# Research on the Competitiveness Evaluation of Private Economy Based on Principal Component Analysis

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## Abstract

The rapid development of private economy has made great contributions to the cause of socialism with Chinese characteristics. In order to promote the development of private economy to a higher level, this paper analyzes the development of private economy in Guangdong Province in recent years, constructs the evaluation index system of regional private economy competitiveness from six dimensions of regional economic strength, business environment, profitability, innovation ability, development potential and corporate social responsibility, and determines the weight of each evaluation index by principal component analysis of private economy competitiveness evaluation model. The results show that the overall competitiveness of private enterprises in Guangdong Province is increasing year by year, the scores of each index are also increasing year by year, and some indexes fluctuate greatly. According to the score of each index, this paper puts forward the countermeasures to enhance the competitiveness of private economy in Guangdong Province, so as to promote the healthy and sustainable development of private enterprise economy.

## Keywords

Private Enterprises, Competitiveness, Evaluation Index System, Principal Component Analysis

## 1. Introduction

Since the reform and opening up, the principal status of private economy in Guangdong Province has been further consolidated, which has played an important role in promoting the steady and sound development of social economy.

In order to maintain the strong development momentum of private economy in Guangdong Province, governments at all levels in Guangdong Province have constantly introduced new policies to promote the development of private economy. Data revealed that the value added of private economy in Guangdong Province increased continuously from 2015 to 2019, with a growth rate of around 8%, indicating a rapid growth. In 2019, the added value of the private economy reached 5,883,836-billion-yuan, accounting for 54.6% of the gross domestic product (Hao. 2018). The contribution rate of private economy keeps increasing, and it has become the main force to boost economic growth in Guangdong Province. This proves the rule that "*Strong and prosperous private enterprises constitute a strong and prosperous nation*". A large number of private enterprises, especially some small and medium-sized enterprises, still face the problem of being large while lacking powerful strength and core competitiveness. Therefore, it is necessary to conduct analysis on the development of private economy in Guangdong province in detail and evaluate the competitiveness of private economy in Guangdong Province in the past five years.

At present, the research on competitiveness mainly focuses on regional competitiveness, industrial competitiveness and enterprise competitiveness. Sun Yongbo et al. (2015), Fan Ci (2016), and others analyzed the importance of the evaluation index system for competitiveness of commercial retail enterprises and discussed how to improve the competitiveness of retail enterprises. Based on the competitiveness theory, Li Min et al. (2018) constructed the competitiveness evaluation index system and evaluation model of coal enterprises under the coal-electricity joint venture model. Hu Feng (2017), Mao Yilei & Liu Zhihui (2018), Yao Haixin & Zhang Xiaoxu (2019) and Cheng Xiang et al. (2020) conducted studies on high-tech listed companies, explored the mechanism that affected the competitiveness of enterprises, and constructed the influencing factor model of the competitiveness of listed companies. Zhao Chunni & Kou Xiaoxuan (2018), Han Caizhen & Gao Jingyi (2020), Yao Yanhong et al. (2017) studied the influence of platform resources, corporate culture and internal and external environment on the competitiveness of enterprises. By analyzing the internal and external factors that affected management on cash flow of enterprises, Liu Qi et al. (2015) constructed an analytical framework of strategic management on cash flow of enterprises based on both internal investment and financing decisions and Michael Porter's Five Forces model. He Zhengquan (2016) and others conducted tests and regression analysis on relevant panel data and found that RMB appreciation had a significant positive impact on enterprise profitability and operating capacity, while, the growth ability is not obviously influenced by RMB appreciation. Yang Lei (2016) and others constructed a comprehensive evaluation index system for the competitiveness of manufacturing enterprises from five dimensions of manufacturing R&D ability, marketing ability, employee ability, organization and management ability and brand influence. Taking high-end equipment manufacturing enterprises as objects, Yang Jin (2017) and

others analyzed the relationship and mechanism between production service outsourcing, modularization of product, dynamic capability and competitiveness of high-end equipment manufacturing enterprises from the perspective of dynamic capability. Through quantitative research on 426 private enterprises in Beijing, Cui Xinjian (2017) and others found that the key to promoting the construction of modern enterprise system is to seek and choose a path for the construction of modern enterprise system that balances the long-term development and short-term business performance of enterprises and coordinates the governance and management of enterprises. Liu Yidan et al. (2010) and others used principal component analysis to comprehensively evaluate the financial performance of enterprises from both qualitative and quantitative aspects, Wang Wenwen (2021) used factor analysis and principal component analysis to evaluate the performance of 44 retail enterprises.

In this paper, analysis on principal components was used to analyze the evaluation indicators of the economic competitiveness of private enterprises, and the economic data of private enterprises in Guangdong province from 2015 to 2019 were used to build a comprehensive evaluation model of the economic competitiveness of private enterprises. Find out the problems faced by private enterprises, and give countermeasures and suggestions to improve the competitiveness of private enterprises.

## 2. Data and Methods

### 2.1. Data Sources

Relevant data of private economy of Guangdong Province from 2015-2019 were used to have a longer-term longitudinal study on the competitiveness of the private economy of Guangdong Province. The competitiveness of private economy of Guangdong was comprehensively evaluated in the long run-in regional influence, business environment, profitability of enterprises, innovation ability, development potential and enterprise social responsibilities. In order to ensure the scientific and accurate statistical data, the basic indicators adopted in this paper are from *Guangdong Statistical Yearbook*, *Report on China Top* 500 *Private Enterprises*, Statistical Bulletin of National Economic and Social Development of Guangdong Province and relevant data on the Internet.

### 2.2. Research Methods

Based on the existing literature, this paper constructed an evaluation index system of economic competitiveness of private enterprises in six dimensions, namely, regional economic strength, business environment, profitability, innovation ability, development potential and enterprise social responsibilities according to the current situation of private enterprises in Guangdong Provinc (Yang, 2015) (see Table 1). Through descriptive analysis of relevant data of private enterprises, the overall competitiveness of private enterprises was revealed, and corresponding countermeasures were proposed for the development of private

**Table 1.** Evaluation index system of economic competitiveness of private enterprises.

| Objective Layer | Level 1 Indicator | Level 2 Indicator | Level 3 Indicator |
|---|---|---|---|
| Competitiveness of regional private economy | Regional influence | Regional economic strength | The proportion of the added value of private economy in the gross domestic product |
| | | | The number of enterprises in China's top 500 private enterprises |
| | | | The number of private enterprises above designated size |
| | | Business environment | The total number of days needed to start a business |
| | | | Growth of private investment |
| | Regional economic strength | Profitability | Profit ratio of sales |
| | | | Return on equity (ROE) |
| | | | Ratio of Profits to Cost |
| | | Innovation capacity | Investment intensity in R&D expenditures |
| | | | Number of authorized patents owned by the enterprise |
| | | Development potential | Growth rate of business revenue |
| | | Enterprise social responsibility | Total profits and taxes of private enterprises |

economy in Guangdong province to a higher level in view of the weaknesses in the competitiveness of private economy in Guangdong Province.

**The analysis on principal component and empirical results are as follows.**

**1) Processing of indicators**

Z-score standardized formula was used to eliminate the influence of different dimensions and orders of magnitude on the evaluation results. The method of combining eigenvalue and cumulative contribution rate is adopted to determine the number of principal components: the cumulative contribution rate is greater than 85%, and the corresponding eigenvalue is greater than 1. It can be seen from Table 2 that the contribution rates of the first three principal components and variance reached 94.55%, and the corresponding eigenvalues were all greater than 1. Therefore, principal component 1, principal component 2 and principal component 3 were used to replace the original 12 indicators.

**2) To determine the expression of principal component**

According to the data in Table 2, the coefficients of each index in the principal component were calculated. To multiply the vector coefficient and standardized value of the original number, as a result, the expressions of each principal component are obtained (see Table 3).

**3) To determine the comprehensive weight of each principal component**

In order to obtain the comprehensive score of principal components, we should, at the outset, determine the comprehensive weight of principal component of each index. Q1 - Q3 are used to represent the weight of each principal component of each three-level indicator and the calculation method is as follows: Multiplying the corresponding coefficient of each principal component in the principal component expression by its corresponding variance contribution rate, and then divide by the sum of variance contribution rate of the three principal components. Finally, the aggregate weight of the principal component of each index can be calculated to obtain the aggregate weight $Q_T$ of the principal component (see Table 4), namely, $Q_T = Q_1 + Q_2 + Q_3$.

Table 2. Interpretation on total variance based on principal components.

| Principal components | Eigenvalue | Variance contribution rate | Contribution rate of cumulative variance |
|---|---|---|---|
| Principal component 1 | 8.45 | 70.45 | 70.45 |
| Principal component 2 | 1.66 | 13.84 | 84.29 |
| Principal component 3 | 1.23 | 10.26 | 94.55 |

Table 3. Coefficients of each principal index.

| Three-Level Indicators | comp1 | comp2 | comp3 |
|---|---|---|---|
| The proportion of the added value of private economy in the gross domestic product | 0.32635 | 0.131046 | 0.125372 |
| The number of enterprises in China's top 500 private enterprises | 0.203356 | 0.389654 | 0.090181 |
| The number of private enterprises above designated size | 0.330626 | 0.159032 | 0.152503 |
| The total number of days needed to start a business | −0.34121 | 0.006598 | −0.10693 |
| Growth of private investment | −0.318 | 0.140191 | −0.19386 |
| Profit ratio of sales | −0.2812 | −0.09551 | 0.491252 |
| Return on equity (ROE) | −0.20841 | 0.587788 | 0.057123 |
| Ratio of Profits to Cost | −0.14841 | −0.16947 | 0.776526 |
| Investment intensity in R&D expenditures | 0.336512 | −0.02447 | 0.170113 |
| Number of authorized patents owned by the enterprise | 0.341534 | 0.065744 | 0.059367 |
| Growth rate of business revenue | −0.20139 | 0.61123 | 0.151163 |
| Total profits and taxes of private enterprises | 0.332131 | 0.155397 | 0.031324 |

Table 4. Weighted value of principal components of each indicator.

| Three-Level Indicators | $Q_1$ | $Q_2$ | $Q_3$ | $Q_T$ |
|---|---|---|---|---|
| The proportion of the added value of private economy in the gross domestic product | 0.243166 | 0.019182 | 0.013605 | 0.275953 |
| The number of enterprises in China's top 500 private enterprises | 0.151522 | 0.057037 | 0.009786 | 0.218345 |
| The number of private enterprises above designated size | 0.246352 | 0.023279 | 0.016549 | 0.28618 |
| The total number of days needed to start a business | −0.25423 | 0.000966 | −0.0116 | −0.26487 |
| Growth of private investment | −0.23694 | 0.020521 | −0.02104 | −0.23746 |
| profit ratio of sales | −0.20952 | −0.01398 | 0.053308 | −0.17019 |
| return on equity (ROE) | −0.15528 | 0.086039 | 0.006199 | −0.06305 |
| Ratio of Profits to Cost | −0.11058 | −0.02481 | 0.084264 | −0.05112 |
| Investment intensity in R&D expenditures | 0.250738 | −0.00358 | 0.01846 | 0.265616 |
| Number of authorized patents owned by the enterprise | 0.25448 | 0.009623 | 0.006442 | 0.270545 |
| Growth rate of business revenue | −0.15006 | 0.08947 | 0.016403 | −0.04418 |
| Total profits and taxes of private enterprises | 0.247474 | 0.022747 | 0.003399 | 0.27362 |

According to the above calculation data, we can obtain the comprehensive evaluation model of economic competitiveness of private enterprises in Guangdong Province:

$$F = 0.275953X_1 + 0.218345X_2 + 0.28618X_3 - 0.26487X_4$$
$$- 0.23746X_5 - 0.17019X_6 - 0.06305X_7 - 0.05112X_8$$
$$+ 0.265616X_9 + 0.270545X_{10} - 0.04418X_{11} + 0.27362X_{12}$$

## 3. Comprehensive Analysis

In order to more conveniently compare the development of private enterprises in Guangdong Province from 2015 to 2019, we calculated the scores of each secondary index according to the evaluation index system of economic competitiveness of private enterprises (see Table 5).

As can be seen from Table 5, the competitiveness index of private enterprises in Guangdong province is increasing year by year, and the score of regional economic strength, business environment, profitability, innovation ability and corporate social responsibility are all changed from negative to positive, indicating that the competitiveness of these five aspects is increasing year by year. The score of development potential is still on the rise in general, but fluctuates greatly. A good business environment has released the development vitality of private enterprises, and Guangdong has a strong private economic strength. As a big province in private economy, Guangdong's private economy contributes more than 50% of the province's GDP, about 60% of its investment, over 70% of its innovation achievements, over 80% of its new jobs and over 95% of its market players. The number of private enterprises of Guangdong Province in China's top 500 private enterprises rose to the third place, reaching 60, and the total revenue and total assets of the listed enterprises ranked first in China.

### 3.1. Problems Existing in the Economy of Private Enterprises in Guangdong Province

In terms of the private enterprise economy in Guangdong Province, there is still a great room for improvement, which is mainly reflected in the following aspects:

Table 5. Scores of economic indicators of private enterprises in Guangdong Province from 2015 to 2019.

| Year | Scores for regional economic strength | Scores for business environment | Scores for profitability | Scores for innovative capability | Scores for development potential | Scores for enterprise social responsibilities |
|---|---|---|---|---|---|---|
| 2015 | −0.545 | −0.646 | −0.074 | −0.589 | −0.052 | −0.252 |
| 2016 | −0.812 | −0.270 | −0.151 | −0.436 | 0.013 | −0.205 |
| 2017 | 0.004 | −0.054 | −0.278 | −0.054 | −0.019 | −0.095 |
| 2018 | 0.405 | 0.400 | 0.325 | 0.451 | 0.067 | 0.149 |
| 2019 | 0.947 | 0.569 | 0.179 | 0.628 | −0.009 | 0.404 |

First, as regional economy is concerned: Guangdong is a big province in private economy that has contributed a lot to the development of social economy in Guangdong Province. On the whole, the private economy of Guangdong Province has strong competitiveness, but the regional development is not balanced. The growth range of private economic added value in the east region, the west region and the mountainous area in the north of Guangdong province is obviously smaller than that in the Pearl River Delta. The imbalance of regional development leads to the further agglomeration of private economy in the Pearl River Delta region.

Second, in aspect of business environment: Significant progress has been made in the reform and development of digital government. In 2018, online government service capacity ranked first in China. *"Reforms to streamline administration, delegate powers, and improve regulation and services"* was continuously deepened, and the list of powers and responsibilities at the provincial level was substantially reduced from 3018 to 986. We made 58 achievements in reforming the business environment system and established the country's first electronic tax bureau, and reduced the whole start-up process of enterprises to three working days.

Third, in terms of profitability: In 2019, the total profit of private enterprises above the scale in Guangdong province was 470.442 billion yuan, with a year-on-year growth of 10.3%. The added value of private economy was 5883.836 billion yuan, with a growth of 6.7%. The profit growth rate was higher than that of private economic added value, and the economic benefit of enterprises was better.

Fourth, concerning innovation ability: In recent years, the comprehensive utility value of Guangdong's regional innovation ability ranked the first in China, and the gap between it and the second continues to widen. Guangdong ranked first in terms of investment in research and development, design capability, technology improvement and sales of new products, which indicates that the radiation driving effect of technology-driven innovation has been fully released.

Fifth, as for development potential: The economic size of Guangdong Province ranks the first in China all the year round. GDP reflects the economic aggregate of a region, while the economic development potential of a region is reflected in the total amount of capital. Jiangsu, the second largest province, has 95 percent of Guangdong's GDP, but only 67 percent of its capital. In terms of population attraction, capital attraction, economic size and growth rate, Guangdong will continue to be the overall leader for a long time to come.

Sixth, in light of enterprise social responsibility: While developing and growing, private enterprises in Guangdong province actively implemented the "innovation-driven" development strategy, and actively fulfill their social responsibilities in the construction of *"Beautiful Guangdong"* and the promotion of poverty alleviation, making contributions to the realization of "three positioning, two leading" in Guangdong Province.

### 3.2. Countermeasures and Suggestions for Improving the Competitiveness of Private Enterprises in Guangdong Province

**1) To improve the talent introduction system and retain talents**

Talents are the first resource. In order to increase innovative and high-level talents, Guangdong and the cities under its jurisdiction have issued relevant supporting policies. After the introduction of talents, it is necessary to do a good job in the identification of talents at all levels and simplify the relevant identification procedures. To implement project funds and incentive policies for various talents. We will improve supporting services for all kinds of talents, especially in housing, spouse employment, schooling for their offspring and medical care to solve their worries at home and put more energy into work.

**2) To promote innovation-driven development of enterprises**

Although Guangdong ranks third after Jiangsu and Shandong in the number of private enterprises in China's top 500 private enterprises. However, the total business income and total assets of China's top 500 private enterprises ranked first in the country. However, a large enterprise does not mean a strong one. The standard of a strong enterprise lies in its innovation ability, governance model and other standards. In the future, the future economic development will be driven by scientific and technological innovation. The competitiveness of knowledge-based economy in Guangdong Province symbolizes the future development of Guangdong. The number of private economic units in Guangdong has been increasing year by year, and now it is nearly 13 million, among which more than 50,000 are high-tech enterprises and more than 70% are private enterprises. It has nurtured a group of leading private high-tech enterprises: Huawei, BYD, DJI, Tencent, etc., with remarkable achievements in development.

**3) To expand the financing channels and solve difficulties in fund raising**

Private enterprises are confined in fund-raising capacity, which is especially true for some small and medium-sized private enterprises. In 2018, Guangdong issued a series of policies to promote high-quality development of the private economy, including ten policy measures with the purpose to solve the problems of the development of the private economy, such as high production cost, difficulty in financing and expensive financing. Guangdong encourages banking institutions to provide non-repaying loans to small and micro businesses, and supports the establishment of on-lending funds for small and micro businesses to reduce the cost of **"Bridge Financing".** Cooperation between taxation, banking and insurance regulatory authorities and banking financial institutions should be actively promoted to expand the scope and quality of participating banking institutions. We will encourage and promote mutual insurance among enterprises and open up financing channels with credit guarantees.

**4) To establish a database on the "Development of Private Economy in Guangdong Province"**

In order to facilitate the economic management departments to timely master

the economic operation of private enterprises in Guangdong Province, the establishment of *"Development Condition of Private Economy"* related database is very necessary. The establishment of the *"Development Condition of Private Economy"* database is conducive to unifying the statistical scope and caliber of private economy and ensuring the authenticity of statistical data. At the same time, the *National Bureau of Statistics*, *the All-China Federation of Industry and Commerce* (*ACFIC*) and other relevant departments should strengthen the real-time monitoring of the data on economic development of private economy in Guangdong Province so as to ensure the timely analysis of indicator data, and timely write the *Annual Report of Non-State-Owned Economy in China*, so as to provide accurate data reference for the economic management and users.

## 4. Conclusion

In the process of constructing the evaluation system of economic competitiveness of private enterprises, many factors need to be considered. Using principal component analysis, this paper constructs a comprehensive evaluation model of economic competitiveness of private enterprises in Guangdong Province. Through the analysis, it can be found that the number of private enterprises above Designated Size, the proportion of private economic added value in regional GDP, the number of authorized patents owned by enterprises and the total profit and tax of private enterprises have a great impact on the competitiveness of enterprises, while the return on net assets, cost profit rate and operating income growth rate have a relatively small impact on the competitiveness of enterprises. Establish a comprehensive evaluation model of economic competitiveness of private enterprises, so that enterprises can make a scientific and reasonable evaluation of their own competitiveness, and take effective measures to solve the corresponding problems and improve the competitiveness of enterprises according to the problems existing in the evaluation. Hope to help enterprises achieve sustainable and stable development.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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