The Application of Analytic Hierarchy Process in the Comprehensive Performance Evaluation of Mixed Ownership Reform in State-owned Enterprises

Hongjing Zhang[a,] *, Mingjing Chen[b]

School of Economics and Management, Northeast Electric Power University, Jilin 132012, China
[a]31417448@qq.com, [b]153179042@qq.com

Keywords: Mixed ownership reform, Analytic Hierarchy Process, Comprehensive performance.

Abstract: The mixed ownership reform is the breakthrough of state-owned enterprise reform. The starting point is to realize the complementary advantages of state-owned capital and non-state-owned capital. The analytic hierarchy process is used to establish a comprehensive performance evaluation index system for state-owned enterprises from three aspects, financial performance, management performance and social performance. The sample of state-owned enterprises listed in the A-share market of Shanghai and Shenzhen stocks from 2007 to 2017 is used as a sample to calculate the mix of 2010~2014. The impact of ownership reform on corporate comprehensive performance. The results show that the reform of mixed ownership has improved the overall performance of state-owned enterprises.

1. Introduction

State-owned enterprises are an important force for strengthening the comprehensive strength of the country and safeguarding the common interests of the people. Promoting the reform and development of state-owned enterprises can enhance the vitality of state-owned enterprises and the control of the state-owned economy as a whole [1]. It is of great significance for establishing a socialist market economic system, promoting rapid and healthy economic development, and improving people's living standards.

The pace of the new round of mixed ownership reform has been further accelerated, and the impact of mixed ownership reform on the performance of state-owned enterprises shows the fruits of reform. Liu Wei (2016) found that after the reform of state-owned enterprises, its total factor productivity (TFP) increased significantly [2]. Chen Lin and Tang Yangliu (2014) have shown that mixed-ownership reform can reduce the policy burden of state-owned enterprises [3]. Compared with the unilateral evaluation of the financial performance of state-owned enterprises, this paper aims to establish an evaluation index sy2stem for the impact of mixed-ownership reform on the overall performance of state-owned enterprises.

DOI: 10.23977/iceccs.2018.032

2. Constructing Comprehensive Performance Evaluation Model of State-owned Enterprises by Using Analytic Hierarchy Process

2.1 Evaluation index selection

The comprehensive performance evaluation indicators of state-owned enterprises adopt three aspects: financial performance, management performance and social performance, and each aspect selects four representative indicators. Financial performance selects the return on total assets (ROTA), debt asset ratio, total asset turnover rate and assets rate. Management performance selects sales growth rate, receivables turnover rate, employee wage rate, and net profit cash content [4]. Social performance selects tax contribution rate, public welfare contribution rate, employment number, unit income sales service fee.

2.2 Constructing a comprehensive performance evaluation system for state-owned enterprises

According to the selected specific evaluation indicators, a hierarchical judgment matrix is constructed. The judgment matrix is constructed by the expert scoring method; its value is based on Saaty's suggestion to quote numbers 1~9 and its reciprocal as a scale. The judgment matrix, weight and consistency check coefficient CR of each level are shown in Table 1, Table 2, Table 3, and Table4.

Table 1 Top Level Judgment Matrix and Factor Weight and Consistency Test

Comprehensive performance	Financial performance	Management performance	Social performance	W_i	CR
Financial performance	1	3	5	0.6483	0.0032<0.1
Management performance	1/3	1	2	0.2297	
Social performance	1/5	1/2	1	0.1220	

Table 2 Judgment matrix and factor weight and consistency test of financial performance evaluation

Financial performance	ROTA	Debt asset ratio	Total asset turnover rate	Assets rate	W_i	CR
ROTA	1	2	3	5	0.4792	0.0219<0.1
Debt asset ratio	1/2	1	2	3	0.2695	
Total asset turnover rate	1/3	1/2	1	3	0.1722	
Assets rate	1/5	1/3	1/3	1	0.0791	

Table 3 Judgment matrix and factor weight and consistency test of management performance evaluation

Management performance	Growth rate	Receivables turnover rate	Net profit cash content	Employee wage rate	W_i	CR
Growth rate	1	2	5	6	0.5053	0.0489 <0.1
Receivables turnover rate	1/2	1	4	5	0.3228	
Net profit cash content	1/5	1/4	1	3	0.1130	
Employee wage rate	1/6	1/5	1/3	1	0.0589	

Table 4 Judgment matrix and factor weight and consistency test of social performance evaluation

Social performance	Tax contribution rate	Public welfare contribution rate	Employment number	Unit income sales service fee	W_i	CR
Tax contribution rate	1	3	4	2	0.4821	0.0733 <0.1
Public welfare contribution rate	1/3	1	1/2	1/2	0.1170	
Employment number	1/4	2	1	2	0.2178	
Unit income sales service fee	1/2	2	1/2	1	0.1831	

The combined weights of the lowest factors and the total level consistency test coefficients are shown in Table 5.

Table 5 Combination weights and consistency test of each factor

Primary indicator	Secondary indicators	Weights	Three-level indicator	Weights	CR
Comprehensive performance Z	Financial performance X_1	0.6483	ROTA Y_1=net profit/average total assets	0.3107	0.0354<0.1
			Debt asset ratio Y_2=end of term liabilities/ total assets	0.1747	
			Total asset turnover rate Y_3= sales revenue/average total assets	0.1116	
			Assets rate Y_4=end owner equity/initial owner's equity	0.0513	
	Management performance X_2	0.2297	Growth rate Y_5=(current sales income - initial sales income) / initial sales income	0.1161	
			Receivables turnover rate Y_6=net sales / average accounts receivable	0.0741	
			Net profit cash content Y_7=net cash flow / net profit	0.0260	
			Employee wage rate Y_8=payroll payable in the current period/number of employees	0.0135	
	Social performance X_3	0.1220	Tax contribution rate Y_9=tax payable / sales income	0.0588	
			Public welfare contribution rate Y_{10}=public welfare expenditure / sales income	0.0143	
			Tax contribution rate Y_{11}=tax payable / sales income	0.0588	
			Public welfare contribution rate Y_{12}=public welfare expenditure / sales income	0.0143	

3. Model construction

Construct a dummy variable whether has undergone mixed-ownership reform and record it as *dt*.*dt*=1 indicates the state after the mixed ownership reform, and *dt*=0 indicates that the state of the mixed ownership reform has not yet been performed.The construction model is as follows:

$$Y_{it}=\alpha_0+\alpha_1 dt+\beta' X+\varepsilon_{it}, \quad (1)$$

Among them, *Y* is the comprehensive performance, α is a constant, *X* is the control variable, including the enterprise scale, cash holding level and *H5*, ε is the error term, *i* is the sample enterprise order, and *t* is the year.

4. Empirical analysis

4.1 Sample selection and data source

This paper selects the state-owned enterprises listed on the A-share market in Shanghai and Shenzhen. Study the comprehensive performance of state-owned enterprises in the period of mixed-ownership reform from 2010 to 2014, using the data time window for 2007-2017. This paper Will be seen as having completed mixed-ownership reform once non-state capital enters the enterprise. In the year when the mixed ownership reform occurred, its data fluctuations may be large. Therefore, the data of the year of reform was eliminated, and finally 294 samples and 3,234 observations were obtained. The data in this paper comes from CSMAR. Some of the missing data is collected manually through Sina Finance, Juchao website and other websites. The software SPSS is used to analyze.

4.2 Data analysis

From Table 6, we can see that the standard deviations of enterprise scale, cash holding level and *H5* are less, and the distribution is more uniform. However, the standard deviations of enterprise comprehensive performance are relatively large and the differences between the maximum and minimum are also relatively large, indicating that the comprehensive performance of different enterprises in different years is still a big change. Among them, the mean value of the virtual variable *dt* indicating whether the reform is carried out is 0.63, which indicates that the reform year of the enterprises participating in the reform is earlier.

Table 6 Descriptive statistics

Variables	N	Minimum	Maximum	Mean value	Standard deviation
Comprehensive performance	3234	-1.5241	362.2101	4.1858	15.1366
dt	3234	0	1	0.63	0.482
Enterprise scale	3234	18.3846	27.4070	22.1968	1.4458
Cash holding level	3234	0.0001	0.9722	0.1332	0.1064
H5	3234	0.0086	0.8099	0.1800	0.1273

According to the regression results in Table 7, *dt* and *H5* are within the 1% confidence interval, and the firm size and cash holding level are within the 5% confidence interval, indicating that the model fits adequately. Among them, *dt*=0.188>0 shows that after the mixed ownership reform, the overall performance of enterprises has increased. That is, the reform of mixed ownership has a positive effect on the comprehensive performance of state-owned enterprises, and promotes the development and promotion of enterprises.

Table 7 Mixed-ownership reform and comprehensive performance regression results

Variables	Standard coefficient	sig	Adjusted R^2
dt	0.188	0.000	0.2531
Enterprise scale	0.030	0.049	
Cash holding level	0.043	0.016	
H5	0.054	0.005	

5. Conclusions

In this paper, we use the three aspects of financial performance, management performance and social performance to construct a comprehensive performance evaluation system, and use the comprehensive performance evaluation indicators to conduct empirical research on enterprises with mixed ownership reform. The study finds that the reform of mixed ownership has indeed improved. The comprehensive performance of state-owned enterprises, but the overall improvement is not very significant; distinguishing regional indicators, the effect of mixed reform in the eastern region is more significant than in the central and western regions.

References

[1] Henry M.K. Mok, Sandy S.M. Chau. Corporate Performance of Mixed Enterprises [J]. Journal of Business Finance & Accounting, 2003, 30(3):513-538.

[2] Liu Wei, Zhang Xunchang and Lan Xiaoyan.The Impact of State-owned Enterprise Mixed Ownership Reform on Total Factor Productivity-An Empirical Study Based on PSM-DID Method[J]. Public Finance Research, 2016,(10):63-75.

[3] Chen Lini, Tang Yangliu.The Reform of Mixed Ownership and the Policy Burden of State-owned Enterprises——An Empirical Study Based on Big Data of Early State-owned Enterprise Property Reform[J]. Economist, 2014,(11):13-23.

[4] Li Chunling, Yuan Runsen and Shang Hun. Construction of Dividend System of Mixed Ownership Reform of State-owned Enterprises [J]. Finance and accounting monthly, 2018(07):47-54.