Statistical Analysis of the Economic Level of Beijing, China

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Abstract According to the data of economic development in Beijing from the year 1995 to 2007, relevant economic indices are selected to analyze the economic development level of Beijing by the Principal Component Analysis Method. Result shows that the national economy maintains high, sustainable and stable development in the years 1995 -2007. Both the primary and secondary industry output values have increased year by year; and the tertiary industry output value has grown rapidly. The annual gross domestic product, the output value of tertiary industry, and the total retail sales of consumer goods have the greatest impact on economic level of Beijing. Output value of secondary industry is the growth ability factor in economic environment. Empirical analysis shows that there are a number of problems in Beijing during the rapid development of economy, such as serious urban pollution, irrational industrial structure, lack of natural resources, rapid development of city scale, and lack of radiation on the surrounding area. Therefore, suggestions are put forward accordingly, including consolidating the functions of national political and cultural center, strengthening the infrastructure of Beijing, perfecting the social security system, improving the industrial competitiveness, and seizing the technological frontier and high-end chain, so as to accelerate the economic development of Beijing, to improve the relevant systems and policies and to provide references for the policy making of government.

Key words Economic level; Principal Component Analysis; SPSS statistical software; China

Socio-economic development is an integrated system of coordinated development of various departments and industries. And comprehensive statistical analysis can help to formulate the macroeconomic policy and regulate the coordinated development of various industries[1]. Beijing, a famous historical and cultural city, is the hub of international exchange and the political and cultural center of China with convenient geographic location and good natural condition. Beijing, together with Xi'an, Luoyang, Kaifeng, Nanjing and Hangzhou, are called the six ancient capitals of China. Since the reform and opening up, economic development of Beijing has been faster than the national average. Although some scholars have carried out researches on the economy of Beijing according to some economic indices, there are few researches using quantitative analysis. Thus, they can not reflect the economic development level of Beijing effectively. Based on this, economic development level of Beijing is analyzed by Principal Component Analysis Method according to the relevant data in Beijing. And the existing problems and rules are found out and corresponding suggestions are put forward in order to realize the sustainable development of economy in Beijing and to offer references for the policy making of governments.

1 Index selection, data source and research method

1.1 Index selection In order to comprehensively and systematically analyze and evaluate the economic development level of Beijing, a total of 10 economic indices in the years 1995 -2007 are selected, which are annual total output value (X_1), total output value of primary industry (X_2), total output value of secondary industry (X_3), total output value of tertiary industry (X_4), total investment in fixed assets (X_5), total retail sales of consumer goods (X_6), financial revenue (X_7), financial expenditure (X_8), total wages of staff and workers (X_9), and output value of agriculture, forestry, fishery and animal husbandry (X_{10})[2] (Table 1).

1.2 Data source Research data in Table 1 are mainly from the 1996 -2008 *Beijing Statistical Yearbook*[2].

1.3 Research method SPSS software is used to analyze the economic development level of Beijing in the years 1995 -2007 by Principal Component Analysis, in order to determine the main factors affecting the economic development level of Beijing in recent years, to find out existing problems and to explore the ways for optimization of economic development.

2 Result and analysis

2.1 Economic development of Beijing According to the data in Table 1, SPSS software is used to analyze the output values of three major industries in Beijing in the years 1995 -2007. Fig. 1 illustrates that under the guidance of correct economic policy, national economy of Beijing has maintained high, sustainable and stable development since the year 1995. GDP has increased from 108 403 million yuan in the year 1995 to 935 330 million yuan in the year 2007, showing a steady increasing trend. Output values of primary and secondary industries are increasing year by year and that of tertiary industry has increased sharply. Among all the GDP in Beijing, output value of tertiary industry accounts for a relatively large proportion, while that of primary industry occupies relatively small proportion. This indicates that the range of tertiary industry is ever-widening in Bei-

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jing, showing a good momentum of development.

Table 1 Economic development index of Beijing in the years 1995 – 2007 $\times 10^8$ yuan

Year	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1995	1 084.03	74.77	499.84	509.42	864.85	827.00	115.26	154.40	382.00	164.47
1996	1 615.73	83.46	683.14	849.13	889.66	923.70	150.90	187.43	442.40	168.92
1997	1 810.09	84.85	738.56	986.68	989.71	1 051.50	182.32	236.40	514.80	170.86
1998	2 376.00	76.70	840.60	1 458.70	1 155.60	1 373.60	265.61	227.33	558.20	174.00
1999	2 677.60	77.10	907.30	1 693.20	1 170.60	1 509.30	320.44	279.09	614.50	180.60
2000	3 161.00	78.60	1 033.30	2 049.10	1 297.40	1 658.70	398.39	345.00	695.50	188.60
2001	3 710.50	80.80	1 142.40	2 487.30	1 530.50	1 831.40	507.68	451.17	777.30	202.20
2002	4 330.40	84.00	1 250.00	2 996.40	1 814.30	2 005.20	600.96	533.99	950.90	213.50
2003	5 023.80	89.80	1 487.20	3 446.80	2 157.10	2 296.90	665.94	592.54	1 098.90	224.70
2004	6 060.30	95.50	1 853.60	4 111.20	2 528.30	2 626.60	830.03	744.49	1 315.10	234.90
2005	6 886.30	98.00	2 026.50	4 761.80	2 827.20	2 902.80	1 007.35	919.21	1 520.10	239.30
2006	7 861.00	88.80	2 191.40	5 580.80	3 371.50	3 275.20	1 235.78	1 117.15	1 805.50	240.20
2007	9 353.30	101.30	2 509.40	6 742.60	3 966.60	3 800.20	1 882.04	1 492.64	2 194.30	272.30

2.2 Principal Component Analysis Principal Component Analysis is conducted by SPSS software. SPSS system solves the principal component according to the correlation matrix of primitive variable after standardization. Therefore, during the standardization treatment of raw data, the principal component, eigenvalue, eigenvector and associated values are all the values with standardized processing[3-6].

2.2.1 Output of correlation coefficient matrix. SPSS software is used to obtain the correlation coefficient matrix of original variables. Table 2 reports that expect the relatively low correlation coefficient between financial expenditure and other 9 variables, correlation coefficients among other variables are all relatively high. Thus, principal component can be extracted.

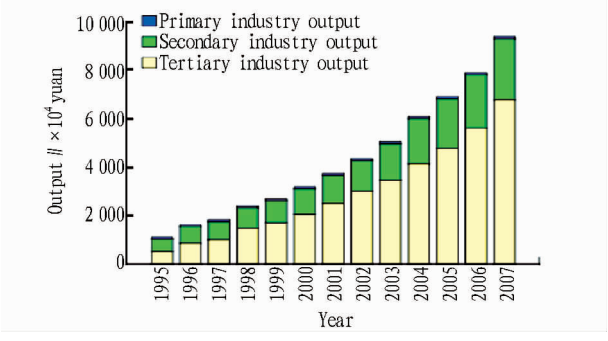

Fig. 1 Output values of three industries in Beijing in the years 1995 – 2007

Table 2 Correlation coefficient matrix

Index	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	1.000	0.858	0.997	1.000	0.994	0.998	0.977	−0.289	0.994	0.985
X_2	0.858	1.000	0.879	0.849	0.859	0.836	0.833	−0.028	0.860	0.882
X_3	0.997	0.879	1.000	0.995	0.991	0.994	0.965	−0.272	0.990	0.982
X_4	1.000	0.849	0.995	1.000	0.994	0.998	0.979	−0.295	0.994	0.985
X_5	0.994	0.859	0.991	0.994	1.000	0.989	0.983	−0.267	0.999	0.975
X_6	0.998	0.836	0.994	0.998	0.989	1.000	0.973	−0.308	0.989	0.984
X_7	0.977	0.833	0.965	0.979	0.983	0.973	1.000	−0.262	0.988	0.957
X_8	−0.289	−0.028	−0.272	−0.295	−0.267	−0.308	−0.262	1.000	−0.251	−0.305
X_9	0.994	0.860	0.990	0.994	0.999	0.989	0.988	−0.251	1.000	0.972
X_{10}	0.985	0.882	0.982	0.985	0.975	0.984	0.957	−0.305	0.972	1.000

2.2.2 Extracted principal component. Table 3 reports the explanatory variables by Principal Component Analysis Method based on SPSS software. According to the principles of principal component extraction, the first principal component can explain the 97.185% information of total variance of the original variables. And the second to the tenth principal components have small eigenvalues, which can be ignored. Therefore, if we extract the first principal component, the overall result of principal component analysis is ideal, and the information loss of the original variables is relatively less.

2.2.3 Analysis of gravel of principal component. According to the output result of SPSS software, gravel of principal component is obtained. Fig. 2 illustrates that eigenvalue of the first principal component is big and its contribution to the interpretation of the original variables is the maximum. Eigenvalues after the second principal component are all small and so do their contribution to the interpretation of the original variables. Therefore, it is appropriate to extract one principal component.

2.2.4 Result analysis. Based on the output result of SPSS software, Table 4 reports that the first principal component has nearly similar positive loads to all the variables, that is, all the coefficients are near 0.995. Therefore, it can be regarded that measurement on all the economic indices reflects the overall level of economic situation in Beijing. Among them, annual total output value, total output value of tertiary industry, and total retail sales of consumer goods have the greatest impacts.

Table 3 Analysis of explanatory variable

Principal component	Initial eigenvalue			Total load of extracted ingredient		
	Total value	Proportion of variance//%	Total accumulated value//%	Total value	Proportion of variance//%	Total accumulated value//%
1	8.748	87.475	87.475	8.748	87.475	87.475
2	0.987	9.869	97.345			
3	0.189	1.887	99.232			
4	0.045	0.453	99.685			
5	0.023	0.227	99.912			
6	0.007	0.071	99.983			
7	0.001	0.010	99.993			
8	0.001	0.005	99.998			
9	0.000	0.002	100.000			
10	1.584E-16	1.584E-15	100.000			

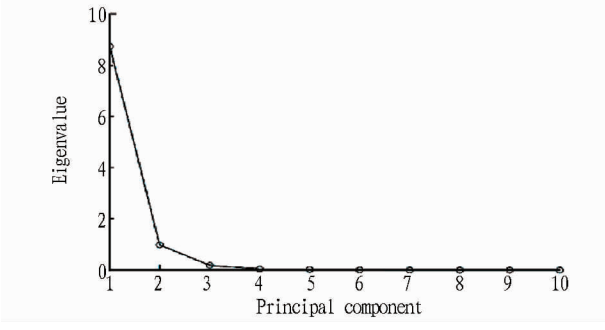

Fig. 2 Gravel of principal component

Table 4 Analysis of initial solution by principal component

Index	Coefficient	Index	Coefficient
X_1	0.998	X_6	0.994
X_2	0.880	X_7	0.980
X_3	0.996	X_8	−0.292
X_4	0.997	X_9	0.995
X_5	0.995	X_{10}	0.989

Research finds out that the information reflected by the first principal component is not only comprehensive but also concentrative, showing the economic fundamental factors in economic environment. Thus, development of the 10 indices can be effectively improved so as to achieve the overall improvement of economic level. Especially, we should pay attention to the three variables of annual total output value, total output value of tertiary industry, and total retail sales of consumer goods. Although the second principal component can not reflect information as concentrative as the first principal component, the two indices having the maximum factor loads (the annual total output value and the total output value of secondary industry) show that the total output value of secondary industry is the growth capacity factor in economic environment. Therefore, improvement of the total output value of secondary industry can stimulate the economic growth of other industries during development, which is conducive to the rapid and steady growth of economy in Beijing (Table 3).

3 Major problems in the economic development of Beijing

Analysis shows that economic development of Beijing has achieved remarkable results. Total economy is continuously improved and the historic leap is realized. Industrial structure has entered into the high-end stage. Bejing has developed from a major industrial base to the service economy city with tertiary industry as the core. Economic growth has changed from extensive mode to intensive mode. And the international standard and openness degree have been improved. However, there are still some problems in the rapid economic development of Beijing.

3.1 Lack of natural resources Beijing, a resource import city, is short of land resources and water resources. A total of 94% coal, 70% electricity, 100% natural gas, 100% oil, and 60% oil products should be transferred from the outside. According to the *Beijing Statistical Yearbook*, total water resource of Beijing in the year 2007 is about 2760 million cubic meters in Beijing in the year 2007. Taking population in 2007 as the cardinal number, per capita water resource of Beijing is only 171.7 cubic meters, which is far lower than the minimum national standard of 1 000 cubic meters and Beijing belongs to severe water shortage area. Besides, land resource in Beijing is increasingly tight, available land area in all is 16 410.54 square kilometers in the year 2007 and the unused land is only 2 086.58 square kilometers in Beijing. At the same time, consumption of land resources is too fast. Since the year 1999, average growth speed of land consumption is 73.4% in Beijing, which is far greater than the speed of economic growth during the same period. The increasingly tense relationship between supply and demand of land resources has become an important influencing factor restricting the rapid economic development of Beijing.

3.2 Rapid expansion of city size With the accelerated urbanization process, population has expanded rapidly in Beijing and is beyond the carrying capacity of urban infrastructure, water, land and other natural resources, which seriously restricts the construction and development of capital Beijing. Negative externality of agglomeration is the source of "City Disease". Although urbanization has brought the benefit of increasing returns to scale for the presentative agglomeration, it also causes a series of problems, such as traffic jam, dense space, environmental deterioration, and gap between rich and poor. Accumulated external costs can offset the scale economy effect. As the national center, the trend of concentration in Beijing has become the self-reinforcing cumulative circulation. And its negative externality will not be automatically reduced before the col-

lapse of growth. On the contrary, it will become more serious[7]. Therefore, it is necessary to take corresponding measures to actively deal with the equilibrium segregation duality during economic growth.

3.3 Serious urban environmental pollution Due to the concentrated population, the rapid development of economy and society, and the irrational use of energy, urban environmental problems have become increasingly prominent. Both winter heating and automobile exhaust emission are the culprit in causing air pollution in Beijing. Stable and rapid development of society and economy will increase the energy consumption and waste generation and cause more pressure on the fragile environment. At the same time, with the fortified function of Beijing and the significant improvement of people's lives, residents will have higher requirements for environment. Sustainable development of environmental protection and improvement is a long and arduous task.

3.4 Lack of radiation on the surrounding area Economy in Beijing has strong agglomeration, but it has weak dominant influence on the surrounding suburbs and regional economy around Bohai. This indicates that as the economic center, Beijing can not effectively integrate the economic resources in surrounding area to form the regional resultant force of economic development. However, with the increasingly saturated economic capacity in Beijing, economic growth will rely more on the growth of surrounding areas.

3.5 Irrational industrial structure Although adjustment of the overall structure of three industries has been basically put in place, proportions of primary, secondary and tertiary industries are 1%, 27% and 72% in the year 2007, respectively, which is close to the level of central city in developed countries. However, there is still considerable space for the improvement of internal structure and growth quality of industries. According the statistics, proportion of heavy industry is still very high, making great contribution to GDP. However, added value and earning rate of production are relatively low due to the lack of autonomous technology and intellectual property. Although producer service develops rapidly, high-end service is still under insufficient supply. Besides, overall division of labor, service standard and specialization degree need to be improved. And the service depends greatly on the manufacturing industry with limited scale in Beijing; the insufficient extraversion service has hindered the continuous, healthy and stable development in Beijing.

4 Countermeasures

4.1 Strengthening the functions of national political and cultural center of Beijing As the capital of China, Beijing should energetically strengthen the urban facilities of political center, economic regulation and control center, information center, and traffic center. As the cultural center of China, Beijing should set up large-scale cultural and sports facilities in key sections representing the highest and latest achievements of China and having guiding significance to the country. Meanwhile, Beijing should further develop cultural industry, and establish regional cultural facilities and cultural street.

4.2 Perfecting the construction of infrastructure Since the reform and opening up, infrastructure construction has been accelerated significantly in Beijing. However, rapid growth of urban population requires better water supply system, gas system, electric power construction, sanitation facilities, urban greening, road traffic, and network communication. Therefore, government in Beijing should adopt corresponding measures to increase investment and to further improve infrastructure.

4.3 Improving the social security system Government should further improve the consciousness and cultural level of urban residents, enhance the concept of sustainable development of citizens, establish a sense of security for their future life, build a good community environment, improve the community supply, community security and other functions, perfect the employment and re-employment system, and social insurance system, social welfare system and social assistance system, and set up pension fund system to meet the challenges of an aging society.

4.4 Enhancing industrial competitiveness Under the background of economic globalization, domestic and foreign development experience of industrial cluster shows that industrial cluster development has become the strategic choice of economic development in countries all over the world with the detailed division of labor, the transformation from comparative advantage in to competitive advantage, and the strategy evolution of market competition from enterprise development strategy to industrial cluster strategy[8]. Economic development of Beijing should take the development of industrial cluster as a strategic selection to form scale effect and to improve the domestic and international competitiveness of industry.

4.5 Preempting the frontier science and technology and the high end of industry chain According to the development history of international city, life science development of New York and the high-end products development of industrial chain in Tokyo have played an important part in maintaining the competitiveness of city[9]. Compared with other cities in China, science, technology and education resources in Beijing City are the forefront, which have the optimal advantages to preempt the technology-intensive industries, capital-intensive industries, and the industries at high-end chain[10].

4.6 Complementary development between service and industry Beijing has become one of the world cities with advanced service industry and financial industry. And development of industry and the openness of multinational corporations are the basis for the development of service industry. According to statistics, growth of the secondary industry is the dynamic factor of the economic growth of Beijing, while output value of tertiary industry is the main component of total economic quantity in Beijing. Therefore, Beijing should further accelerate the development of industry, achieve industrial modernization, actively promote the development of economy, and realize the complementary development between service and industry.

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基于主成分投影模型的西北农村生态校园经济效益评价及应用

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摘要 选取财务成本效益(投资收益率、财务净现值、益本比)、社会经济效益(医疗费用节省率和培训过的农民户均增收率)、技术经济效益(冲厕节水率、病虫害减少率、果业或蔬菜增收率和工人技术水平提高率)和生态经济效益(造林费用节省率、CO_2 减排率、SO_2 减排率、土壤改良、化肥节约率)共 4 个 1 级指标 14 个 2 级指标,依据 3 种不同模式生态校园的经济效益的原始调查数据,利用主成分投影评价法,采用功效系数变换法对指标值进行归一化处理,在将矩阵元素进行无量纲化处理的基础上,探讨了我国西北农村生态校园模式经济效益评价指标权重的计算方法,建立了生态校园经济效益评价的主成分投影评价模型。结果表明,从财务成本的角度来说,3 种生态校园模式的经济效益并不是很显著,在实现生态效益的同时也实现了其经济效益;从主成分投影评价模型的总体评价结果来看,猪、厕 - 沼 - 菜模式整体经济效益最佳,草 - 羊、厕 - 沼 - 果次之,厕 - 沼 - 菜最差,具有的较强实际意义,为全国其他地区农村中小学进行生态校园建设的经济效益评价研究和推广提供理论基础。
关键词 农村生态校园;经济效益;评价;主成分投影

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北京市经济水平统计分析

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摘要 依据 1995 ~ 2007 年北京市经济发展的相关数据,选取相关经济指标,采用主成分分析法对 1995 ~ 2007 年北京市经济发展水平进行分析。结果表明,1995 ~ 2007 年国民经济保持高速、持续、稳定的发展,第一、二产业产值均逐年递增,第三产业产值增长迅猛;年生产总值、第三产业总产值和社会消费品零售总额对北京市经济水平情况影响最大,第二产业总产值是北京市经济环境中的增长能力因子。通过实证分析发现,在经济高速发展的同时,北京市经济发展过程中存在着自然资源匮乏、城市规模发展过快、城市污染严重、缺乏对周边地区的辐射能力、产业结构不合理这一系列问题,为此,有针对性地提出强化全国政治中心、文化中心功能、加强北京基础设施建设、完善社会保障体系、提升产业竞争力、抢占科技前沿和产业链的高端等对策建议,以期加快北京经济发展,完善相关制度和政策,为政府制定相关政策提供依据。
关键词 经济水平;主成分分析;SPSS 统计软件