

# Study on Development of Sharing Economy Based on Principal Component Analysis

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**Abstract**— With the widespread penetration of the sharing economy in all fields of economy and society, its contribution to economic development has become more and more remarkable. The development of sharing economy has positive significance for achieving high speed growth and successful transformation under the new normal economy of our country. Based on the review and analysis of the research results of the sharing economic theory, this paper establishes a sharing economic development index system, and uses principal component analysis to calculate. Finally, some suggestions and Countermeasures for the development of sharing economy are put forward.

**Keywords**— Sharing economy, Principal component analysis.

## I. INTRODUCTION

The sharing economy is a synthesis of economic activities that an individual uses his idle resources to share with others through the Internet platform to gain profits. It is a new economic model that emerges after the development of modern information technology to a certain stage. It typically includes an information technology-based marketplace created by third parties that individuals used to share their belongings, knowledge or experience or to raise funds for businesses and projects. The sharing economy began to emerge in the United States as early as around 2000, but its substantial growth came after the financial crisis of 2008. With the emergence of a series of physical sharing platforms such as Uber and Airbnb, sharing started from purely unpaid sharing, information sharing, Toward a certain level of remuneration for the main purpose of "sharing economy" and formed a wave in the world. With the extensive penetration of the shared economy in all fields of economy and society, the continuous innovation and maturation of the business model, the contribution rate of the sharing economy to economic development will also significantly increase. At present, the sharing economy is mainly active in the service industries related to people's lives such as transportation, housing, education, medical care, housekeeping and finance. It is not difficult to predict that the future will rapidly penetrate into more productive fields. Sharing the economy has triggered many new phenomena and new problems that require continuous follow-up. However, no consensus has been reached on the definition, characteristics and scope of the sharing of the economy. The current statistics on national economy in our country still cannot accurately reflect the impact of the sharing economy on economic growth and employment, as well as the statistical basic work such as the relevant statistical standards, institutional methods and accounting methods to be built. Therefore, this article attempts to build a comprehensive index system of sharing economic development level to characterize the development trend of sharing economy, use Principal Component Analysis (PCA) to measure the development index of sharing economy, and analyze the current situation of sharing economy.

## II. THE INDEX SYSTEM OF SHARING ECONOMIC DEVELOPMENT LEVEL

### A. Index System Construction

Since it is difficult to accurately grasp the connotation and elements of the sharing economy at this stage, we try to start from the side and build an evaluation index system for sharing economic development on the basis of sharing the basic, current and effective economic development. In addition, we tend to draw on the principle of selection of indicators of the United Nations Human Development Index (HDI) to measure and share the economic development index with as few indicators as possible, but with strong correlation with the subject of assessment and high data availability. In addition, this modeling we mainly consider the sharing economy in the field of consumption, not included in the production capacity of the sharing. Based on the above principles, the evaluation index system for sharing economic development includes three first-level indicators of nurturing environment, activity and development effectiveness. Each second-level indicator sets 2-4 second-level indicators, including nine second-level indicators (See Table 1 for details).

TABLE 1. Index system construction

Level 1 indicators	Level 2 indicators
Cultivate foundation	Mobile Internet users
	Month mobile Internet access traffic
	Add fixed broadband Internet access users
Active level	Cognitive activity based on Baidu Index
	Based on the activity of YiKuan QianFan
Achievements	Mobile payment count
	Mobile payment amount
	Express business volume
	New registration of the main market

#### (a) Cultivate foundation

Sharing the economic turmoil has emerged under the conditions of modern information technologies such as the Internet and the mobile Internet. Therefore, we selected mobile Internet users, mobile Internet access traffic in the current month and new fixed broadband Internet access users

III A two indicators, all from the Ministry of Industry and Information Technology monthly bulletin released regularly.

#### (b) Active level

We all see the active situation of sharing economic development at this stage, but it lacks the traditional statistical indicators to measure. At the first level of activity indicators, we try to use data mining techniques to design secondary indicators, including two different secondary indicators based on the Baidu Index and Yi Fan Qian App.

#### (c) Achievements

As the sharing economy is mainly based on online transactions, its rapid development will inevitably lead to the mobile payment blowout growth, while accelerating the development of modern logistics and economic vitality. Therefore, under the indicator of effectiveness of development, we have set second-level indicators such as the number and amount of mobile payments, express traffic volume and the newly registered market entities. The data sources are the statistical bulletins regularly released by the department.

#### B. Principal Component Analysis

Principal component analysis is a commonly used statistical method. Its core idea is to use the method of orthogonal transformation to convert a set of variables that may have correlation into another set of linearly uncorrelated variables and replace the excessively lengthy original data with fewer scalar quantities. During the process, most of the information that can hold the original data is not destroyed. The converted group of variables called the main component.

The principal components of the analysis of the basic algorithms and steps are as follows:

- Collect  $n$  samples of the  $p$ -dimensional random vector to list the observation data matrix. List observation data matrix.
- The sample data is standardized to eliminate the impact of various possible differences between the various indicators.

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{\sqrt{\text{var}(x_j)}}, i = 1, 2, \dots, n; j = 1, 2, \dots, p \quad (1)$$

- Calculate the correlation coefficient matrix of the standardization index:

$$R = [r_{ij}]_{p \times p} = \frac{Z'Z}{n-1} \quad (2)$$

- Solve the characteristic equation of the sample correlation coefficient matrix  $R$  to get  $p$  eigenvalues As well as the eigenvectors corresponding to each eigenvalue:
- Find the cumulative variance contribution rate:

$$e_j = \lambda_j / \sum_{i=1}^p \lambda_i \quad (3)$$

And according to the variance contribution rate to determine the number of principal components of the variance of the various principal components accumulated, you can get the variance contribution rate, the general take the cumulative variance contribution rate of 75% -95% of the first  $k$  principal components;

- Find the main components:

$$F_p = \sum_{i=1}^p H_p \times Z_p \quad (4)$$

- Finally, we take the variance contribution rate of  $k$  principal components as the weighted average to get the weight of the original index, and finally get the comprehensive score of each province and city in different years:

$$I_n = \sum_k \omega_k \times z_{nk} \quad (5)$$

### III. EMPIRICAL ANALYSIS

In this paper, SPSS19.0 software was used to analyze the variance contribution of 19 index variables and the public factor of principal component analysis. The analysis results are shown in Table 2. According to the principle of principal component analysis of common factor extraction, the eigenvalues of variable 1 and variable 2 are both greater than 1, so two common factors are selected for interpretation. From the results of variance contribution and cumulative contribution, we can see that two The contribution of the common factors to the variance is 71.432% and 15.916%, respectively. The cumulative contribution is 87.348%, which accords with the requirement of common factor analysis of principal component analysis. It also shows that the above two common factors basically reflect most of the information covered by the original data.

TABLE 2. Explain the total variance

X	Initial eigenvalue			Extract square and load		
	total	Variance %	heap %	total	Variance %	heap %
1	6.429	71.432	71.432	6.429	71.432	71.432
2	1.432	15.916	87.348	1.432	15.916	87.348
3	.524	5.826	93.174			
4	.305	3.389	96.564			
5	.158	1.753	98.317			
6	.108	1.203	99.520			
7	.027	.305	99.825			
8	.014	.154	99.979			
9	.002	.021	100.000			

According to the resulting composition matrix and formula the score of the principal component can be expressed as:

$$F_1 = 0.968 \times X_1 + 0.972 \times X_2 + 0.902 \times X_3 + 0.861 \times X_4 + 0.955 \times X_5 + 0.928 \times X_6 + 0.0607 \times X_7 + 0.855 \times X_8 + 0.696 \times X_9 \quad (6)$$

$$F_2 = 0.191 \times X_1 + 0.178 \times X_2 + 0.167 \times X_3 - 0.0456 \times X_4 + 0.067 \times X_5 - 0.007 \times X_6 + 0.969 \times X_7 - 0.204 \times X_8 - 0.590 \times X_9 \quad (7)$$

As a result, we can get the final index to share the overall economic development.

As can be seen from Figure 1, the economic development index for the whole year of 2015-2016 has seen an overall increase. The economic development index has been slightly fluctuated in early 2015 and early 2016, and the rate of increase has further accelerated since April 2016, And maintain steady increase.

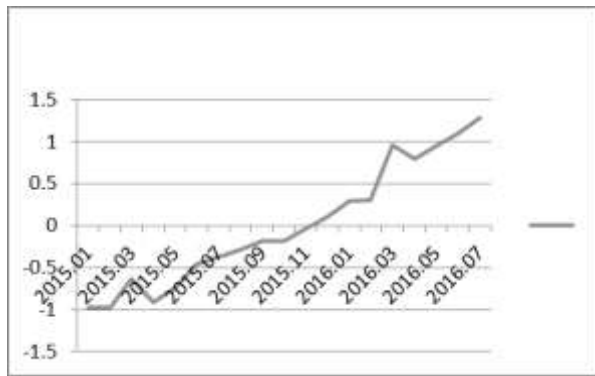


Fig. 1. Composite score line chart

#### IV. CONCLUSION

##### A. To Consolidate the Basis for Sharing the Hardware and Software for Economic Development

The hardware base, namely, the promotion and construction of mobile Internet and fixed Internet, further upgrading and lowering the costs so that more people can more easily participate in the sharing of economic consumption and services at a lower cost. Software that is a clear policy-based. On the one hand, as more and more state-of-the-art economies share their budgets, the government should first of all adopt a gesture of encouragement and tolerance and control and release instead of forbidding or limiting for the first time. On the other hand, it is suggested that the development of a shared economic platform should be promoted with reference to the supportive policies on taxation of small and micro enterprises.

##### B. Accelerate the Sharing of Government Data and Make it Public

On the one hand, the timely and effective sharing of government data is a necessary prerequisite for the rapid monitoring and effective response to the development of new things such as sharing of the economy. When the government proposes data needs such as monitoring of economic sharing, the government can not just add and blindly increase the number of reports. Instead, it should subtract and effectively connect data silos of various departments and local governments to make existing data more significant utility. On the other hand, a greater degree of government data will be

disclosed to the public, which will greatly stimulate new economic development including sharing the economy and bring together the wisdom and power of the masses to exert the "double wound" multiplier effect to realize the vast treasure of government data. The real effective development and utilization.

##### C. Strengthen the Statistical Monitoring of the Economic Platform for Sharing

It is suggested that government departments of statistics should strengthen cooperation with major economic platforms and take the platform as the starting point to do a good job of statistical monitoring of the sharing economy. In the first instance, the government should master the number of participants in the economy and the amount of investment and financing in the platform so as to accurately measure the level of economic vitality and development, effectively measure the share of economic growth in employment and promote the overall economic growth, and timely reflect the development achievements of sharing economy.

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