Urban Attractiveness Evaluation and Population Size Prediction based on Text Mining

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Abstract

Talent resources with professional knowledge background as well as expertise play a great role in the development of cities. With the overall improvement of the domestic economy, better construction of city talent platforms and enhancing city attractiveness have become the key to city development. In order to investigate the impact of city talent attraction policies on city attractiveness, 22 new first-tier cities in China are used as examples to develop evaluation indicators and measure city attractiveness in conjunction with comfort object theory, and on this basis, city categories are explored and the development characteristics of each new first-tier city are analysed. The textual analysis is combined with the comparison of each city's talent attraction policies to make predictions on the future development and population size of the cities, and to give reasonable suggestions on the formulation of city talent attraction policies.

Keywords

Talent Resources; City Attractiveness; Comfortables; Talent Attraction Policies.

1. Introduction

In the current period, the global economy is recovering from the impact of the new crown epidemic. The innovative consciousness and ability of innovative people with strong educational backgrounds or professional skills is not only a key factor in helping cities to recover quickly economically, but also a decisive force in strengthening their core competitiveness and enhancing their overall strength. Talent attraction is not only an attraction to areas outside the city, but also an attraction to talent within the region. By improving their own economic and social environment, regions can increase their ability to attract talent and guide external and internal talent to enter or stay and contribute to the construction of the region[1].

In the case of China, as early as the end of the 20th century, some regions in China have already introduced policies to attract talents[2]. By 2020, under the trend of "talent economy", the "new first-tier" cities, represented by Nanjing, Chengdu and Chongqing, have successively introduced more comprehensive talent attraction policies, and the battle for talent in each city has entered a white-hot stage, with each major city competing to The battle for talent has entered a white-hot stage, with major cities competing to attract talent by introducing welfare policies and systems such as settlement, housing purchase and employment and entrepreneurship subsidies.

In China, it is undeniable that the four first-tier cities of Beijing, Shanghai, Guangzhou and Shenzhen are supreme in terms of their attractiveness to talent, whether in terms of economic

development, policies and benefits, or salary packages, they are firmly ahead of other cities. However, it is also important to note that living and working in these cities is also very stressful. Firstly, high housing prices discourage the inflow of labour by increasing the cost of living[3],; secondly, the inflow of many talents brings about greater social competition and the fast-paced pressure can reduce people's sense of well-being.

As a result, the "new tier 1" cities are becoming the new target for many innovative talents compared to the high stress environment of the tier 1 cities. The number of new Tier 1 cities in China is far greater than that of Tier 1 cities, and with the same rapid development and job demand, the government has been making efforts to introduce new policies to attract innovative talent.

With the epidemic in recent years, people have become more cautious about the cities they choose to work in and more conservative in their career choices than in the past. Given the heritage and reputation of Tier 1 cities, it is imperative for new Tier 1 cities to find an effective direction for reforming their policies on the introduction of talent in order to ensure that the city's talent pool is available for development in the post-epidemic period. Therefore, an accurate grasp of innovative talent flow mechanisms and the development of reasonable talent introduction policies are important for cities to attract talent to resume economic development. Whether there is sufficient attention to policy shortcomings and effective changes during the epidemic will be considered and analysed in terms of comfort object theory and the effectiveness of talent attraction policies.

The paper is structured as follows. The second part provides the theoretical background of the city attractiveness evaluation model, as well as exploring the utility and development history of talent attraction policies in Chinese cities; the third part presents the research design, including the rationale for the selection of the cities studied and the analytical framework for comparing city policy differences. The fourth section identifies the talent attractiveness of new first-tier cities and the differences between cities, and explores the effectiveness of policy changes in the post-epidemic era in relation to city policies. The fifth section provides a summary of the current tendencies of talent attraction policies in new first-tier cities in relation to real-life policies.

2. Study on City Attractiveness and Talent Introduction Policies

Cities are integrated, organic systems, and an important reason for their economic growth is their ability to attract and retain talent. Talent attractiveness, as a comparative concept, is an important measure of a city's overall competitiveness [4].

Early on, Mobley established the Mobley model to analyse the influencing factors of talent mobility, laying the foundation for the theory of talent attractiveness influence model [5]. After that, based on talent mobility theory, Lepawsky et al. studied the factors influencing the attractiveness and retention of highly educated talent in St. John's, Canada[6]. Douglas Wester analyzed the competitiveness of cities based on economic structure, regional endowment, human resources and institutional environment, and established a corresponding competitiveness model [7]. Gao Ziping established an evaluation index system of Shanghai's talent attractiveness based on three aspects: institutional environment, social and cultural atmosphere and living environment, and further analysed various external factors affecting Shanghai's talent attractiveness[8]. Based on talent mobility theory, Hu Bentian and Cao Huan constructed an evaluation system of talent attractiveness of cities in the Yangtze River Delta region and further explored regional development differences to provide new ideas for analysing the high-quality integrated development of the Yangtze River Delta [9].

While the above studies are all based on urban economy and environment and talent mobility theory, in the late 20th century, American economists proposed a new theory that suggested

strengthening the level of comfort in cities to improve their economic growth environment, known as the 'comfort theory'. This theory provided a new perspective on evaluating the attractiveness of cities, suggesting that cities should enhance their attractiveness to talent not only in terms of the economic environment and job opportunities, but also in terms of their focus on life opportunities [10]. The comfort object theory emphasises the importance of the urban living environment for people, and that for creative, highly educated talent, the human environment and atmosphere of a city is more important. Moreover, compared to the general public, highly qualified talents are more sensitive to living standards, and many people with high knowledge and ability would rather bear high rent and high consumption than pursue higher quality urban comforts[11]. Wang Ning was the first to introduce the concept of comforts to China, exploring the issue of fairness and equality in the allocation and intake of intra-city comforts from a sociological perspective [12]. Based on China's national conditions, Zheng Shuli expanded the concept of comfort goods and proposed the concept of "institutional comfort goods" with Chinese characteristics, and argued that household registration, as an institutional comfort good, plays an important role in attracting and retaining talents in Chinese cities and enterprises[13].

For example, Ma Ling et al. constructed a comprehensive index system for China's urban comfort system, analysed the comprehensive comfort level of 26 major cities in China, and used a clustering method to analyse the characteristics and differences of comfort in urban clusters [14]. attractiveness of cities and give development suggestions in combination with the characteristics of various types of cities [15]; or focus on a certain aspect of urban comfort to analyze cities, such as Wu Youmeng using urban consumption comfort as an evaluation system to explore the spatial pattern of domestic development [16]; or use urban comfort as a variable to explore the locational preference of research talent mobility [17].

Talent policies have a positive leading role in a region's talent career and economic and social development. In the current society, competition for attracting talent is fierce everywhere, so scholars have paid more and more attention to the research on related talents, and a large number of studies on various types of talents and their related talent policies have emerged. In this context, it is an important issue for policy researchers to study the profound meanings in policy texts, compare the differences in talent introduction policies in different regions, and find out the shortcomings in talent introduction policies in different regions, so as to promote the perfect development of talent policies in each region [18].

A reasonable talent policy has a positive leading role in a region's talent career and economic and social development. For policy makers who wish to improve their policies for attracting talent, it is important to design them by shaping the location factors that are important for mobile talent. Both urban amenities and job opportunities are important to the location choice of innovative talent. Different age groups and levels of talent focus on different aspects, for example academic professors prefer to work near high quality peers and at universities of international prestige and appropriateness, so building a city with a high level university is more attractive to them. A synthesis of existing research has found that current interpretations of talent policy have initially developed a more complete body of research, providing a framework and methodology for this paper's analysis that can be drawn upon and clearly understood.

3. Research Design and Methodology

3.1. Construction of the Indicator System

The attractiveness of a city to talent is the result of a combination of factors, and when innovative talent is considering a city, they need to consider the local comfort system and weigh up the combined influence of comfort and anti-comfort factors. When a city's comfort factor is

high enough, its attractiveness to innovative talents will be relatively strong. Therefore, the construction of a city attractiveness evaluation system needs to consider how to select the indicators for each aspect.

Based on the talent introduction policies introduced by each city, this paper takes into account the factors that are preferred when talent flows and the availability of data, follows the principles of scientific, systematic, timely and operable selection of indicators, and refers to the research results of Ye Xiaoqian [15]. Combined with the actual situation in China, strong subjective factors were eliminated, and six primary indicators, including economic comfort, cultural comfort, public service comfort, natural ecological comfort, living standard comfort and scientific and educational innovation environment, as well as 52 secondary indicators, were constructed in conjunction with the comfort object theory, constituting a rating system for the attractiveness of urban talent.

The first is ecological comfort. The first consideration is the ecological amenity that makes the city habitable. According to existing research, it is found that comfortable natural conditions and excellent environmental governance will have a higher attraction to people. This paper reflects the level of local amenity in terms of both greenery and environmental management. As the pursuit of quality of life increases, people are increasingly concerned about the air quality and greenery of the cities they live in. The ecological environment of a city is not only the natural environment, but also the man-made environment. While the natural environment is often determined by the geographical location of the city, the man-made environment is not only related to the geographical location of the city, but also depends on the level of governance of the city. Therefore, exploring the construction of urban eco-environmental comforts at the level of air quality, greening construction and pollution control can better reflect the level of action of the local government.

Secondly, public service amenities. The quality of public services in a city is a good reflection of the level of action of the local government. For urban residents, the government has the responsibility to provide basic social security and welfare, such as good educational conditions and medical conditions. Surveys have shown that people generally focus on the availability of good medical care in a city, while excellent education is a guarantee that when talented people move in, their next generation will be well educated. In order to reflect the medical and educational conditions of cities, this paper measures them mainly from the perspective of resource allocation, so as to explore whether cities have the capacity to accommodate more talents and provide them with good medical and educational conditions. Secondly, the level of social security, such as the participation rate in various social insurance schemes, can reflect the level of employment security in a city. This paper focuses on the number of participants in the three basic types of insurance, namely medical, pension and unemployment, to reflect the level of social security in a city. In addition, the ease of setting up a business and the level of transport development are important factors in attracting innovative talent and ensuring its smooth development, and the ease of transport in a city is related to the range of work and living services. Therefore, this paper describes the accessibility of cities in terms of the allocation of public transport resources.

Thirdly, it is an economic development comfort object. If a city's economic strength is to be reflected, it needs to be analysed not only in terms of its current economic scale, but also in terms of its rate of development. The larger the annual GDP and the faster the growth rate of the city, the better the overall level of economic construction of the city, so it can be reflected in terms of GDP and GDP growth rate. At the same time, the industrial structure and development of a city will reflect the level of development of the city, for example, the proportion of tertiary industry can reflect the level of economic development of a city from the side. When people consider where to go for employment, the local income level and employment situation are often very intuitive and important considerations. Wage income and employment situation are

the most basic reference for career development, and this paper characterises them in terms of the average wage of in-service workers and urban registered unemployment rate.

Fourthly, development conditions are comfortable things. Innovative talents prefer to work in an environment with a strong innovation atmosphere. The scientific and educational environment of universities and the level of innovation of enterprises in a city are closely related to the development prospects of innovative talents. Developed regions generally pay much attention to research investment and platform construction to provide innovative talents with a quality research and working environment. Innovative talents are mainly employed in universities and high-tech enterprises, and cities with more university students have a greater advantage in terms of talent resources. At the same time, the innovation environment can reflect the city's original research capability and the overall level of technological innovation, and the investment in education and science and technology is closely related to the city's education level and the quantity and quality of research output.

Fifth is cultural comfort. In the context of an increasingly developed economy, people are pursuing a more diversified lifestyle and, as a result, the leisure and cultural atmosphere of cities is becoming increasingly important. Cultural amenities and leisure consumption facilities are beginning to be seen as important drivers of economic development in cities, rather than as an adjunct to it. Based on the differences in the domestic social and cultural environment and the availability of indicator data, and with reference to the existing livable city indicator system in China, this paper reflects the level of construction of cultural amenities from two perspectives: cultural inclusiveness and cultural facilities, and reflects cultural inclusiveness in terms of the number of people engaged in cultural, sports and recreational activities and the number of Internet broadband access users, and reflects cultural facilities in terms of the number of public libraries and museums per 100 people. The number of books in public libraries and museums per 100 people reflects the level of cultural facilities.

Sixth, consumption comfort. In this regard, this paper reflects the consumption environment and the cost of living, and chooses the proportion of employees in industries closely related to residents' lives, such as catering and retail, to reflect the city's consumption environment. As for the cost of living, the level of consumption and property prices in a city are factors that cannot be ignored when considering where to develop. The traditional Chinese concept is to live and work in peace and happiness, and most people want to be able to solve their housing problems while they are employed and developing. However, the more developed and well-located a city is, the higher the property prices and the higher the cost of renting an apartment, making it a greater burden for talent at the start of their development. Studies have shown that high housing prices have a crowding-out effect on the inflow of talent. Housing prices and consumer indices are important factors that cannot be ignored when choosing a city for innovative talent.

In summary, based on the comfort object theory and existing literature, this paper constructs a comprehensive index system for evaluating the attractiveness of cities to science and technology innovation talents, which includes 6 primary indicators and 52 secondary indicators, as shown in Table 1.

Table 1. City talent attractiveness evaluation index system

Evaluation objectives	Tier 1 indicators	Secondary indicators	Direction
City talent attraction	Economical and comfortable	Gross regional product	+
		Gross regional product per capita	+
		GDP growth rate	+
		Share of tertiary sector employees	+

		Share of tertiary sector in GRP	+
		Average wage of employed workers	+
		Growth rate of average wage of employees in employment	+
		Registered urban unemployment rate	-
		Total value of imports and exports	+
	Cultural comfort	Number of people engaged in cultural, sports and recreational activities	+
		Number of Internet broadband access users	+
		Number of national-level scenic spots	+
		Public library collections	+
		Number of museums and professional exhibition halls	+
		Number of cinemas and theatres	+
	Public service comfort	Number of kindergartens	+
		Number of key secondary schools	+
		Number of tertiary hospitals	+
		Number of beds per 10,000 population	+
		Number of doctors per 10,000 people	+
		Number of urban workers covered by basic pension insurance	+
		Number of urban workers covered by basic medical insurance	+
		Number of participants in unemployment insurance	+
		Passenger traffic by civil aviation	+
		Railway passenger traffic	+
		Length of rail lines	+
		Number of rental cars at the end of the year	+
		Road area per capita	+
	Natural and ecological comfort	Average temperature in January	+
		Precipitation in January	+
		Average temperature in July	-
		Precipitation in July	+
		Greenery coverage in built-up areas	+
		Number of days with air quality at or better than Grade 2	+
		Park green space per capita	+
		Comprehensive utilization rate of general industrial solid waste	+
		Centralised treatment rate of sewage treatment plants	+
		Harmless disposal rate of domestic waste	+
	A comfortable standard of living	Number of high-end shopping centres	+
		Number of completed residential units	+
		Consumer Price Index for Urban Residents	-
		Average sales price of commercial	-

		properties	
	Science, education and innovation environment	Number of general higher education schools	+
		Share of education expenditure in public finance expenditure	+
		Share of expenditure on science and technology in public expenditure	+
		Number of State Key Laboratories	+
		Number of university students in general colleges and universities	+
		Number of patent applications	+
		Number of high-tech enterprises in high-tech zones	+
		Number of R&D personnel in national high-tech enterprises	+
		R & D personnel of enterprises in national high-tech zone full time when	+
		Foreign Direct Investment Contract Projects	+

3.2. An Empirical Exploration of Urban Attractiveness

3.2.1. City Sample Selection and Data Sources

This study is on China's new first-tier cities, and the list has been created for the first time since 2013, with 15 cities on the list re-evaluated and maintained annually since 2016. We screened the cities that have appeared on the list since its creation, a total of 22 cities. This covers 15 provinces and regions in China.

These cities are mainly located in the central and eastern regions of China, in line with the actual geographical distribution of China's economic development. After analysis, we found that the "New First Line" cities are either municipalities directly under the central government, with a strong economic base and a large middle class population, as well as considerable political resources; or regional centres, with the ability to radiate to many surrounding provinces, strong educational resources, profound cultural deposits and convenient transportation; or provincial capitals of economically developed eastern regions and open coastal cities. The city has a good economic foundation, convenient transportation and unique urban charm.

The data used in this article is based on city indicators selected from the 2019 data of each new first-tier city, and is obtained from the 2019 China City Statistical Yearbook, the China Torch Statistical Yearbook and the Statistical Yearbook of each new first-tier city.

3.2.2. Scoring Calculation

In this paper, in order to avoid the influence of subjective factors to a greater extent, the entropy method of objective assignment is therefore used to determine the weight of each indicator. The specific calculation formula is shown below.

First, the indicators are standardised. For positive indicators, equation (1) is used for processing; for negative indicators, equation (2) is used for processing.

$$X_{ij} = \frac{x_{ij} - x_{\min}}{x_{\max} - x_{\min}} \tag{1}$$

$$X_{ij} = \frac{x_{\max} - x_{ij}}{x_{\max} - x_{\min}} \tag{2}$$

Where, denotes the value of the jth indicator of the ith city, denotes the maximum value of the indicator series, denotes the minimum value of the indicator series, and is the result after standardisation.

The second step is to calculate the share of each city in the indicator under the jth indicator.

$$p_{ij} = \frac{X_{ij}}{\sum\limits_{i=1}^{n} X_{ij}} \tag{3}$$

In the third step, the entropy value of the jth indicator is calculated.

$$e_j = -\frac{1}{\ln(n)} \sum\limits_{i=1}^{n} p_{ij} \ln(p_{ij}) \tag{4}$$

In the fourth step, the information entropy redundancy is calculated.

$$d_j = 1 - e_j \tag{5}$$

In the fifth step, the weights of each indicator are calculated.

$$w_j = \frac{d_j}{\sum\limits_{j=1}^{m} d_j} \tag{6}$$

In the sixth step, the overall score for each city is calculated.

$$S_i = \frac{\sum\limits_{j=1}^{m} X_{ij} w_j}{\sum\limits_{j=1}^{m} w_j} \times 100 \tag{7}$$

3.2.3. Entropy Method Analysis Results

The city attractiveness scores calculated from the above formula are shown in Table 2.

According to the scores in the table, Chongqing has the highest score and the strongest overall attractiveness, followed by Chengdu, Hangzhou and Suzhou, with Dalian scoring the lowest, with the highest city scoring 2.9 times higher than the lowest city.

Analyzing these cities according to their geographical location, this paper finds that the eastern coastal cities as a whole are ranked higher than the central and western cities, with the exception of the western region where Chengdu, Chongqing and Xi'an are ranked more highly. In terms of China's administrative divisions, municipalities directly under the central government, such as Tianjin and Chongqing, are ranked higher.

Table 2. New first-tier cities attractiveness composite score

Cities	Economical (0.143)	Ranking	Cultural (0.142)	Ranking	Public service (0.284)	Ranking
Chongqing	8.12	4	9.04	2	19.84	1
Chengdu	7.80	7	9.29	1	16.81	2
Hangzhou	8.89	3	6.18	3	11.87	4
Suzhou	11.12	1	5.35	4	11.55	5
Nanjing	8.95	2	5.11	5	10.17	7
Wuhan	7.99	5	3.74	10	9.77	8
Xi'an	5.78	18	4.47	7	10.78	6
Tianjin	3.81	21	3.88	8	12.99	3
Dongguan	7.22	10	4.88	6	8.79	9
Changsha	7.46	9	2.59	14	6.43	13
Ningbo	7.62	8	3.77	9	5.57	16
Hefei	5.78	17	1.68	21	4.50	20
Foshan	6.51	14	3.27	12	3.84	21
Zhengzhou	6.48	15	3.27	13	7.15	12
Qingdao	6.62	12	2.01	19	7.91	11
Kunming	4.87	19	3.73	11	5.89	15
Wuxi	7.89	6	2.41	16	4.73	18
Fuzhou	6.59	13	2.45	15	3.78	22
Xiamen	6.88	11	1.82	20	4.72	19
Jinan	6.21	16	2.37	17	5.94	14
Shenyang	3.45	22	2.13	18	8.29	10
Dalian	4.79	20	1.53	22	5.16	17

Cities	Natural Ecology (0.124)	Ranking	Living standards (0.092)	Ranking	Science, education and innovation environment (0.214)	Ranking	Total points	Ranking
Chongqing	6.18	11	7.78	1	9.80	7	60.59	1
Chengdu	5.61	14	4.85	3	9.93	5	54.47	2
Hangzhou	9.12	1	1.94	20	9.88	6	47.72	3
Suzhou	5.92	13	2.51	18	10.46	4	46.81	4
Nanjing	6.22	10	2.90	13	12.18	2	45.67	5
Wuhan	6.26	9	2.96	12	12.81	1	43.43	6
Xi'an	3.18	19	3.95	5	10.78	3	38.67	7
Tianjin	2.86	22	3.32	10	9.74	8	36.60	8
Dongguan	6.61	6	0.75	22	8.54	9	36.59	9
Changsha	7.69	3	3.74	8	6.69	14	34.76	10
Ningbo	8.74	2	2.58	17	5.13	17	33.54	11
Hefei	5.60	15	6.55	2	8.00	10	32.26	12
Foshan	6.12	12	4.09	4	7.81	11	32.07	13
Zhengzhou	3.61	17	3.80	7	6.75	13	31.15	14
Qingdao	4.37	16	3.02	11	7.04	12	30.83	15
Kunming	7.24	4	3.57	9	4.25	19	29.38	16
Wuxi	6.61	5	2.36	19	3.96	20	27.70	17
Fuzhou	6.48	8	2.78	15	4.30	18	26.65	18
Xiamen	6.53	7	1.01	21	5.40	16	26.33	19
Jinan	3.48	18	2.75	16	5.68	15	26.00	20
Shenyang	3.11	20	3.88	6	3.73	21	24.78	21
Dalian	3.08	21	2.90	14	2.68	22	20.69	22

The twelve cities listed in this book, such as Chengdu and Hangzhou, are the capital cities of each province, and the list shows that there is a wide gap between the provincial capitals; however, Suzhou and Dongguan, two non-capital cities, are outstanding performers, outperforming most of the provincial capitals. Suzhou and Dongguan are respectively one of the important central cities in China's Yangtze River Delta and the central city on the east coast of the Pearl River Delta, and Suzhou has great geographical advantages due to its proximity to Shanghai and Dongguan's borders with Guangzhou and Shenzhen.

In terms of indicator weights, comfort in public services (0.284) has the highest weighting, followed by comfort in science, education and innovation (0.214), economic comfort (0.143) and cultural comfort (0.142), followed by comfort in nature and ecology (0.124) and comfort in living standards (0.092). The higher weights for scientific, educational and innovative environment and public service comfort, and the greater difference in weight with other as well as indicators, suggest that cities have the greatest variability in these two areas and that the indicators associated with them have a greater impact on city attractiveness. A city's level of public service comfort reflects whether the city can do a good job in providing convenient transportation, medical care and educational security, which are of high concern to scientific and technological talents, and whether it can provide a high quality of life for innovative talents. The high weighting of the scientific and educational innovation environment reflects the city's ability to provide excellent research platforms and resources, and create a good research environment and innovation atmosphere for talents, on top of ensuring the quality of life of innovative talents, which has an important impact on the attractiveness of the city's talents. At the same time, the comprehensive strength of a city's economic development and cultural atmosphere are also important factors in attracting innovative talents.

4. Cluster Analysis

To further compare and analyses the overall attractiveness of each city, this paper uses SPSS to conduct a cluster analysis of the 22 first-tier cities, dividing the above 22 cities into 4 major categories, the results of which are shown in Table 3.

Table 3. New first-tier cities classification

Classification	Cities	Number of cities
Category I	Chongqing	1
Class II	Tianjin, Chengdu, Nanjing, Hangzhou, Wuhan, Xi'an	6
Category III	Wuxi, Suzhou, Ningbo, Xiamen, Foshan, Dongguan	6
Category IV	Shenyang, Dalian, Hefei, Fuzhou, Jinan, Qingdao, Zhengzhou, Changsha, Kunming	9

Chongqing is alone in the first category and its overall attractiveness is significantly higher than that of other cities. As the largest municipality directly under the Central Government in Western China, Chongqing has a large geographical area and a large population, and has been very strong in terms of economic development during the city's development. Moreover, Chongqing's housing prices and price indices have grown more moderately than those of other cities in the same class, and the comfort level of living is higher, and the level of cultural construction is better, which greatly enhances Chongqing's urban attractiveness.

Cities in the second category include Tianjin, Chengdu, Nanjing, Hangzhou, Wuhan and Xi'an, which are municipalities and provincial capitals respectively. According to the sub-item scores, it can be seen that cities in this category are in the middle to upper level under all types of comfort scores, and are more prominent in the comfort of public services and the comfort of

science, education and innovation, but in terms of the living index, the comfort level is reduced due to the high housing prices and high living index.

Cities in the third category include Wuxi, Suzhou, Ningbo, Xiamen, Foshan and Dongguan. Most of the cities in this category have medium comfort scores and are able to have high ratings for certain comfort items. Dongguan stands out for its cultural comfort and natural ecological comfort scores, while Foshan's house price level is at a lower level than cities in the first and second categories, and prices are rising at a more moderate rate, resulting in a higher comfort of living score.

Cities in the fourth category include Shenyang, Dalian, Hefei, Fuzhou, Jinan, Qingdao, Zhengzhou, Changsha and Kunming. Most of the cities in this category are located in the central and western regions or in the northeast, and their scores for each indicator are relatively low overall, with different combinations of competitive advantages and disadvantages, and significant differences. In terms of geographic location, these cities do not have obvious advantages and none of them have national resources or functions. To attract more talents in science and technology innovation, they need to fully explore their respective characteristics and make use of their strengths in a certain area to build their core competitiveness.

5. Urban Population Projections

Based on the population data of each new first-tier city from 2015 to 2020, the population scale after the implementation of the talent attraction policy is predicted. Because the year of the implementation of the talent attraction policy is relatively short and the available data is small, this paper adopts the GM(1,1) method to predict the population scale of the cities in the next three years. The results are shown in Figure 1.
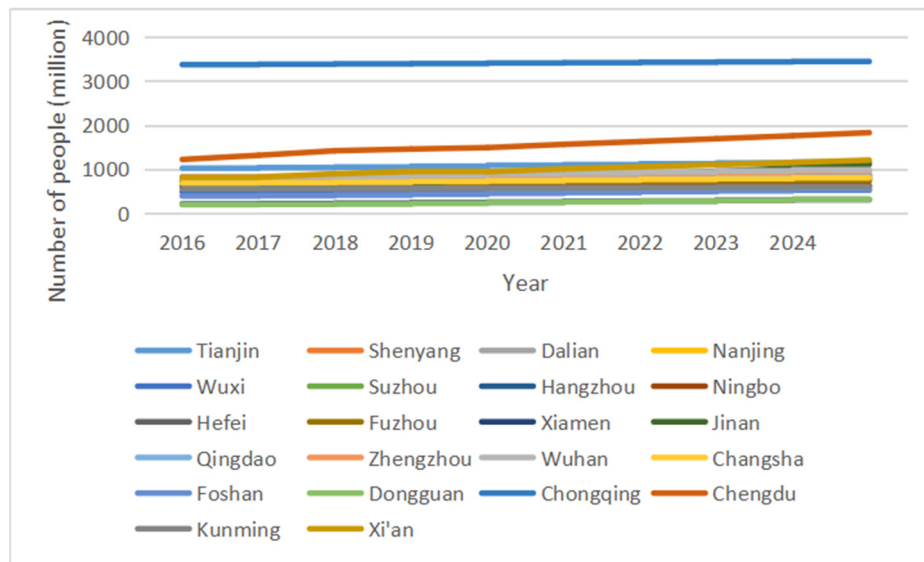

Figure 1. Urban population projections

It is clear that the population size of the new first-tier cities is on the rise after the implementation of the talent attraction policy, with the population of Hangzhou and Chengdu increasing more rapidly. Chongqing, Dalian and Shenyang have a slower growth trend. Although Chongqing has a higher overall score, it has a large overall population base, so the slow growth rate is more reasonable. The Northeast region, on the other hand, has a more varied development trend than the East, and therefore has a slower growth rate.

6. Talent Attraction Policy Analysis

Talent introduction policies can be revealed through the study of policy instruments, and the analysis of policy instruments emphasises the issue of matching policy instruments with policy objectives. In the research on the use of policy tools to analyse talent policy, most scholars have divided the use of talent policy tools by constructing a two-dimensional analysis framework of X and Y dimensions. This paper constructs a two-dimensional framework for the analysis of talent policy, i.e. Dimension X - the policy tool dimension, and Dimension Y - the talent level dimension, and analyses the intrinsic links between them. Using this policy framework, a textual analysis of the specific content of talent introduction policy texts in 22 cities is conducted.

In the process of cities' efforts to introduce talent, it is evident that cities have different levels of demand for different types of talent according to each city's policy text. Although China does not have a unified standard for dividing talent into levels, the talent plans of each city give very similar criteria for identifying talent, and Yang Libo et al[19] argue that the study of talent according to levels is conducive to the idea of talent classification and management.

New Tier 1 cities have been characterised by a strong homogeneity in formulating talent policies in recent years, with policies introduced at close to each other. New Tier 1 cities have successively launched comprehensive talent introduction policies after 2016, and by 2020, all Tier 1 cities have launched talent attraction policies. And, the designated policies mainly include incentives for various types of talents, settlement, housing purchase, rental, children's enrolment, medical protection and spouse work deployment.

Analysis of the two-dimensional policy tool shows that the higher the talent grade, the more support benefits are involved and the stronger the support. At this stage, local talent attraction efforts have focused too much on "high-level talent" and less on supporting the development of middle-level and grassroots talent. However, a significant number of high-level talents have grown up from middle-level and grass-roots talents. From the overall perspective of talent work, the formation of a stable echelon of talent development is of great significance to the development of the economy and society.

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