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A Study on Urbanization Efficiency analysis of China's 31 provinces and cities

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중국 31개 성 및 직할시의 도시화 효율성 분석에 관한 연구

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Abstract The purpose of this study is to analyze the efficiency of urbanization in 31 provinces and cities in China, including both desirable and non-expected outputs produced during the urbanization process. Efficiency was analyzed by applying the SBM-DEA model using the urbanization calculation data of 2017 in 31 provinces and cities in China. The results show that the urbanization efficiency of eastern region is the highest, followed by central region and northeast region, and the urbanization efficiency of western region is the lowest. This study is meaningful in that it analyzes the efficiency of urbanization in 31 provinces and cities in China and suggests the direction of continuous urbanization policy. This study is limited in that it does not reflect the past trend only by conducting cross-sectional analysis for one year in 2017, and it is necessary to comprehensively evaluate urbanization efficiency by conducting additional longitudinal area analysis in the future.

Key Words : SBM-DEA, Urbanization, Efficiency, CCR, BCC

요 약 본 연구의 목적은 도시화 과정에서 생산되는 바람직한 산출과 기대 하지 않는 산출 모두를 포함하여 중국 31개 성과 직할시에 대해 도시화 효율성을 분석하는 것이다. 중국 31개 성 및 직할시의 2017년 도시화 관련 산출 데이터를 활용하여 SBM-DEA모델을 적용해 효율성을 분석하였다. 분석결과 동부지역의 도시화 효율이 가장 높고 중부와 동북지역의 도시화 효율이 그 다음으로 낮으며 서부지역은 도시화 효율이 상대적으로 가장 낮은 것으로 나타났다. 본 연구는 중국 31개 성 및 직할시의 도시화 추진의 효율성을 분석하고 지속적인 도시화 정책 추진의 방향을 제시하였다는데 의의가 있다. 이번 연구는 2017년 1년간의 횡단면적 분석만 시행하여 과거의 추이를 반영하지 못한 한계가 있으며, 향후 종단면적 분석을 추가적으로 실시하여 도시화 효율성을 종합적으로 평가할 필요가 있다.

주제어 : 자료포락분석, 도시화, 효율성, CCR, BCC

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1. Introduction

City is the core of a country's political, economic, social and cultural development, so we should aim for high efficiency. The quality of urban development is reflected by urban efficiency. In the process of urban development, urban efficiency is a very important measurement index. Due to many problems have been found in the process of urban development, the country pays more and more attention to the improvement of urbanization quality and urban development efficiency. From the national new urbanization planning to the report of the 18th National Congress of the CPC Central Committee, and then to the Central Urbanization Work Conference and the Central Urban Work Conference, it is mentioned that attention should be paid to improving the quality of urbanization and urban efficiency. Urban efficiency refers to the ratio of effective total output of urban factor to total input under certain production technology conditions, which is a comprehensive embodiment of the effective allocation, operational status and management level of urban input factor resources[1]. Urban efficiency can effectively measure the operation, management and allocation of each input factor resources, and explore the efficiency and changes of the city. It is not only helpful to understand the degree of utilization of each factor , but also of great significance to the country's formulation and adjustment of urban policies. As China's urbanization level continues to accelerate, urban efficiency plays a crucial role in urban development. High-efficiency cities generate high returns, accelerate capital accumulation, and expand industrial scale, thus increasing the influence and attraction of cities. According to the results of the research on the urbanization efficiency by the scholars using the DEA method, due to different research perspectives and different input-output index system, so the results of urban efficiency evaluation are also quite different. Therefore, based on the establishment of a reasonable urban input-output system, the purpose of this study uses the SBM-DEA model of non-expected output, and the relevant data of 31 provinces and cities in China, to analyze the urbanization efficiency, analyze the current situation of urbanization efficiency, the existing problems and the influencing factors of urbanization efficiency, in order to provide effective information and decision support for the formulation of corresponding management policies.

2. Theoretical background

2.1 DEA model

Data envelopment analysis (DEA) is an efficiency evaluation method developed on the basis of the concept of relative efficiency by the famous operations research experts A.Charnes and W.W.Cooper. It is a very effective tool to evaluate the resource allocation efficiency of Decision Making Units(DMU) with multiple inputs and outputs. The DMU here refers to the object to be studied. The relative effectiveness of DMU is evaluated by mathematical programming and statistical data with the input or output of DMU unchanged. DEA method is applicable to the comprehensive evaluation of the effectiveness of multiple outputs and multiple inputs. It does not need any weighting assumptions, it calculates the optimal weight is based on the actual data of DMU input and output. so it can effectively avoid the influence of subjective factors. Moreover, DEA has advantages in simplifying operation and reducing errors. It has been widely used in various fields such as efficiency and competitiveness of financial institutions, efficient school efficiency, health care organization efficiency and regional investment efficiency.

SBM-DEA model has the advantages of traditional DEA model. The difference from the traditional model, is that putting the slack variables into the objective function that can not only solve the problem of input and output relaxation, but also solve the problem of efficiency evaluation in the existence of non-expected output, which can avoid the deviation and influence caused by the difference of radial and angle to certain extent, and better reflect the essence of efficiency evaluation. Therefore, this paper adopts the SBM-DEA model with non-expected output to analyze and study the urbanization efficiency of 31 provinces and cities in China by using relevant data.

2.2 literature review

Since the reform and opening up, the rapid development of urbanization has made an important contribution to the economic and social development, Urbanization concentrates the advanced social elements in a certain region, making the original urban functions more perfect and the structure more reasonable[2]. Urbanization has played a positive role in improving social and economic development, people's income and material living conditions. People can invest more resources in the propaganda and construction of education, medical care, health and sports, thus constantly improving the material living standards and spiritual realm of the people[3]. However, the problems of high energy consumption, high pollution and high investment have not been solved, with the promotion of sustainable strategy and the awareness of environmental protection, the traditional urbanization development mode needs to be replaced by the new efficient and sustainable development mode[4]. Cities should aim at pursuing efficiency, however, for a long time, the "growth" of Chinese cities has been equated with "development", and urban development is also unilaterally understood as the growth of urban economy, the expansion of scale and the change of structure. The characteristics of"high consumption, high pollution and low output"of urban economic growth are obvious, this kind of growth not only reduces the quality of urban development, but also wastes a lot of resources. However, a city is a complex and huge system including economy, society, resources and environment. How to effectively evaluate and improve the operation efficiency of this system is the key to improve the level of urban development[5]. Early scholars' research on urbanization mainly focused on urbanization construction and urbanization level. while the research on urbanization efficiency started relatively late, Analysis of existing literature shows that most of the early papers measure urban total factor productivity[6], there are also studies that combine the relationship between urbanization efficiency and economic development or other fields[7], and the focus of most papers is to construct the index system to evaluate the efficiency of urbanization, then on the basis of space-time difference, this study analyzes the factors which influence[8,9], and most of them used the comprehensive evaluation method, data envelopment analysis (DEA) and stochastic frontier analysis (SFA) to study different objects such as national, provincial and cities were studied[10-12]. Moreover, DEA method can also be applied to different industries and departments. At present, DEA has been widely used in regional economic research, logistics and supply chain management and bank evaluation. In Korea, there are studies on water supply efficiency with DEA [13], eco-efficiency in power plants with DEA [14], and kimchi-related manufacturers with DEA [15]. This study uses the sbm-dea model with non-expected output to study 31 provinces and cities in China, which is somewhat different from existing studies.

3. Analyze Method

3.1 CCR & BCC models

With the development of time, scholars have put forward various DEA models, including CCR model, CCGSS model, CCWH model and some extended models. Among these models, CCR model and BCC model are the most representative. The difference between the CCR model and the BCC model is that the CCR model assumes the constant return to scale remains unchanged(Constant Returns to Scale : CRS), while the BCC model is based on the CCR model and assumes that the return on scale is variable (Variable Return to Scale: VRS). The CCR model is an input oriented model. It is assumed that it is feasible only when all the decision making units operate at the optimal scale, but DMU cannot operate at the optimal scale due to some reasons. In this case, the BCC model with variable scale returns should be used.

3.2 Input and output index

At present, most studies on urbanization efficiency in China adopt traditional DEA method, However, due to the problem of multi-output in the development of urbanization, when evaluating the efficiency of urbanization, we should not only consider the expected output such as economy and social welfare level, but also take into account the environmental pollution, traffic accidents and other non-expected output. because they are part of urban development, non-expected output will have a great impact on urban efficiency, so it is not comprehensive to study urban efficiency by ignoring non-expected output. China has a vast country with uneven development levels in different regions, and there is a big gap in efficiency among different regions. This paper takes 31 provinces and cities as research objects. The data in this paper are from China Statistical Yearbook (2018), China Fire Yearbook (2018), and statistical yearbooks and statistical bulletins of provinces, autonomous regions and municipalities. Data analysis was performed using DEA-Solver 8.0 with the output of CCR and BCC models. Yuan Xiaoling analyzed the evolution characteristics of urban efficiency by using the number of employment, the local budget expenditure, the total investment in fixed assets of the whole society, the total amount of actually utilized foreign capital as input index, and GDP per capita, the local budget income, the total wages and the total retail sales of social consumer goods as output index[9]. Yang lei used the fixed assets investment, land area and the total number of employment as input index and output index to set the gross urban product to analyze the urban efficiency of guangdong province[10]. Zong Jiafeng use of input and output index are practitioners, the total capital stock, urban GDP, the total retail sales of social consumer goods and waste water, waste gas. Ren Yufei set by the input index is the total cost of the fixed asset investment, the actual use of foreign capital value, the urban area is, the amount of water, the total number of employees, energy consumption and output index is where GDP, gross industrial output value, fiscal revenue, the added value of the third industry emissions, waste water, waste gas emission, smoke emissions[2]. After summarizing and analyzing the existing literature, based on the principle of index selection of comprehensiveness, feasibility and authenticity, consider the results of previous studies based on the index system of urbanization evaluate the efficiency of this paper(shown in Table 1).

Input index: The most basic production input factors for economic activities are capital, land and labor. In this study, land resources, financial resources and human resources are selected as input index, the area of urban built-up area is used to represent land resources, the total

Table 1. Input and output indexes for DEA Analysis

Index	Index name	Unit
Input (X)	area of urban built-up area	km2
	total investment in fixed assets	100 million yuan
	financial expenditure	10 thounsand yuan
	number of employment	10 thounsand people
Output (Y)	ratio of tertiary industry	%
	financial revenue	10 thounsand yuan
	per capita consumption expenditure of residents	yuan
	fire accidents	piece
	traffic accidents	piece
	wastewater emissions	10 thounsand ton
	air pollutants	10 thounsand ton

investment in fixed assets and financial expenditure are used to represent financial resources, and the number of employment is used to represent human resources.

Output index: When cities develop, there will be expected and non-expected production. In this paper, the ratio of tertiary industry, financial revenue and per capita consumption expenditure of residents are used to represent economic development, the number of fire and traffic accidents are used to represent safety accidents, wastewater emissions and air pollutants are used to represent pollution emissions. In the analysis of impact index, data of municipal districts or built urban areas are basically adopted, this is because urbanization development focuses on municipal districts or urban built-up areas. And with the city's economic development, road construction, population is concentrated, building density, fires and the incidence of traffic accidents and other safety accidents will increase relatively, focuses on urban land use types in the second industry and the tertiary industry, impact on environment and resources, urban development problems such as high investment low output, so this study selected the number of fire occurrences, the number of traffic accidents, the wastewater and air pollutant emissions as undesired output index.

4. The Empirical Analysis

4.1 Efficiency analysis

According to the SBM-DEA model with non-expected outputs and the efficiency evaluation input-output index system determined in this study, the descriptive statistics of 31 provinces and cities in China in 2017 are as follows (shown in Table 2).

In the input index, the maximum, minimum, average and standard deviation of the urbanization completed area are respectively 5,911km^2, 148km^2, 1,814km^2 and 1,299km^2. The maximum, minimum, average and standard deviations of total fixed assets are 5.5203 trillion yuan, 197.6 billion yuan, 2.0517 trillion yuan and 1.4417 trillion yuan, respectively. It can be seen that there is a very large gap among 31 provinces

Table 2. Descriptive statistics of input-output factors in 2017

Index (Unit)	Max	Min	Avg	Sd.
area of urban built-up area	5,911	148	1,814	1,299
total investment in fixed assets	55,203	1,976	20,517	14,417
financial expenditure	15,037	1,373	5,588	2,842
number of employment	5,514	124	1,301	1,111
ratio of tertiary industry	81	42	50	8
financial revenue	11,320	186	2,951	2,445
per capita consumption expenditure of residents	39,792	10,320	18,372	6,709
fire accidents	21,549	116	9,080	6,185
traffic accidents	23,900	329	6,550	4,996
wastewater emissions	882,020	7,176	225,697	182,102
air pollutants	246	4	95	60

and cities in China. In the output index, the maximum, minimum, average and standard deviation of per capita consumption expenditure of urban residents are 39,792 yuan, 10,320 yuan, 18,372 yuan and 6,709 yuan respectively. The discharge of wastewater was 8820.2 million tons, 71.76 million tons, 2256.97 million tons, and 182.02 million tons respectively, which also showed great differences.

4.1.1 DEA - CCR Analysis

The input and output factors of 31 provinces and cities were analyzed by DEA-CCR model, focusing on the output, and the results of efficiency analysis of urbanization are shown as follows (shown in Table 3). The results of CCR-O efficiency analysis show that Tianjin, Shanghai, Hainan, Tibet, Qinghai and Ningxia had the highest urbanization efficiency, while the remaining 25 provinces, such as Beijing, Zhejiang, Jiangsu, Guangdong and Shandong, had relatively low urbanization efficiency. The urbanization efficiency of jilin, henan, guangxi, xinjiang and heilongjiang is less than 0.5, which indicates that the efficiency

Table 3. Efficiency score and ranking (CCR-O) & (BCC-O) of 31 provinces and cities in 2017

CCR-O			BCC-O		
DMU	Score	Rank	DMU	Score	Rank
Tianjin	1	1	Beijing	1	1
Shanghai	1	1	Tianjin	1	1
Hainan	1	1	Shanghai	1	1
Xizang	1	1	Guangdong	1	1
Qinghai	1	1	Hainan	1	1
Ningxia	1	1	Xizang	1	1
Beijing	0.9528	7	Qinghai	1	1
Zhejiang	0.8759	8	Ningxia	1	1
Jiangsu	0.8742	9	Jiangsu	0.9544	9
Guangdong	0.8554	10	Gansu	0.8908	10
Shandong	0.7485	11	Zhejiang	0.8761	11
Fujian	0.7335	12	Heilongjiang	0.8484	12
Shanxi(산서)	0.6983	13	Shandong	0.8087	13
Chongqing	0.6724	14	Shanxi(산서)	0.7822	14
Liaoning	0.655	15	Neimenggu	0.7589	15
Guizhou	0.6379	16	Guizhou	0.7415	16
Hebei	0.5926	17	Liaoning	0.738	17
Gansu	0.5774	18	Fujian	0.7346	18
Hubei	0.5685	19	Yunnan	0.7152	19
Jiangxi	0.5517	20	Chongqing	0.711	20
Anhui	0.5455	21	Jilin	0.7024	21
Sichuan	0.5366	22	Hunan	0.6928	22
Neimenggu	0.5342	23	Xijiang	0.6688	23
Shanxi(섬서)	0.5331	24	Sichuan	0.6671	24
Hunan	0.5143	25	Hebei	0.6493	25
Yunnan	0.5002	26	Guangxi	0.6448	26
Jilin	0.4981	27	Jiangxi	0.6041	27
Henan	0.4845	28	Shanxi(섬서)	0.604	28
Guangxi	0.4511	29	Hubei	0.5923	29
Xinjiang	0.4507	30	Anhui	0.5669	30
Heilongjiang	0.4488	31	Henan	0.5591	31

Table 4. Non-efficiency (input index) of 31 provinces and cities

DMU	Score	area of urban built-up area	total investment in fixed assets	financial expenditure	number of employment
Beijing	1.00	0.00	0.00	0.00	0.00
Tianjin	1.00	0.00	0.00	0.00	0.00
Shanghai	1.00	0.00	0.00	0.00	0.00
Guangdong	1.00	0.00	0.00	0.00	0.00
Hainan	1.00	0.00	0.00	0.00	0.00
Xizang	1.00	0.00	0.00	0.00	0.00
Qinghai	1.00	0.00	0.00	0.00	0.00
Ningxia	1.00	0.00	0.00	0.00	0.00
Jiangsu	0.95	9.57	16.96	0.00	7.91
Gansu	0.89	2.24	0.40	0.61	0.00
Zhejiang	0.88	12.42	12.38	0.00	11.79
Heilongjiang	0.85	7.12	2.74	0.78	0.00
Shandong	0.81	20.52	21.31	0.20	0.00
Shanxi(산서)	0.78	2.68	0.05	0.08	0.00
Neimenggu	0.76	3.04	3.87	0.61	0.00
Guizhou	0.74	0.78	3.58	1.08	0.00
Liaoning	0.74	11.00	0.00	0.00	0.05
Fujian	0.73	5.23	10.06	0.00	6.35
Yunnan	0.72	2.20	6.52	1.38	0.00
Chongqing	0.71	3.36	5.61	0.00	3.04
Jilin	0.70	4.80	3.79	0.19	0.00
Hunan	0.69	3.40	11.79	1.23	0.00
Xijiang	0.67	2.32	2.90	0.31	0.00
Sichuan	0.67	10.54	11.88	1.55	0.00
Hebei	0.65	6.75	12.46	0.46	0.00
Guangxi	0.64	3.50	7.16	0.52	0.00
Jiangxi	0.60	2.36	7.21	0.16	0.00
Shanxi(섬서)	0.60	2.17	8.71	0.22	0.00
Hubei	0.59	6.62	12.22	0.00	0.59
Anhui	0.57	5.46	10.94	0.00	1.47
Henan	0.56	5.00	16.61	0.34	2.02

of general budget expenditure of these five regions is quite different from that of other regions. From the perspective of regional division, the efficiency of Jilin and Heilongjiang in northeast China is less than 0.5, and only Liaoning has an efficiency of 0.655. In the eastern region of Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan the efficiency values are all above 0.5. In six provinces in central China, in addition to henan efficiency value did not reach 0.5, the rest of the Shanxi, Anhui, Jiangxi, Hubei, Hunan and other five provinces efficiency value is more than 0.5. In 12 provinces in western China, Guangxi and Xinjiang is less than 0.5, the efficiency of Xizang, Qinghai and Ningxia is 1,And Chongqing, Neimenggu, Sichuan, Guizhou, Yunnan, Shanxi, Gansu and other 7 to the efficiency value is between 0.6724 ~ 0.5002.

What is interesting in the analysis is that the urbanization efficiency of Tibet, Qinghai and Ningxia in the western region is relatively optimal because the factories or enterprises that pollute the environment are few and the ecological environment is superior.

Table 5. Non-efficiency (output index) of 31 provinces and cities

DMU	Score	ratio of tertiary industry	financial revenue	per capita consumption expenditure of residents	fire accidents	traffic accidents	wastewater emissions	air pollutants
Beijing	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tianjin	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shanghai	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guangdong	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hainan	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xizang	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qinghai	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ningxia	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jiangsu	0.95	0.24	0.00	0.88	0.01	0.25	0.01	2.56
Gansu	0.89	0.00	3.59	0.47	0.08	0.02	0.02	10.19
Zhejiang	0.88	0.20	0.00	0.85	0.02	0.43	0.02	3.14
Heilongjiang	0.85	0.00	5.89	0.56	0.06	0.03	0.06	9.69
Shandong	0.81	0.16	0.00	1.51	0.02	0.35	0.01	3.60
Shanxi(산서)	0.78	0.00	1.27	0.67	0.05	0.05	0.05	9.90
Neimenggu	0.76	0.00	2.26	0.00	0.06	0.00	0.02	9.39
Guizhou	0.74	0.00	0.00	0.71	0.04	0.07	0.02	6.89
Liaoning	0.74	0.00	2.21	0.12	0.13	0.10	0.12	9.91
Fujian	0.73	0.02	0.00	0.00	0.05	0.25	0.05	5.35
Yunnan	0.72	0.00	0.72	0.72	0.05	0.05	0.06	8.71
Chongqing	0.71	0.00	0.34	0.20	0.04	0.03	0.05	6.74
Jilin	0.70	0.00	3.94	0.14	0.06	0.06	0.04	8.21
Hunan	0.69	0.00	0.00	0.71	0.03	0.01	0.04	4.92
Xijiang	0.67	0.00	5.01	0.41	0.06	0.03	0.00	8.80
Sichuan	0.67	0.00	0.00	1.22	0.03	0.13	0.02	4.41
Hebei	0.65	0.00	0.00	1.13	0.01	0.15	0.01	4.64
Guangxi	0.64	0.00	3.24	0.57	0.04	0.00	0.05	7.57
Jiangxi	0.60	0.00	0.00	0.62	0.04	0.01	0.02	5.83
Shanxi(섬서)	0.60	0.00	0.42	0.33	0.05	0.03	0.03	7.38
Hubei	0.59	0.00	0.00	0.84	0.02	0.10	0.01	4.14
Anhui	0.57	0.00	0.00	0.68	0.02	0.11	0.01	5.39
Henan	0.56	0.00	0.00	1.11	0.01	0.00	0.02	4.39

4.1.2 DEA – BCC Analysis

Then, input and output factors of 31 provinces and cities were analyzed using dea-bcc model, model, focusing on the output, and the results of efficiency analysis of urbanization were as follows (shown in Table 3). The efficiency analysis results of BCC-O show that the efficiency of Beijing, Tianjin, Shanghai, Guangdong, Hainan, Xizang, Qinghai and Ningxia is 1, with the best relative efficiency. The efficiency of Jiangsu, Gansu, Zhejiang and 23 other provinces is relatively non-efficient, but its efficiency is also over 0.5. The efficiency of Hubei, Anhui and Henan is the lowest relatively, with 0.5923, 0.5669 and 0.5591 respectively.

4.2 Non-efficiency Analysis

From Table 4 and Table 5 we can know that jiangsu evaluation index is 0.95, if the area is in the city, the total amount of investment in fixed assets, fiscal expenditure, the percentage of the third industry, and per capita consumption

Table 6. Comparison between BCC and CCR model

DMU	CCR	BCC	Comparison
Gansu	0.577	0.89	
Guangdong	0.855	1	◎
Guangxi	0.451	0.64	
Guizhou	0.638	0.74	
Jilin	0.498	0.7	
Neimenggu	0.534	0.76	
Ningxia	1	1	◎
Liaoning	0.655	0.74	
Beijing	0.953	1	◎
Sichuan	0.537	0.67	
Shandong	0.749	0.81	◎
Shanxi(산서)	0.698	0.78	
Shanghai	1	1	◎
Shanxi(섬서)	0.533	0.6	
Xinjiang	0.451	0.67	
Anhui	0.546	0.57	
Yunnan	0.5	0.72	
Jiangxi	0.552	0.6	
Jiangsu	0.874	0.95	◎
Zhejiang	0.876	0.88	◎
Tianjin	1	1	◎
Qinghai	1	1	◎
Chongqin	0.672	0.71	
Xizan	1	1	◎
Fujian	0.734	0.73	
Henan	0.485	0.56	
Hebei	0.593	0.65	
Hainan	1	1	◎
Hunan	0.514	0.69	
Hubei	0.569	0.59	
Heilongjiang	0.449	0.85	
Average	0.693	0.79	

spending respectively increased by 9.57, 16.96, 7.91, 0.24 and 0.88, the fire number, the number of traffic accidents, the wastewater emissions and atmospheric pollutants emissions by 0.01, 0.25, 0.01 and 2.56 respectively, the efficiency can be promoted.

In other areas where the relative efficiency is less than 1, if the area of urban built-up area, total investment in fixed assets, financial expenditure, number of employment, ratio of tertiary industry, financial revenue and per capita consumption expenditure of residents are increased, the number of fire accidents, traffic accidents, wastewater emissions and air pollutants are reduced, also can achieve the optimal efficiency.

4.3 Comparison of DEA-CCR and BCC Analysis

In order to find out the inefficiency of economies of scale, we compared the efficiency results of BCC analysis and CCR analysis. The results are shown in the following table (shown in Table 6). It can be seen from Table 6 that 8 of the 31 provinces and cities in China are the most efficient. According to the data of Jiangsu, the efficiency score in the CCR analysis is 0.874, and the efficiency in the BCC analysis. The score is 0.95 and the value analyzed in BCC is higher. The efficiency scores in the BCC model and the CCR model are both 1 , the highest efficiency area is 6 regions in total, accounting for 16% of the total DMU. Beijing and Guangdong only achieved an efficiency of 1 in the BCC model, which indicates that the reason for inefficiency is that the economies of scale have inefficient.

5. Conclusion

This paper analyzes the urbanization efficiency of 31 provinces and cities in China by using SBM-DEA model. Input variables used in the analysis are area of urban built-up area, the total investment in fixed assets, financial resources table and the number of employment, and output variables are the ratio of tertiary industry, financial revenue, per capita consumption expenditure of residents, number of fires accidents, number of traffic accidents, waste water emission and air pollutant emission. Through the study, we find that the urbanization efficiency in the eastern region is the highest, followed by the urbanization efficiency in the central and northeast regions, and the

urbanization efficiency in the western region is the lowest. The urbanization efficiency in China generally shows a pattern of decreasing from the eastern coastal region to the inland region. The relative efficiency of urbanization in various regions is uneven. In Xizang, Qinghai and Ningxia, as the population is less and the government's fiscal spending is bigger, so as to measure the efficiency of urbanization is higher.

Based on the above analysis results, we can get the following Implications. First, we should change the pattern of urban economic growth. The initial extensive, inefficient, high consumption and pollution urbanization is not the real urbanization. From a long-term perspective, we should take a new road of urbanization that relies on science and technology for intensive, high efficiency, low consumption and environmental protection, and should also pay attention to the economical and scientific use of water resources, energy, improve the comprehensive utilization efficiency of resources, the development of circular economy.

Secondly, the scale of the city is not the bigger the better, urban agglomeration is to have effect, all kinds of industries are in a city, led to the division of professional level is very low, it is difficult to improve the efficiency of the city, need to promote the industrial structure. Promote the adjustment of traditional industrial structure and energy structure through the leading role of scientific and technological innovation, reduce resources and environmental consumption in urbanization development, and vigorously develop new economic forms with high technological content, good economic returns, low resource consumption, and low environmental pollution.

thirdly, there are significant differences in urbanization efficiency and sources of efficiency loss among the 31 provinces and cities. In order to improve urbanization efficiency, it is necessary to take into full consideration the resource situation, environmental bearing capacity, characteristics of development stage and development potential of each region, and make targeted urbanization efficiency improvement plans according to local conditions.

This study is limited in that it does not reflect the past trend only by conducting cross-sectional analysis for one year in 2017, and it is necessary to comprehensively evaluate urbanization efficiency by conducting additional longitudinal area analysis in the future.

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