The Evaluation of Economic Potential of Cities in Sichuan Province by AHP

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Abstract: By AHP algorithm, this article analyzes the economic potential of 7 cities in Sichuan province, namely Chengdu, Minyang, Nanchong, Deyang, Zigong, Yibin, and Panzhihua, five factors acting as the criteria, including the GDP, local fiscal revenue, higher education population, labour productivity and average household. Moreover, a scientific judgment matrix is created based on real data to determine the weights. It can be concluded that the Chengdu boasts the highest value in every aspect, Yibin, Nanchong, Mianyang, Zigong, Deyang and Panzhihua rank next, and Panzhihua is the worst. Therefore, the city Panzhihua should be given some economic help. Based on real data, it is valuable to harness AHP algorithm for establishing the economic evaluation system, which provides reference for making economic strategy in Sichuan province.

1. Introduction

Approximately 87 million people live in Sichuan province of China, spreading in more than 20 cities and hundreds of towns [1]. We hold the belief that economic potential is possible to be measured accurately if we collect data of factors that contribute to economy and give each factor an appropriate weight. This paper takes 7 major cities and calculate their economic potential with following 5 factors: GDP, local fiscal revenue, higher education population and labor productivity. Economists holding different views and theories diverge their opinions in importance of each factor in economy; therefore, we synthesis more than 20 latest economical papers, choose a moderate view, and determines weight of each factor based on the moderate view [2-5].

With the purpose of analysis economic potential of cities in Sichuan Province of China, an effective model considering AHP is proposed in this paper. After we calculating the weight of each factor, based on varies economists, we evaluate each city in each factor and generate a matrix which we can use to compare the “scores” of each city in a reasonable and fair way. Simple addiction of those factor is insufficient to determine a city’s economic potential because a city weak in a specific factor may has other advantages [6-8]. Therefore, we use AHP mathematical model, which takes in factors, weight of factors and evaluation of each city in a particular factor, and return a general score of evaluation of each city. An evaluation does not perfectly reflect economic potential of a city, but it serves as a good indicator.

2. The Process of AHP

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions [9-11], based on mathematics and psychology. The procedure for using the AHP can be summarized as:

Step 1: Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.

Step 2: Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. We get the judgement matrixes, and calculate the maximum eigenvalues $\lambda$and their eigenvectors ω respectively, then we obtain the weights of each factors by normalize the elements of eigenvectors.

Step 3: Synthesize these judgments to yield a set of overall priorities for the hierarchy.

Step 4: Check the consistency of the judgments.

Step 5: Come to a final decision based on the results of this process.

3. Application of AHP Models in Economic Potential Ranking

3.1 Hierarchical Structure and Selected Criteria

The AHP method is employed to rank the economic potential of seven cities in Sichuan province in this paper. We takes 7 major cities of Sichuan province as the index layer of AHP ,they are Chengdu, Mianyang, Nanchong, Deyang, Zigong, Yibin and Panzhihua, and evaluate their economic potential with following 5 factors: GDP, local fiscal revenue, higher education population, labour productivity, and average household .they are set as criteria layer. The structure of AHP can be shown in Fig.1.

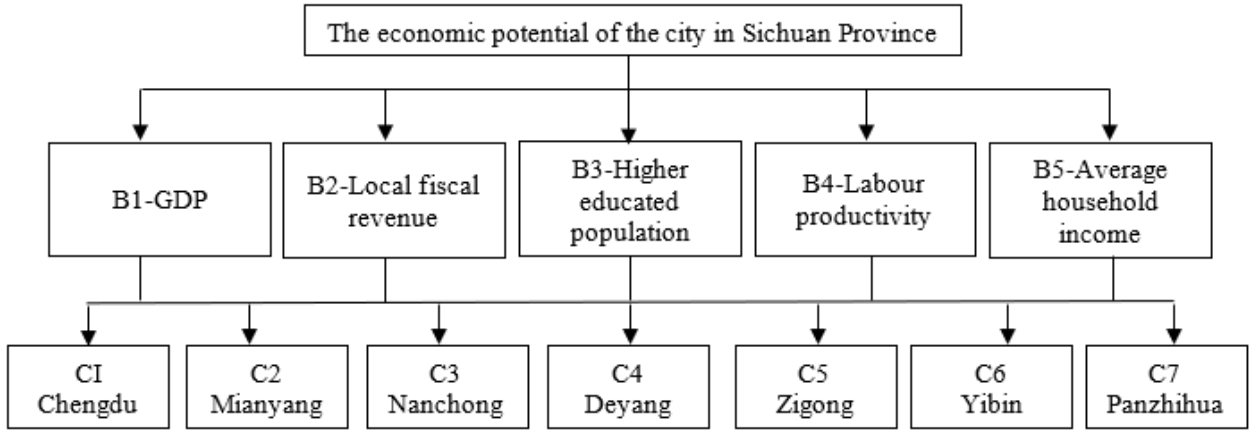

Fig.1 Hierarchical structure for economic potential ranking by AHP

3.2 Calculated Weights

We build the judgement matrix as following to calculate the weights of every factors. The judgement matrix of criteria layer is shown in table.1 while the index layer is shown in table 2-6.

Table 1. The judgement matrix of criteria layer

A	B1	B2	B3	B4	B5
B1	1	5	2	3	2
B2	1/5	1	1/3	1/4	1/3
B3	1/2	3	1	2	1
B4	1/3	4	1/2	1	1/2
B5	1/2	3	1	2	1

Table 2. The judgement matrix of index layer(B1)

B1	C1	C2	C3	C4	C5	C6	C7
C1	1	5	6	7	9	4	8
C2	1/5	1	4	3	5	1/2	4
C3	1/6	1/4	1	3	5	1/3	6
C4	1/7	1/3	1/3	1	4	1/4	5
C5	1/9	1/5	1/5	4	1	1/6	2
C6	1/4	2	3	4	6	1	7

C7	1/8	1/4	1/6	1/5	1/2	1/7	1

Table 3. The judgement matrix of index layer(B2)

B2	C1	C2	C3	C4	C5	C6	C7
C1	1	4	3	5	4	2	7
C2	1/4	1	1/2	2	1	1/2	4
C3	1/3	2	1	3	2	1/2	4
C4	1/5	1/2	1/3	1	1/2	1/3	2
C5	1/4	1	1/2	2	1	1/2	3
C6	1/2	2	2	3	2	1	5
C7	1/7	1/4	1/4	1/3	1/3	1/5	1

Table 4. The judgement matrix of index layer(B2)

B3	C1	C2	C3	C4	C5	C6	C7
C1	1	3	4	4	5	3	6
C2	1/3	1	2	2	2	1	1/3
C3	1/4	1/2	1	1	2	1/2	3
C4	1/4	1/2	1	1	2	1/2	3
C5	1/5	1/2	1/2	1/2	1	1/2	2
C6	1/3	1	2	2	2	1	4
C7	1/6	3	1/3	1/3	1/2	1/4	1

Table 5. The judgement matrix of index layer(B4)

B4	C1	C2	C3	C4	C5	C6	C7
C1	1	5	2	6	5	2	8
C2	1/5	1	1/3	2	1	1/3	3
C3	1/2	3	1	4	3	1	5
C4	1/6	1/2	1/4	1	1/2	1/4	2
C5	1/5	1	1/3	2	1	1/2	3
C6	1/2	3	1	4	2	1	4
C7	1/8	1/3	1/5	1/2	1/3	1/4	1

Table 6. The judgement matrix of index layer(B5)

B5	C1	C2	C3	C4	C5	C6	C7
C1	1	3	4	4	6	2	5
C2	1/3	1	2	2	3	1/3	3
C3	1/4	1/2	1	1	2	1/2	4
C4	1/4	1/2	1	1	3	1/3	2
C5	1/6	1/3	1/2	1/3	1	1/4	1/2
C6	1/2	3	2	3	4	1	3
C7	1/5	1/3	1/4	1/2	2	1/3	1

Then we calculate the calculate eigenvectors $\omega = (\omega_1, \omega_2, \cdots, \omega_n)$ of the maximum eigenvalues λ of each matrix and normalize them [12], finally we obtain the weights of every factors as shown in Table.7.

Table 7. Weights for criteria layer and index layer analyzed by AHP

Criteria		GDP	Local fiscal revenue	Higher educated population	Labour productivity	Average household income
Weights of criteria layer		0.37959	0.060851	0.20947	0.14062	0.20947
Weights of index layer	Chengdu	0.41683	0.359	0.35764	0.359	0.34493
	Minyang	0.1479	0.080728	0.10099	0.080728	0.13855
	Nanchong	0.10091	0.20322	0.15201	0.20322	0.10509
	Deyang	0.067502	0.050755	0.058432	0.050755	0.09082
	Zigong	0.056576	0.0851	0.096208	0.0851	0.042744
	Yibin	0.18794	0.18634	0.20085	0.18634	0.22293
	Panzhihua	0.022336	0.034852	0.03387	0.034852	0.054941

3.3 Ranking Results and Analysis

According to the weights calculated by AHP, the final ranking values of the economic potential of cities in Sichuan province were obtained, they are shown in Table.8.

Table. 8 Ranking results

City	Total weights	Rank
C1: Chengdu	0.3777	1
C2: Minyang	0.1226	4
C3: Nanchong	0.1331	3
C4: Deyang	0.0671	6
C5: Zigong	0.0677	5
C6: Yibin	0.1977	2
C7: Panzhihua	0.0341	7

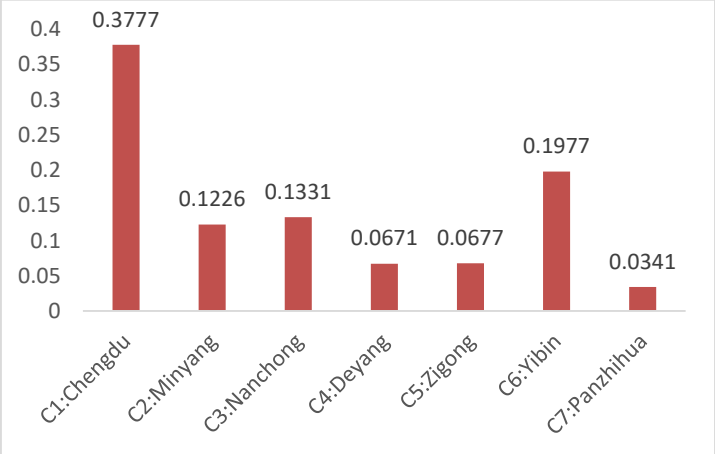

Fig.2 Ranking results bar

It’s obvious that Chengdu hold dominant position in economic potential, and Yibin is the next one while Minyang and Nanchong are very closed to each other. There is no denying that Panzhihua is the poorest one in every criteria of economic potential. Therefore, we should increase our economic support to the low-ranking cities, such as Zigong, Panzhihua and Deyang. Necessary measures should be taken to improve low ranking cities economic situations. And Chengdu are supposed to develop faster and faster in the future.

4. Conclusion

It can be concluded that the economic potential of seven cities in Sichuan Province are evaluated by AHP method, and the GDP, local fiscal revenue, higher education population, labour productivity and average household are selected as the criteria for economic potential ranking. The results show that the Chengdu prohibit the highest value in every aspects, and Yibin, Nanchong, Mianyang, Zigong, Deyang and Panzhihua are the next. The ranking results reflect the real situation, and provide valuable reference for making economic strategy in Sichuan province.

Acknowledgements

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