# Research on Economic Influencing Factors of Zhejiang Province Based on Principal Component Analysis

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**Abstract:** *Zhejiang Province, a relatively well-rounded province in China's economic development, has seen significant fluctuations in its economic performance in the post-pandemic era. Therefore, studying the economic influences behind this phenomenon will guide its future development in the long run. This paper adopts the method of principal component analysis, selecting the economic data of Zhejiang Province from 2013 to 2021. It classifies and studies the economic evaluation indicators according to the criteria of economic internal and external circulations combining the relevant circumstance of the post-pandemic era. The conclusion is that the internal circulation is of higher importance and priority compared to the external circulation of the economy, which is closely related to the pandemic resistance of the economy. This leads to a proposal to improve the resistance of economy to pandemic by developing the economic internal circulation. Thus, Indirect improvements to the proportion of the economic external circulation could be accordingly formulated.*

**Keywords:** *Zhejiang Province; Economic Double Cycle; Principal Component Analysis; Post-pandemic Era*

## 1. Introduction

Since 2012, China's economy has been characterized by sustained and healthy development, with significant progress in all areas, and especially a huge shift in the way the economy develops. Compared with the rapid industrial-based economic development in the early period of the Economic Reform and Open up, a more diversified, sustainable and open development way is the inevitable trend of economic development since the 21st century. Economic development is influenced by a variety of factors that are characteristic of the times and identifying the main factors affecting economic development based on the specific economic development status is an effective reference for planning economic development. Zhejiang Province is in the eastern coastal region, with many ports, dense population, and has a high level of urban development and more comprehensive economic development. Zhejiang's economic development includes many influential elements such as opening to the outside world, ecological construction, scientific and technological development, etc. It is more comprehensive and has a more mature development model. However, Zhejiang's economy has had significant fluctuations since the Covid-19 pandemic in 2020, and the manifestation of economic factors at the external and internal circulation levels have a significant impact on this. Therefore, the study of the factors influencing the economic development of Zhejiang Province is of high reference value for the formulation of regional characteristic economic policies. It could also help evaluate Zhejiang's economic situation dynamically as the international economic and pandemic situations shift.

## 2. Analysis of the Current State of Research

There are many studies on the topic of economic development influencing factors, and the research perspectives and methods are plentiful. Comprehensively, Qing Feng-ling used principal component analysis to summarize relevant indicators based on data from the official website of the National Bureau of Statistics of China in the analysis of economic development factors in Henan Province and summarized that increasing fixed asset investment and accelerating the development of secondary and tertiary industries are more significant. Chen Liang's study on the evaluation of the quality of economic development in Shandong Province conducted a principal component analysis based on the 2017 National Economic and Social Development Bulletin, suggesting that improving innovation capacity and

openness are two factors that account for a relatively large share of economic development. In a study on the evaluation of the quality of economic development in Shanxi Province, Zhang You-zhi applied principal component analysis to conclude that the ecological cost, economic structure dimension and economic stability have a greater degree of influence on the economic development of Shanxi based on the information of data published in the Shanxi Statistical Yearbook from 2007 to 2017.

In the specific direction of economic development, based on the White Paper on the Development of China's Digital Economy (2017), China Statistical Yearbook (2015-2018), Fan Zi-fu et al. listed relevant indicators and data and applied principal component analysis to describe the development of the digital economy and clarify the main influencing factors such as information infrastructure construction, scientific and technological innovation and economic growth. Cui Xi-wen et al. obtained the relevant indicators for marine economic evaluation according to the China Marine Statistical Yearbook, and used principal component analysis to screen out the economic factors with a higher degree of influence as marine science and technology workforce capital and basic labor supply level, etc. Based on the data on science and technology finance and economic growth from the Jiangsu Provincial Statistical Yearbook (2004-2018), Han Peng-ju used principal component analysis to derive the indicators of the components of science and technology finance that have a greater degree of influence on economic growth to summarize the main influencing components such as fiscal expenditure on science ,technology, the construction of science , technology financial institutions,   the introduction and training of talents.

Synthesizing the research progress in the above literature, principal component analysis is widely used in the study of economic impact factors and is more useful in assessing the impact factors of economic development in different periods and different regions. In terms of the studied period, from 2018-2020, studies on the factors influencing China's economic development, while relatively numerous, are limited to previous research ideas, with few comprehensive impact indicators in line with the theme of the pandemic period, and relatively little literature on the economy of Zhejiang Province for the comprehensive study. Therefore, based on the existing research literature, this paper conducts a relevant study on the factors influencing economic development in Zhejiang Province, and makes the following two innovations: 1.Classify traditional economic evaluation indicators according to the inner and outer circulations of the economy. 2. In the context of the times of the covid-19 pandemic, the reliance on economic development and the pandemic is established and the corresponding indicators are cited, providing fresh references and effective suggestions for the direction of economic development and resource allocation in Zhejiang Province.

## 3. Construction of an Index System of Economic Impact Factors in Zhejiang Province

*Table 1: Indicator system*

| System | Element | Indicator | Unit |
|---|---|---|---|
| Economic development level | Internal economic circulation dynamic | R&D as a share of GDP | % |
| | | Year-end resident population | pcs |
| | | Digital economy gains as a share of GDP | % |
| | | Fixed asset investment | Billion yuan |
| | External economic circulation dynamic | Total external economic trade | Million dollars |
| | | International tourism revenue generation | Million dollars |
| | | Amount of actual foreign investment utilized | Million dollars |
| | | New government policy on openness | pcs |
| | Economic pandemic resistance | GDP growth rate | % |
| | | Number of bed turnaround | time |
| | | Registered urban unemployment rate | % |
| | | Inflation rate | % |
| | | Number of participants in basic medical insurance | pcs |
| | Eco-vitality | Freshwater reserve | $m^3$ |
| | | Woodland area per capita | $m^2$ |
| | | Annual average Sulphur dioxide concentration | $mcg/m^3$ |

Relevant data are cited from the 2013-2021 Zhejiang Provincial Statistical Yearbook, Zhejiang Provincial Bureau of Statistics. This paper summarizes the factors affecting economic development into four dimensions based on the Government Work Report of 2021, formulated by the State Council: economic internal circulation dynamics, economic external circulation dynamics, economic pandemic resistance and ecological dynamics. These four aspects are entered into the search engine and the key words that appear more frequently and have practical significance are accepted. A total of 16 basic variables are included in the system, as shown in Table 1.

## 4. Model Selection

Principal component analysis is the process of dimensionality reduction of a larger number of original variables to form a composite, high-coverage principal component. Each of components has its own representations. This paper was studied based on SPSS 23. Due to the large variety of variables in the study and the non-uniformity of the magnitudes, the data collected needed to be standardized first. If there are m indicators for analysis and a total of n objects. The $j^{th}$ indicator for the $i^{th}$ evaluation object is $x_{ij}$. Conversion of individual indicator values into standardized indicators $\tilde{x}_{ij}$.

$$\tilde{x}_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}, (i = 1, 2, ..., n; j = 1, 2, ..., m) \quad (1)$$

$$\bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}, s_j = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_{ij} - \bar{x}_j)^2}, (j = 1, 2, ..., m) \quad (2)$$

The matrix of correlation coefficients is then calculated, and the eigenvalues are found and arranged in descending order of magnitude.

$$0 \le \lambda_m \le ... \le \lambda_2 \le \lambda_1 \quad (3)$$

Eigenvectors.

$$\mu_1, \mu_2, ..., \mu_m \quad (4)$$

$$\mu_j = (\mu_{1j}, \mu_{2j}, ..., \mu_{nj})^T \quad (5)$$

Composition of m new indicator variables from feature vectors.

$$\begin{cases} M_1 = \mu_{11}\tilde{x}_1 + \mu_{21}\tilde{x}_2 + ... + \mu_{n1}\tilde{x}_n \\ M_2 = \mu_{12}\tilde{x}_1 + \mu_{22}\tilde{x}_2 + ... + \mu_{n2}\tilde{x}_n \\ .................................... \\ M_m = \mu_{1m}\tilde{x}_1 + \mu_{2m}\tilde{x}_2 + ... + \mu_{nm}\tilde{x}_n \end{cases} \quad (6)$$

Where M is the principal component, and the number of principal component factors is determined by the cumulative contribution. The eigenvalues with a cumulative contribution of 85% are used as a criterion, and finally the specific functions represented by each principal component are summarized and interpreted according to the type of indicator it contains.

## 5. Empirical Analysis

The significance level P was obtained by the Bartlett's test of sphericity at P=0.00<0.05. The total variance of the variables after standardization was calculated using SPSS software. From Figures 1 and 2, the cumulative contribution of the first three principal components reach to 90%, so three principal components are chosen.

The total variance explanation is shown in Table 2.

*Table 2: Total variance explanation*

| Components | Initial Eigenvalue | | | Extraction of sum of squares of loads | | |
|---|---|---|---|---|---|---|
| | Total | Percentage variance | Cumulation % | Total | Percentage variance | Cumulation % |
| 1 | 9.968 | 62.297 | 62.297 | 9.968 | 62.297 | 62.297 |
| 2 | 2.879 | 17.944 | 80.291 | 2.879 | 17.944 | 80.291 |
| 3 | 1.614 | 10.085 | 90.376 | 1.614 | 10.085 | 90.376 |
| 4 | 0.851 | 5.319 | 95.695 | | | |
| 5 | 0.368 | 2.298 | 97.992 | | | |
| 6 | 0.239 | 1.495 | 99.487 | | | |
| 7 | 0.082 | 0.513 | 100.000 | | | |

The coefficient vectors of the principal components are shown in Table 3.

*Table 3: Component matrix*

| | Component | | |
|---|---|---|---|
| | M1 | M2 | M3 |
| X1 | 0.984 | -0.086 | -0.132 |
| X2 | 0.979 | 0.188 | -0.046 |
| X3 | 0.990 | 0.132 | -0.007 |
| X4 | 0.967 | 0.213 | -0.066 |
| X5 | 0.956 | -0.088 | 0.021 |
| X6 | -0.781 | 0.443 | -0.043 |
| X7 | -0.083 | 0.796 | -0.523 |
| X8 | -0.209 | 0.533 | 0.063 |
| X9 | -0.419 | 0.806 | 0.300 |
| X10 | -0.211 | 0.467 | 0.805 |
| X11 | 0.776 | -0.571 | 0.081 |
| X12 | 0.576 | -0.186 | 0.745 |
| X13 | 0.891 | 0.360 | -0.098 |
| X14 | -0.905 | -0.360 | -0.008 |
| X15 | -0.979 | -0.192 | -0.013 |
| X16 | -0.910 | -0.357 | -0.036 |

According to the analysis in Table 3, it can be concluded that the higher loadings of R&D as a proportion of GDP, year-end resident population, digital economy earnings, fixed asset investment, total water supply, forest land area per capita and Sulphur dioxide emissions in M1 are associated with the internal circulation of the economy and environmental friendliness. Therefore, M1 is called sustainable economic internal circulation. As an object to consumption, the quality of goods influences consumers' desire to consume, and the investment in technological development is an important indicator of the quality of production. The higher the proportion of R&D in GDP, the more advanced means of production the high-tech industry can possess. As a virtual manifestation of the economy, the digital economy has greatly simplified the consumer process and increased people's desire to consume with its convenient consumption methods and fast. The level of economic development is closely linked to the state of the ecological environment, and development and construction based on the destruction of the ecological balance is not conducive to sustainable economic development, and the costs of restoration are far greater than the benefits of ecological destruction.

The amount of actual foreign investment utilized made a corresponding contribution to the growth of GDP, so M2 is international factors. M3 represents the economy's sudden factor resistance. The number of hospital bed turnovers is an important measure of bed usage and represents the severity of the Covid-19 pandemic. Meanwhile, the widespread business shutdowns and factory closures caused by the new pandemic have led to a significant increase in unemployment in Zhejiang Province compared to previous years. Such a phenomenon has led to a decrease in the income, varying degrees, and a decrease in the desire to consume.

## 6. Conclusions

This paper explains the factors that have a greater degree of influence on Zhejiang Province's economic development based on the content of the indicators of the principal components, with the following main conclusions.

1)The current development of the inner circle of the economy is of greater importance and priority.

The results of the principal component analysis show that the economic inner circle can generate

higher returns for Zhejiang Province and can effectively promote the qualitative development of the economy while preserving quantity. The negative effects like generally lower incomes and rising prices on consumption show it more urgent and effective to solve the problems in the economic inner circulation.

2) The external circulation of the economy and the pandemic resistance of the economy are closely linked.

The economic benefits of the policy of opening up to the outside world for Zhejiang Province have been on an increasing trend since the Economic Reform and Open Up, while the related income for 2019 and 2020 has fallen sharply, and the external circulation of the economy, which is an important factor driving economic growth, should be adjusted accordingly. And as mentioned before, the decline in the position of the external circulation of the economy within the overall circulation is mainly due to the global pandemic. Zhejiang's economy has been affected by the pandemic for a relatively short period of fluctuation and is more resistant to the pandemic. Internationally, the control of the pandemic and economic development has entered a normalized parallel mode, and the risks and fluctuations that the pandemic may bring are gradually decreasing. Therefore, the difficulty of improving the external circulation of the economy through economic means in Zhejiang is gradually decreasing. The corresponding measures should consider the dependence between the resistance of the economy to the pandemic and the degree of restoration of an open economy.

Based on the above findings, this paper makes relevant recommendations for the economic development of Zhejiang Province.

1) Export to domestic sales to expand the internal circulation of the economy:

Taking the high demand for high quality products and lower income of consumers in Zhejiang Province into account, we can rely on the high quality of our export products and sell them domestically at lower prices. Creating Festivals in central business districts and duty-free zones would be a better way to stimulate consumption and economic growth with lower prices and appropriate duration of festivals.

2) Indirectly adjusting the proportion of the economy's external circulation based on the degree of stability of the economy's internal circulation:

The pandemic situation and the economic situation are judged according to the bed turnover rate and the inflation rate. If the pandemic situation is better and the internal circulation of the economy is more stable, the proportion of the external circulation of the economy will be increased through the expansion of export sales and integration into the international industrial chain; if not, the proportion of the external circulation will be reduced, the resistance of the economy to the pandemic will be strengthened by strengthening the internal circulation, and the proportion of the external circulation will be increased again as the pandemic situation improves.

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