3. Data and Discussion:

3.1. population change

The population can be regarded as the essential code of urban vitality, with changes in population indicating the overall attractiveness of a city and the underlying structures of the city that hint at the potential for future growth. The differences in population between Guangzhou and Langfang can be seen not only in the size of the gap but also in the underlying mechanisms of population movement and the evolutionary patterns of age composition.

As a megacity, Guangzhou has exhibited remarkable sustainability and stability in population growth. According to the historical data, the permanent resident population of Guangzhou has been increasing from 9.4968 million in 2005 to 15.2902 million in 2014 and is still growing. By 2023, the actual population under the administrative management of the city was conservatively estimated to be above 18 million. This is not merely the result of natural population growth but also the result of strong mechanical population growth, i.e., the net population inflow.

As demonstrated by the 2023 data on the migration of the resident population in Guangzhou, the total number of people moving into the city is 220,516, and the total number of people moving out of the city is only 42,786. This results in an increase of 177,730 people, or a 17‰ rate. This is the most direct method of counteracting the negative effects of an aging population. As demonstrated in Table 1, the permanent resident and registered resident populations in Guangzhou have maintained stable growth, despite the low birth rate.

Table 1. Basic demographic data of Guangzhou from 2021 to 2024.

	permanent resident population	urbanization rate	registered population	Birth population	deceased population	birth rate	rate of natural increase
2021	1881.06	86.46%	1011.53	11.8	5.55	1.182%	0.630%
2022	1873.41	86.48%	1034.91	10.96	5.74	1.07%	0.51%
2023	1882.7	86.76%	1056.61	11.58	7.69	1.11%	0.37%
2024	1897.8	87.24%	1075.02	11.43	5.48	1.07%	0.56%

In contrast, the population growth of Langfang City shows a unique pattern of regional collaboration. The permanent resident population of Langfang City by the end of 2023 was 5.478 million, with a figure of 4.971 million for the number of residents. This shows a net increase of 1.1052 million in the population since the 2010 census, with an average annual increase of 2.29%. However, the population growth shows a clear trend of regional differences. According to Table 2, the actual permanent population of Langfang has been declining in the past few years. With the low birth rates remaining unchanged, the declining population shows a "net outflow." This is not conducive to the prevention of "urban hollowing."

The population concentration of Langfang is mainly in the "Three Northern Counties" of Sanhe, Dachang, and Xianghe along the border with Beijing, and in Guangyang and Gu'an. The population growth in the region mainly results from the "crowding-out effect" of the high housing costs and household registration restrictions in Beijing. This has led to the phenomenon of many young professionals working in Beijing choosing to live in Langfang, resulting in a unique "sleeping city" phenomenon [10]. However, the population growth in the region has not been effectively converted into productivity. Langfang is in an awkward "core city siphon" state, in which the high-level human capital is concentrated in the region, but their consumption and tax and innovation contributions are still concentrated in Beijing.

Table 2. Basic Population Data of Langfang City from 2021 to 2024.

	permanent resident population	urbanization rate	registered population	Birth population	Number of deaths	birth rate	rate of natural increase
2021	553.82		493.8	3.8	2.1	0.780%	0.360%
2022	549.53	66.01%	496.5	3.2	1.9	0.64%	0.25%
2023	547.8	66.80%	497.1	3.1	2.4	0.63%	0.14%
2024	546.9	67.20%	497.2	3.2	2	0.64%	0.23%

3.2. Age Structure Change

The age structure composition is one of the major indicators to evaluate "hollowing out." Guangzhou possesses remarkable vitality in demographic composition. According to Table 3 below, in 2023, Guangzhou's registered population aged from 18 to 60 comprised 57.59% of the total population in Guangzhou. The elderly population aged over 60 comprised 19.38%. Although Guangzhou is facing the problem of aging, its aging rate is much lower than that of the national average due to the continued inflow of young people. Among Guangzhou's "silver-haired population," those aged from 60 to 69 years (young seniors) account for over 50%. Therefore, there is great potential in their social engagement and opportunities to build up secondary dividends. Langfang has seen a rapid acceleration in its aging process. According to data from the Seventh National Population Census, compared to that in 2010, the proportion of the population aged over 60 in Langfang increased by 4.61 percentage points to 18.70%, which is the national benchmark. Meanwhile, the proportion of the population aged from 15 to 59 dropped by 9.36 percentage points. The southern part of Langfang is composed of counties and cities. The lack of industrial magnetism led to the outflow of young people in these regions. The age structure composition is typical of "hollowing out."

Table 3. Age Structure of Population in Guangzhou and Langfang.

Age Composition (2023/2020)	Guangzhou (2023 household registration) proportion	Guangzhou (2023 household registration) population	Langfang (2020 census) proportion	Nationwide (2023) proportion
0-14 years / under 18	23.03%	2,433,876	17.95%*	16.36%
Working Age (15-59/18-60)	57.59%	6,084,510	63.35%*	68.5%*
60 years of age and above	19.38%	2,047,684	18.70%*	21.1%

Note: Data for Langfang and some parts of the country are based on census or estimated values.

3.3. Economic Structure Comparison

As demonstrated in Table 4, Guangzhou has achieved an economic output of 3,035.573 billion yuan in 2023, representing a 4.6% year-over-year increase. Guangzhou not only ranks among the top cities in China in terms of economic output but also has achieved an economic output per capita of 161,634 yuan, representing a 4.5% year-over-year increase. This strong economic base enables Guangzhou to maintain high public expenditures and attract premium production factors.

On the other hand, the economic output of Langfang has reached 360.83 billion yuan in 2023, representing a 3.8% year-over-year increase. Although the economic output growth rate of Langfang in some years has benefited from the low base effect, the economic output of Langfang only represents 11.9% of the total economic output of Guangzhou. In addition, the economic output per capita of Langfang has reached 65,763 yuan, less than half of that of Guangzhou. This weak economic base has put Langfang at a disadvantage in the competition with other regions. In the economic competition of regions, the economic output per capita of Langfang is under the pressure of competition from Beijing and Tianjin.

The income level is the most direct factor in influencing the migration of the population. In 2023, the per capita disposable income of the residents of Guangzhou has reached 80,500.86 yuan, representing a 4.8% year-over-year increase. This high income not only enables the region to retain talent but also drives the development of the service industry. The structure of the consumption expenditures of Guangzhou has demonstrated that the largest portion of the expenditures is on housing, followed by food and tobacco, and then education, culture, and entertainment. This is because the residents of Guangzhou pursue the best quality of life. On the other hand, the per capita disposable income of the residents of Langfang has reached 53,459 yuan, the highest in the province of Hebei. Nevertheless, it is still about 30,000 yuan less than that of Guangzhou. When the high-income cities of Guangzhou and Shenzhen are nearby, the labor force of low-income regions such as Langfang will always flow to the regions with higher income levels.

Table 4. Basic Economic Data of Guangzhou and Langfang.

Economic and Income Indicators (2023)	Guangzhou City	Langfang City	Provincial/National Average
GDP (billion yuan)	30,355.73	3,608.30	-
Per capita GDP (yuan)	161,634	65,763	89,358 (Nationwide)
Urban residents' disposable income (yuan)	80,500.86	53,459	51,821 (Nationwide)
Urban residents' consumption expenditure (yuan)	49,480.27	34,283	32,994 (Nationwide)
General public budget revenue (100 million yuan)	1,944.15	-	-

3.4. Industrial structure comparison

The rationalization and upgrading of the industrial structure represent the fundamental approach to the prevention of economic hollowing out. As indicated in Table 5, the industrial structure of Guangzhou exhibits distinct post-industrial characteristics, with the proportion of the primary, secondary, and tertiary industries standing at 1.0:25.6:73.4 in 2023. Not only does the proportion of the tertiary industry remain high, but the internal structure of the tertiary industry is also extremely optimized, with the proportion of modern service industries reaching as high as 66.4% of the added value of the tertiary industry. Finance, trade, and information technology have become the new pillars of the city. From the perspective of strategic emerging industries, the strategic emerging industries of Guangzhou, represented by the "3+5" strategic emerging industries, have created an added value of 933.354 billion yuan in 2023, accounting for 30.7% of the city's GDP. With regard to the development of high-tech manufacturing industries, the new energy vehicles manufactured in Guangzhou recorded a year-on-year increase of 110% in 2023, indicating the strong iteration capability of the industrial structure.

By contrast, the industrial structure of Langfang is still based largely on manufacturing, with the proportion of the tertiary industry standing at 6.0:32.0:62.0 in 2023. Although the proportion of the service industry is high, reaching more than 60% of the entire industrial structure, it can be seen that the service industry is largely based on trade, logistics, and real estate development, while modern high-value-added service industries are relatively limited. Although the city has established a relatively sound industrial foundation, as indicated by the increase of 2.9% in the industrial output value of enterprises above a designated size in 2023, as well as the breakthroughs made in high-tech industries like aerospace and biomedicine, the overall size of the industrial structure remains relatively small. A critical problem is that the development of the industrial structure of Langfang is largely influenced by that of Beijing, as the city hosts some of the premium projects of Beijing while remaining largely an industrial support zone of Beijing.

Table 5. Industrial Structure Data of Guangzhou and Langfang.

Industrial Structure Index (2023)	Guangzhou City	Langfang City	National level (reference)
Primary industry share (%)	1.1	6.0	7.1
Secondary industry share (%)	25.6	32.0	38.3
Tertiary industry share (%)	73.3	62.0	54.6
Growth rate of industrial enterprises above designated size (%)	-	2.9	4.6
Total retail sales of consumer goods (in billions of yuan)	11,012.62*	1,504.4	-

3.5. Innovative Comparison

Innovation competence is the ultimate benchmark for the vitality of a city in the future. The significant gap in R&D investment, patent output, and corporate entities between Guangzhou and Langfang implies the different innovation ecological niches in these two cities. In 2023, the R&D investment in Guangzhou exceeded the threshold of 100 billion yuan for the first time, reaching 104.299 billion yuan, accounting for 3.44% of the city's GDP, which is far higher than the average level in the country, i.e., 2.64%. This strong foundation for R&D has nurtured a thriving community of high-tech enterprises in Guangzhou. As shown in Figure 6, the number of high-tech enterprises in Guangzhou exceeded 13,000 in 2023, with over 5,000 enterprises seeking certification from the government. The city also granted 118,100 patents in 2023, including 36,300 invention patents, up 31.6% from the previous year. This thriving innovation ecosystem not only retains the city's talent pool but also attracts global innovation forces to become a strong defense against brain drain.

Langfang has shown active innovation vitality in recent years but is still limited to the regional level. In 2023, the city obtained 10,200 authorized patents, including only 1,206 invention patents. Although it ranked top in county-level technological innovation in Hebei Province for consecutive years, the output still lags far behind the level in the first-tier city Guangzhou. Another notable feature in Langfang's innovation strategy is the "outward-oriented" approach to absorbing technology transfer contracts from Beijing and Tianjin. In 2022, the technology contract value from these two regions was significant in the city's total technology contract value. Although the "R&D in Beijing, manufacturing in Langfang" approach did help Langfang improve its innovation output in the short term, the weak bargaining power in the industrial chain comes from the lack of accumulation in core technologies developed in-house. Without nurturing tech leaders in the region, Langfang is risking the hollowing-out effect in the long run.

Table 6. Comparison of Innovation Data between Guangzhou and Langfang.

Innovation Output Indicators (2023)	Guangzhou City	Langfang City
R&D expenditure (billion yuan)	1,042.99	-
R&D investment intensity (%)	3.44	1.52 (2021)
Number of high-tech enterprises (in thousands)	13,178 (2023)	1,258 (2022)
Annual patent grants (items)	118,100	10,200
Number of granted invention patents	36,300	1,206
Technology Contract Value (Billion Yuan)	2,550.82	226.7 (2022)

3.6. Comparison of Public Services

The level of public services, such as education, health care, and infrastructure, is crucial in influencing the choice of community for residents. Guangzhou has managed to develop strong community resilience due to high-density allocation of resources, whereas Langfang is vulnerable to potential threats such as passive allocation of resources and reduced student enrollments in schools. As the education center in southern China, the education level in Guangzhou has grown alongside the population. As shown in Figure 7, in the year 2023, the city had a total of 1,008 primary schools, 566 secondary schools, and 84 vocational colleges, with the number of schools increasing steadily over the years. This high level of educational resources not only retains the population in the city but also attracts many migrants due to the high level of education.

On the other hand, the level of educational resources in Langfang shows significant gaps in both quantity and quality. As of 2023, the city had a total of 54 regular high schools, 175 junior high schools, and 754 primary schools. Although the city has introduced high levels of educational resources from Beijing, the southern region is characterized by a decline in student enrollments in some schools due to the outflow of the population. This decline in the level of educational resources is a precursor to the hollowing effect, which accelerates the exodus of the population from the city.

The distribution of medical resources also demonstrates the urban capacity disparity. Guangzhou, a medical hub in the region, boasted 6,677 healthcare institutions by 2023. Among these, 331 were hospitals. The high-level medical resources not only serve the local residents but also attract a significant number of patients from the surrounding provinces due to the strong magnet effect. The healthcare system in Langfang is still in the "coordinated reception" phase. The city boasted 6,434 healthcare institutions by 2023. The total is close to that of Guangzhou, but most of the institutions are primary clinics and township health centers. Only 189 of the hospitals have genuine high-level diagnostic and treatment capabilities. The city still depends on the referral systems of Beijing and Tianjin for high-end medical resources. This "reduces the city's appeal to high-net-worth and middle-aged elderly populations, exacerbating social structural imbalances."

Table 7. Comparison of Public Service Data between Guangzhou and Langfang.

Public service indicators (2023)	Guangzhou City	Langfang City	National level (reference)
Number of healthcare institutions (units)	6,677	6,434	1,093,600
Number of hospitals (units)	331	189	38,700
Number of ordinary primary schools	1,008	754	136,332
Number of regular secondary schools (institutions)	566	229	67,809*
Number of primary school students (in tens of thousands)	129.45	52.7	-
Number of junior high school students (in tens of thousands)	43.20*	24.1	-

4. Formation mechanism

In regional economic systems, cities at the center tend to have a strong gravitational effect on factor inputs. Guangzhou, as the center of the Pearl River Delta region, has promoted mutual development among cities. In contrast, Langfang, under the direct influence of Beijing's dominant core, sees its high-quality resources continually draining to Beijing's capital. Due to Langfang's low level of industrial development complexity, it cannot offer sufficient value return. This effect of "siphoning" far outweighs that of "radiation," triggering functional decline.

The hollowing-out process of industry starts from the loss of competitiveness in traditional pillar industries. Langfang's excessive reliance on low-value-added industries makes it vulnerable to environmental pressures and technological advancements. When a region's industry structure cannot provide sufficient high-paying jobs, educated youth are forced to look for opportunities outside. This also undermines the capacity for enterprises to innovate, causing industries to become stuck at the bottom of the industry.

When mechanical population growth stagnates and natural growth is limited by low fertility rates, demographic structures are divided. Guangzhou maintains its population through migrant populations. In contrast, Langfang faces a critical aging problem. Aging not only affects labor supply but also weakens social consumption vitality. When the urban core's population changes from youthful to elderly, the attractiveness of education, innovation, and entertainment industries also decreases. This further undermines social capital.

When factor outflows reduce tax revenues, local governments are unable to sustain high-quality public services. This undermines public service quality, causing residents to flee. This creates a vicious cycle of "service deterioration → population exodus → fiscal exhaustion. "Guangzhou maintains public service upgrades through tax revenues. This enhances its capacity to increase agglomeration. However, cities such as Langfang are likely to experience a long-term process of functional decline.

5. Conclusion

The different paths taken by Guangzhou and Langfang offer valuable references for China's urban governance. It is critical for China's urban governance to recognize the differences between these cities and adopt differentiated competitive strategies. For those cities that need to pursue urban growth, like Guangzhou, the most critical task for urban governance is to further optimize the resources and spillover effects that are already available and maintain their position in the global production network through the layout of higher-end strategic emerging industries.

For those cities that are facing the risk of "urban hollowing," like Langfang, the most critical task for urban governance is to carry out functional reconfiguration. It is critical for satellite cities not to become "sleeping cities" for core cities but to build niche ecological positions in specialized industries through coordinated development. By further integrating with Tongzhou District and the Daxing International Airport Economic Zone, satellite cities can attract premium innovation resources in Beijing to build a closed-loop value system.

It is also critical for small and medium-sized cities to implement a comprehensive talent service strategy by offering lower living costs and higher inclusiveness in public services compared to core cities so as to attract the young and middle-aged labor force that is facing tremendous pressure in core cities to return. It is critical for China's urban governance to build an independent and attractive social ecosystem so that the phenomenon of "hollowing out" can be fundamentally curbed.

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