Economic Effects of the Modern Information Service Industry in China: Evidence from Beijing

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Abstract The Modern information service industry plays an important role in the development of China's national economy. In this chapter, from five aspects of the output effect, capital formation effect, technology progress effect, employment effect and industrial effect, an economic effect evaluation index system including 16 indicators is constructed. And taking Beijing as an example, economic effect evaluation is studied from 1995 to 2013 using factor analysis. The results show that the 3 common factors extracted—called technology factor, output factor, and capital factor by rotation—explains 87.775 % of the original variable information, in which the weight of the Technology factor is the largest at 0.789, and the effect on local economy continuously improves. Therefore, technological progress and employment effects should be paid more attention for modern information service industry in China.

Keywords Modern information services industry · Economic effect · Factor analysis

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1 Introduction

With the promotion of infrastructure, expansion of new markets, and diversified improvement of Internet programs, the modern information service industry in China has developed rapidly to a new rational stage. In Beijing, modern information service, with the advantages of location, policy, and talent, gains more opportunity for priority development. In 2013, the growth rate of information transmission, computer services, and software industry was 7.9 % in Beijing, and gross industrial production is 174.96 billion RMB, which is 9.0 % of Beijing's GDP and 11.67 % of the service sector's GDP. Thus, the development degree of modern information service industry has become an important measurement of a country's or region's development level n terms of modernization and comprehensive economic strength.

Some scholars have studied the development of the information service industry from different aspects. Landrum and Prybutok proposed and tested a model of library success that showed how information service quality relates to other variables associated with success [1]. Andergassen and Nardini proposed a simple model where long waves of innovation arise from the endogenous propagation of information among industries [2]. Hung analyzed the information service industry in Taiwan to build the measurement indicators for IC [3]. Zhao and Wang analyzed the location quotient of industry competitiveness of the modern information service industry in Beijing city and showed that the comprehensive competitiveness was in a leading position in the country, but it was also facing the problem of lack of innovation and content standards and norms, such as the lack of international competitiveness [4]. Hu and Liu focused on the system construction of the information service industry and research of institution operation on the basis of industrial institution. They constructed an input-output model to reflect the relationship between input and output, the correlation effect, and the ripple effect on the modern information service industry [5].

Regarding existing research on modern information service industry, most of the research focused on the development of the industry itself, not deeply involved in association with the economic effect, and lacked a comprehensive analysis of economic effect for the modern information service industry. Because different indexes are often used to investigate the ability of the economic effect, a unified economic effect evaluation index system has not yet been developed for the purpose of improving regional industry development and providing strong support for economic development.

2 Construction of the Evaluation Index System

According to the development characteristics of the industry and the impact on the economy, and following scientific systematic optimization and practical design principles, the economic effect evaluation index system of the modern information

Table 1 Economic-effect evaluation index system

Target layer	Criteria layer		Indicator layer	Calculation method
Economic effect	Direct economic effect	Output effect	Profit ratio of sales (X1)	Gross profit/sales revenue (%)
			Proportion of output value of industry (X2)	Output value of industry/output value of region (%)
			Sales revenue growth rate (X3)	Sales revenue growth/sales revenue last year (%)
			Output growth rate (X4)	Output growth/output value last year (%)
		Capital formation effect	Growth rate of fixed-asset investment (X5)	Fixed-asset investment growth/fixed-asset investment last year (%)
			Proportion of fixed-asset investment (X6)	Fixed-asset investment/output value (%)
			Proportion of fixed-asset investment of industry (X7)	Fixed-asset investment of industry/fixed-asset investment of region (%)
	Indirect economic effect	Technical progress effect	Labor productivity (X8)	Industrial-added value/average number of employees (million Yuan/person)
			R&D expenditure (X9)	R&D internal expenditures (billion Yuan)
			Quantity of scientific achievement (X10)	Number of chapter and book (number)
			Quality of scientific achievement (X11)	Number of award-winning achievements (number)
		Employment effect	Quantity of labor force (X12)	Number of urban employees at the end of the year (person)
			Labor cost (X13)	Average salary of urban employees (Yuan)
			Quality of labor force (X14)	Number of R&D personnel (person)
		Industrial effect	Industrial structure effect (X15)	Output value of industry/output of tertiary industry (%)
			Industrial agglomeration effect (X16)	Output value of Zhongguancun Science and Technology Garden (billion Yuan)

service industry is constructed from two aspects of direct effect and indirect effect. The economic effect is further divided into the output, capital formation, technical progress, employment, and industrial effects. Among them, the output and capital formation effects are regarded as the direct economic effect; the technical progress, employment, and industrial effects are regarded as indirect economic effects. Through analysis of the main influence factors on the 5 aspects, 16 indicators were selected as the subordinate indicators as shown in Table 1.

3 Empirical Analysis

In this chapter, the definition of modern information service industry is made according to “Beijing information service industry classification.” Considering the availability of relative data, the information transmission, computer services, and software industry as variables is analyzed in China from 1995 to 2013. The data come from China Statistical Yearbook, Beijing Statistical Yearbook, Electronic Information Industry Statistics Yearbook, and China’s software and information development report. Because there are strong correlations between the evaluation indicators, the factor analysis method was adopted.

3.1 KMO and Bartlett’s Test

Using SPSS software, factor analysis was performed on the original data. The results of KMO and Bartlett tests on correlation between variables showed that the KMO value is 0.71, the Bartlett value is 559.432, and the probability value $P < 0.000$. Therefore, the correlation coefficient matrix is not a unit matrix, and the factor analysis method is suitable.

3.2 Factor Extraction

Table 2 shows the list of the total variance explained in 16 original variables during the process of factor analysis. It can be seen that the characteristic roots of the first factor (F1) is 11.079, which explains 69.244 % of the total variance; the characteristic root of the second factor (F2) is 1.802, which explains 11.259 % of the total variance; and the characteristic root of the third factor (F3) is 1.163, which explains 7.272 % of the total variance; and the cumulative variance contribution rate of the first three factors is 80.503 %. Therefore, F1, F2, and F3, the three common factors, are extracted in the next step, which basically retain the original variables information and has the role to reduce the dimension.

Table 2 Total variance explained

Initial eigenvalues				Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	11.079	69.244	69.24	11.079	69.24	69.244
2	1.802	11.259	80.5	1.802	11.26	80.503
3	1.163	7.272	87.78	1.163	7.272	87.775
4	0.857	5.356	93.13			
5	0.52	3.248	96.38			
6	0.237	1.479	97.86			

3.3 Factor Rotation

The further transformation of rotation is implemented using Varimax rotation with the Kaiser normalization method. Table 3 shows the rotated component matrix.

As shown in Table 3, the factor loadings of the indicators of labor productivity (X8), R&D expenditure (X9), scientific achievement (X10, X11), quantity of labor force (X12), labor cost (X13), and quality of labor force (X14) are higher in the first factor (F1), so it can be called the "technology factor." The higher factor loadings for the second factor (F2) appear in the indicators of the proportion of output value of industry (X2), output growth rate (X4), and industrial structure effect (X15). Therefore, the second factor (F2) can be called the "output factor." The third factor (F3), which has higher factor loadings in the growth rate of fixed-asset investment (X5), proportion of fixed-asset investment (X6), and proportion of fixed-asset investment of industry (X7), is regarded as the "capital factor." Compared with the component matrix, factor rotation has obvious separation effect for factor loadings so that each factor represents the more prominent economic significance.

Table 3 Rotated component matrix

	Component				Component		
	1	2	3		1	2	3
X1	0.904	−0.123	0.155	X9	0.986	−0.028	0.061
X2	0.884	0.345	−0.187	X10	0.971	−0.01	0.126
X3	0.399	−0.341	−0.354	X11	0.962	−0.044	0.137
X4	−0.354	0.828	−0.204	X12	0.983	−0.051	0.053
X5	0.199	−0.163	0.888	X13	0.996	0.028	0.002
X6	−0.75	0.186	0.385	X14	0.954	−0.129	0.104
X7	−0.813	−0.244	0.346	X15	0.583	0.736	0.037
X8	0.957	0.002	0.088	X16	0.984	0.004	0.049

Table 4 Composite score from 1995 to 2013

Year	F1	F2	F3	Total score	Year	F1	F2	F3	Total score
1995	−1.1209	−1.6179	0.0454	−1.07	2005	0.0423	1.3238	0.3082	0.09
1996	−1.0927	−1.6623	0.1618	−1.04	2006	0.1714	0.6920	0.9683	0.12
1997	−0.9924	−1.1981	−0.0472	−0.93	2007	0.4433	0.8453	0.2694	0.47
1998	−0.8716	−0.7303	0.2367	−0.75	2008	0.6839	0.1108	0.4611	0.51
1999	−0.9229	0.1595	0.3424	−0.68	2009	0.9437	0.4909	1.1384	0.8
2000	−0.9497	0.63019	1.0768	−0.57	2010	1.1183	1.2960	1.6766	0.57
2001	−0.7469	1.50241	1.4120	−0.28	2011	1.2550	0.6009	1.5037	0.91
2002	−0.6397	1.0759	−0.5981	−0.44	2012	1.6548	0.4501	1.6064	1.41
2003	−0.5090	1.0497	−0.2813	−0.31	2013	1.8968	0.5180	1.1548	1.55
2004	−0.2789	−0.0269	−1.6074	−0.38					

3.4 Factor Scores

Next, according to formula (1), total factor scores from 1995 to 2013 are calculated to reflect the economic effect of the modern information service industry in Beijing; the results are shown in Table 4.

$$Y = \frac{\lambda_1 F_1 + \lambda_2 F_2 + \lambda_3 F_3}{\lambda_1 + \lambda_2 + \lambda_3} = 0.789F_1 + 0.115F_2 + 0.096F_3 \tag{1}$$

From the calculation results, the total scores of economic effect indicate that the impact on the local economy of the modern information service industry continues to improve. From formula (1), the weight of the technology factor is the largest, 0.789, which shows that the impact of technological progress and employment should be paid more attention in the modern information service industry. Compared with the other two factors, the technology factor has maintained steady growth in the past 10 years. In fact, both the amount of labor and labor quality have obviously improved, which makes a great contribution to the comprehensive factor score from 1995 to 2013. Because of the impact of the financial crisis, in recent years the score of the output factor appears to show a decreasing trend. In addition, the score of the capital factor violates significance, and it is not difficult to see that investment in the modern information service industry has improved since 2012.

4 Conclusion

The influence of the modern information service industry on the national economy shows both direct and indirect effects, which are specifically reflected in the five aspects of the output, capital formation, technology progress, employment, and industrial effects. As an example, using factor analysis, the economic effect in Beijing is measured by the evaluation index system including 16 indicators. The 3 common factors extracted by factor rotation—technology, output, and capital—together explain 87.775 % of the original variable information from 1995 to 2013, and the impact on the local economy of the modern information service industry in Beijing continues to improve from the view of comprehensive scores. In fact, the value of the modern information service industry remains at approximately 8 % of the area's GDP in recent years, and its growth rate is significantly higher than that of all industries in most years.

However, in Beijing, most of the information service enterprises are still in relatively small in scale, in which the number of employees is fewer than 100 people, and the enterprises with >500 employees accounts for only 5.3 % of all. At present, the proportion of corporate R&D investment for the modern information service industry in Beijing is less than one third of the international well-known enterprises. Basic software R&D ability is relatively backward: For example, in 2012 China's mobile intelligent terminal shipments amounted to 600 million, ranking first in the world, but all of the native operating system belonged to foreign brands. These are known to be the main factors hindering the economic effect of the industry from the above-mentioned factors. Therefore, it should further be emphasized to expand the variety of financing channels, strengthen technology R&D, pay attention to personnel training, and improve the competitiveness of the industry.

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