An Analysis of Talent Attraction in Shenzhen Based on Entropy Weight Method

Wen Luo*

3234193107@qq.com

Guangdong University of Technology, Guangzhou, China

Abstract. It is of great significance to explore the level of talent attraction and industrial development structure of cities under the current background for the improvement and amendment of city's policies. This paper first selects 7 first-level indicators as the core elements of the evaluation model to evaluate the talent attraction level of Shenzhen, and then subdivides the indicators into 20 second-level indicators to form the talent attraction evaluation index system. Then the entropy weight method is used to determine the weight of each index, and finally the comprehensive talent attraction score of the four first-tier cities is calculated and compared with Shenzhen and other cities. Then, the evaluation model of the attractiveness level of a city to various talents is established, and the specific policy differences among various industries in first-tier cities are deeply analyzed, and policy suggestions are put forward.

Keywords: Evaluation Model; Talent Attraction; Entropy Weight Method; Policy Suggestion

1 Introduction

With the gradual acceleration of economic development and social pace, the competition for talent among first-tier cities is intensifying. It is an urgent problem to select appropriate indicators to establish an evaluation system, quantify the level of urban talent attraction, and provide assistance for attracting talents to cities.

Zhao et al. (2023)[1] constructed an index using the entropy weight method and found that economic development, public services, and environmental quality are key factors influencing talent attraction. Jiang et al. (2023)[2] showed that average salary income and GDP are key factors influencing the attractiveness of high-level talents. Reiner et al. (2017)[3] primarily compared talent attraction for international academic talents based on city talent policies. Tendeiro (2019)[4] found that the primary factors influencing talent mobility are quality of life, employment, and economic conditions. Hidalgo et al. (2006)[5] found that the most attractive factors in cities are often historical culture and entertainment venues.

This paper aims to select appropriate indicators to quantify the talent attraction of cities and analyze the level of talent attraction in different industries using Shenzhen as an example, and provide corresponding recommendations.

IEDM 2024, February 23-25, Kuala Lumpur, Malaysia

DOI 10.4108/eai.23-2-2024.2345932

2 Methodology

2.1 Talent attraction level evaluation index system

We take "talent attraction level" as the target level, and construct the criterion level from seven dimensions: economic development level, consumption level, public service level, natural environment, social security, scientific and technological development, and living conditions, which can be represented by the following equation (1):

$$CLTE = f(E, C, P, N, S, T, L) \quad (1)$$

Where E stands for economic development level, C stands for consumption level, P stands for public service level, N stands for natural environment, S stands for social security, T stands for scientific and technological development, and L stands for living conditions. A total of 20 indicators are selected under the criterion layer to form the index layer, and the evaluation index system of talent attraction level is constructed. See **Table 1** for details.

Table 1. Index system construction table

destination layer	criterion layer	index layer
Talent attraction level (X)	economic development level(X_1)	Per capita GDP(X_{11}) per capita disposable income (X_{12}) GDP growth rate (X_{13}) Proportion of output value of tertiary industry (X_{14}) Total foreign trade imports and exports(X_{15}) Average annual wages of employees (X_{16})
	consumption level(X_2)	Per capita consumption expenditure of urban residents (X_{21})
	public service level (X_3)	Number of students enrolled in regular colleges and universities (X_{31}) Education expenditure as a proportion of government expenditure(X_{32}) Proportion of government expenditure on medical and health care (X_{33}) Number of health technicians per 1,000 population(X_{34}) Culture, sports and media expenditure as a proportion of government expenditure(X_{35})
	natural environment(X_4)	Harmless treatment rate of household garbage(X_{41}) Days with good air quality(X_{42}) Green coverage area of built-up area (X_{43})
	social insurance(X_5)	Fiscal expenditure on social security and employment(X_{51})
	technological development(X6)	R&D expenditure as a percentage of GDP(X_{61}) the number of granted patents(X_{62})
	living condition(X_7)	Urban area per capita(X_{71}) Average selling price of commercial housing(X_{72})

2.2 Positive and standardized processing

With n evaluation indexes and m objects to be evaluated, the expression of judgment matrix X is following equation (2)

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \tag{2}$$

Considering that the indicators used in this paper contain both very large and very small indicators, which have different influence directions on the model evaluation results, vector normalization method is used to standardize the indicator data, and the matrix after standardization is Z, then each element as shown in equation (3):

$$z_{ij} = \begin{cases} \dfrac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} & (a) \\ \dfrac{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}{x_{ij}} - 1 & (b) \end{cases} \tag{3}$$

Where: Formula (a) is an extremely large index formula; Formula (b) is an extremely small index formula.

2.3 Entropy weight method

Entropy weight method is an objective weighting method, which can eliminate human factors and objectively reflect the information of the original data itself. The principle is to use information entropy to represent the variation degree of the index. The smaller the information entropy is, the less the information reflected by the index, and the lower its corresponding weight value should also be. The weighting process using entropy weight method is as follows.

1) Calculate the probability matrix P

The normalized post-judgment matrix Z can be obtained from the above, then the calculation formula of the elements in P is following equation (4)

$$P_{ij} = \frac{z_{ij}}{\Sigma_{i=1}^{n} z_{ij}} \tag{4}$$

2) Calculate information entropy and information utility values

The information entropy and information utility value of each index are shown in the following equations (5) and (6) respectively.

$$e_j = -\frac{\Sigma_{i=1}^{n} p_{ij} \ln(p_{ij})}{\ln n} \tag{5}$$

$$d_j = 1 - e_j \tag{6}$$

Where e_j is the information entropy of the JTH indicator, and d_j is the information utility value of the JTH indicator(j = 1, 2, …, m).

3) The objective weight can be obtained by normalizing d_j

The final weight of each index can be calculated following equation (7).

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j} \tag{7}$$

Where w_j is the objective weight of the JTH indicator($j = 1, 2, \ldots, m$).

3 Empirical analysis

3.1 Data resource

This paper collects 20 specific indicators of four representative first-tier cities in China, namely Shenzhen, Beijing, Shanghai and Guangzhou. And the data are mainly from the official database of the National Bureau of Statistics to ensure the authority and authenticity of the data.

3.2 Data pre-processing

In order to preliminarily understand the basic situation and quality of the data, this paper first makes descriptive statistics of the collected data.

Table 2. Descriptive statistical table

variable name	maximum	minimum	mean	standard deviation	kurtosis	skewness
Per capita GDP	187526	85897	127924.545	26864.74	-0.893	0.28
per capita disposable income	78026.6	33176	52343.798	12609.019	-1.086	0.314
GDP growth rate	0.429	0.011	0.092	0.061	22.231	4.058
Proportion of output value of tertiary industry	0.837	0.487	0.685	0.095	-0.95	0.06
Total foreign trade imports and export	62860300	11616259	36393433.02	14607204.82	-0.862	-0.652
Average annual wages of employees on the job	201504	55143	111949.227	38598.318	-0.392	0.589
Per capita consumption expenditure of urban residents	240803.03	26467.01	41960.236	31358.68	40.019	6.187
Number of students enrolled in regular colleges and universities	141.257	7	55.429	35.566	-0.163	0.446
Education expenditure as a proportion of government expenditure	0.383	0.075	0.177	0.096	-0.387	1.097
Proportion of government expenditure on medical and health care	0.211	0.038	0.082	0.047	0.759	1.338
Number of health technicians per 1,000 population	15.5	5.17	8.81	2.654	-0.369	0.392
Culture, sports and media expenditure as a proportion of government expenditure	0.091	0.009	0.03	0.025	-0.2	1.216
Harmless treatment rate of household garbage	100	61	96.057	8.016	8.174	-2.706
Days with good air quality	365	167	296.318	53.437	0.076	-0.839
Green coverage rate of built-up area	49.29	36.2	43.27	3.89	-1.133	-0.165

Fiscal expenditure on social security and employment	10784000	518856	4528540.705	3363484.778	-1.017	0.627
R&D expenditure as a percentage of GDP	0.054	0.008	0.023	0.013	-0.565	0.716
the number of granted patents	279177	18346	92722.636	59199.885	1.123	1.185
Urban area per capita	7.497	1.13	3.64	2.022	-0.593	0.826

Table 2 reports the descriptive statistical results of the data. According to the statistics described in the chart, it can be seen that the per capita GDP is increasing steadily and the consumption situation is also improving steadily. With the increase of people's income, the purchasing power of consumers has been improved, and the consumption structure is also changing. The traditional basic needs of life are gradually satisfied, and people begin to pay attention to enjoying life and improving the quality of life. The increasing proportion of cultural entertainment also represents that people are gradually pursuing more diversified forms of cultural entertainment, such as movies, music, art exhibitions, literary reading, etc. Society is attaching more and more importance to the status and role of culture and art. The tertiary industry is developing well, mainly including service industry, cultural and creative industry, information technology and other fields closely related to people's lives. With the development of economy, the proportion of service industry has gradually increased, and its contribution to economic growth has become increasingly significant. The rise of cultural creative industry has brought people full spiritual enjoyment, and has also become a key element to attract talents.

3.3 The calculation results of entropy weight method

To sum up, the entropy weight method is used to get the objective weight of the last indicators, and then the comprehensive score is calculated to get the comprehensive score table of each city in different years. The results are shown in **Table 3**.

Table 3. Ranking table of the total score of each city

Year	Shenzhen	Beijing	Shanghai	Guangzhou
2011	0.314746913	0.383141359	0.208429971	0.181791586
2012	0.204112589	0.397975228	0.20457484	0.165669826
2013	0.21653157	0.444873189	0.23350495	0.162288679
2014	0.223579165	0.469873195	0.236586736	0.18491072
2015	0.200017311	0.470487766	0.242036275	0.235407492
2016	0.218849001	0.47104227	0.280963825	0.25929195
2017	0.246537182	0.503268963	0.310155424	0.273568905
2018	0.283071555	0.551675318	0.319767588	0.299488951
2019	0.304125583	0.62625924	0.342962663	0.324098249
2020	0.35565963	0.635211293	0.364212782	0.342891619
2021	0.409858088	0.679418152	0.422914907	0.372229585

From the four cities we selected, Shenzhen ranked third, which shows that Shenzhen's talent attraction level still has room to improve, but it is still the choice of most talents. Overall, Shenzhen has a high level of talent attraction.

Table 4. Secondary industry score table

City	Shenzhen	Guangzhou	Beijing	Shanghai
comprehensive evaluation	0.77375141	0.352787133	0.075147736	0.75679807
ranking	1	3	4	2

Table 4 reports the scores of four cities in the secondary industry. Shenzhen ranked first in the secondary industry score, which shows that the development of Shenzhen's secondary industry is good. Shenzhen is also a special zone city in China, known for its strong manufacturing and secondary industries. Shenzhen's secondary industry talent attraction is ahead of other similar cities. This is largely due to the industrial cluster effect, the collaborative development of various enterprises has created a good environment, and the attraction of talents has been enhanced.

Table 5. Tertiary industry score table

City	Shenzhen	Guangzhou	Beijing	Shanghai
comprehensive evaluation	0.23514739	0.26797995	0.821809483	0.601465035
ranking	4	3	1	2

Table 5 reports the scores of four cities in the tertiary industry. Ranked fourth in the tertiary industry score, Shenzhen is a relatively young city compared to Guangzhou, Shanghai and Beijing. In the early days of reform and opening up, Shenzhen developed mainly on the basis of manufacturing, and built a large number of manufacturing enterprises relatively quickly. In contrast, Guangzhou, Shanghai and Beijing had more of a traditional service industry base in their early days.

Table 6. Science and technology industry score table

City	Shenzhen	Guangzhou	Beijing	Shanghai
comprehensive evaluation	0.589425452	0.175640269	0.435759857	0.042405953
ranking	1	3	2	4

Table 6 reports the scores of four cities in the science and technology industry. Shenzhen ranked first in the science and technology industry score, which shows that Shenzhen attaches great importance to scientific and technological innovation. Shenzhen has accumulated a strong industrial foundation and advantages in electronic information, communications, biomedicine, artificial intelligence and other high-tech industries. Shenzhen has a large number of well-known technology enterprises and innovative companies, forming a certain industrial agglomeration effect.

4 Conclusion

Based on the above data, we can make a comparison chart of comprehensive scores of these cities. **Fig 1** shows the scores of different industries in these four first-tier cities.

As can be seen from **Fig 1**, in the field of secondary industry, among the four first-tier cities, Shenzhen and Shanghai are significantly more attractive to secondary industry talents, while

Guangzhou and Beijing are slightly less attractive. In the field of tertiary industry, Beijing is developing most rapidly among the four first-tier cities, followed by Shanghai and Guangzhou, and Shenzhen is lagging behind in this field. In the field of science and technology, the development of the four first-tier cities is improving year by year, among which Shenzhen develops faster, Guangzhou and Beijing follow closely, and Shanghai has the slowest development of science and technology and the lowest comprehensive strength.

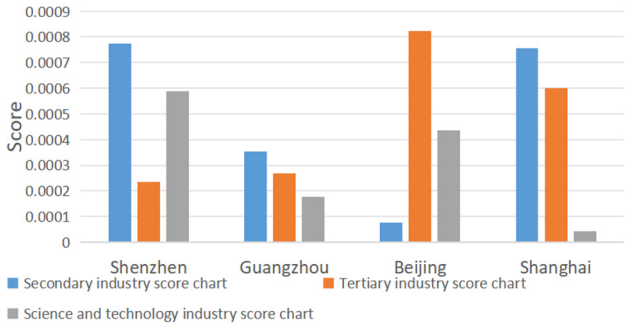

Fig. 1. Comparison of comprehensive scores in various fields in first-tier cities

On the whole, Shenzhen can further strengthen the development of high-end manufacturing, new materials, artificial intelligence, biomedicine and other fields. We will continue to expand investment in infrastructure such as transportation and public service facilities, optimize the urban transportation network, and improve the efficiency of urban operation. At the same time, we should pay attention to ecological environment construction and promote sustainable development. Strengthen cooperation with world-class cities and enterprises, and attract more foreign investment and international enterprises to invest and cooperate in Shenzhen. Actively participate in international business exchanges and cooperation activities to build a more internationally competitive Shenzhen brand. At the same time, we will strengthen market supervision, ensure fair market competition, and promote the healthy development of enterprises. By providing relevant policy support in business, alleviating population pressure and strengthening infrastructure construction, Shenzhen will attract more talents in the future.

References

[1] Zhao, L., Fan, H. Z., Yu, M. L.: On the Evaluation of Cities' Attractiveness to Talents—A Case Study of Hefei Urban Circle. Journal of Wuhan Business University, Vol. 37(03), pp. 69-73. (2023)

[2] Jiang, Y., Yao, Y. N., Chen, Y. J.: Analysis on Attraction of High-level Talents in Nantong Center for Disease Control and Prevention Based on Grey Relational Degree. Occupation and Health, Vol. 39(03), pp. 414-417. (2023)

[3] Reiner, C., Meyer, S., Sardadvar, S.: Urban attraction policies for international academic talent: Munich and Vienna in comparison. Cities, Vol. 61, pp. 27-35. (2017)

[4] Tendeiro, J.M.R.: Attributes That Influence The Attraction Of Talent: Porto's Case. (2019)

[5] Hidalgo, M.C., Berto, R., Galindo, M.P., Getrevi, A.: Identifying attractive and unattractive urban places: categories, restorativeness and aesthetic attributes. Medio Ambiente y Comportamiento Humano, Vol. 7(2), pp. 115-133. (2006)