

Financing Constraints, Principal-Agent and Chinese Listed Firms' Output Efficiency

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Abstract

It is shown that output under financing constraints and principal-agent can be modeled as a one-side deviation from a frictionless output level. The effects of financing constraints and principal-agent can be identified and quantified by imposing a distribution assumption on the effects. Panel data on Chinese listed firms between 2008 and 2013 are used in the estimation. It is found that: (1) the output efficiency of Chinese listed firms is significantly affected by financing constraints and principal-agent; (2) the severity of financing constraints and principal-agent of firms in different regions varies; (3) firms' output efficiency in east China varies greatly, and the mean efficiency is the lowest of the three regions.

Keywords: *Financing Constraints Principal-agent Output Efficiency Heteroscedastic Stochastic Frontier Model*

1. Introduction

Over the past decades, many researches have been devoted to study problems of financing constraints and principal-agent. As two of the most important governance mechanism of listed firms, financing constraints and principal-agent have significant influence on investment decision and performance of firms. And they have been research focus for domestic and overseas scholars over the past years.

In the capital market, the problem of information asymmetry exists extensively. Based on the pecking order theory, Fazzari chose dividend payout ratio to measure financing constraints, and added it to the investment model, then studied the relationship between financing constraints and investment-cash sensitivity, the results showed that financing constraints are positively associated with investment-cash flow sensitivity (Fazzari, Hubbard and Petersen, 1998) [1]. Later scholars have drawn the similar conclusion that financing constraints has significant effect on investment behavior (Schaller, 1993; Caballero, 1999) [2-3]. Chinese scholars (Wei Feng, 1999; Yujun Lian & Jian Chen, 2007) [4-5] chose the similar method as Fazzari's, and studied Chinese listed firms' investment behavior, but the results are controversial. By using the heteroscedastic stochastic frontier model, Yujun Lian (2009) [6] studied the effect of financing constraints on the investment efficiency of Chinese listed firms, the empirical results showed that the

investment efficiency of Chinese listed firms declined 20-30% due to financing constraints, compared with the optimal level.

The traditional principal-agent theory was proposed by Jensen and Meckling (1976) [7], which was based on ownership dispersion. By analyzing the 49 firms identified by Fazzari as having unusually high investment-cash flow sensitivities, Kaplan and Zingales (1997) [8] studied the relationship between financing constraints and investment-cash flow sensitivities, and the results showed that firms that appear less financing constraints exhibit significantly higher sensitivities than firms which appear more financing constraints, the result was completely opposite to Fazzari's. Cleary (1999) [9] obtained the similar result as Kaplan's, and considered that it can be explained by the agency cost of free cash flow hypothesis, and financing constraints is not the only cause of investment-cash flow sensitivities. Yi Zhang and Chen Li (2005) [10] considered that the main reason of Chinese investment-cash flow sensitivities is over-investment, which is caused by principal-agent, but Yujun Lian and Jian Cheng (2007) [5] considered that it is a consequence of financing constraints and principal-agent. In recent years, ownership concentration and controlling-shareholder have relieved the free-rider problem and the supervision for managers is done by the controlling-shareholder. Although ownership concentration and controlling-shareholder have relieved the problems caused by the traditional principal-agent, new problems has emerged, that is the principal-agent problems between major shareholder and monitory shareholders, which is called "the second agent problem". In order to obtain the private benefit of control, the controlling-shareholder will make inefficient financial decision, especially the inefficient capital allocation decision, which is harmful to the firm's value and the benefit of minor shareholders (Matin, 2007) [11]. Wei Dou (2011) [12] empirically studied the inefficient investment problems of Chinese listed companies, the results showed that corporate inefficient investment behaviors are determined by financial restrain and agent conflict which induced by private benefit of control.

It is obviously that the problems of financing constraints and principal-agent have affected listed firms. Domestic and overseas scholars have studied these problems' effects on the investment behavior. But researches on the influence on firm's output are relatively less. Hardly a scholar has put the problems of financing constraints and principal-agent into a single model to study the effects on the output efficiency. By using the heteroscedastic stochastic frontier model, the paper studied the effects on the output efficiency of Chinese listed firms, which caused by financing constraints and principal-agent. The approach has the advantages as financing constraints and principal-agent has one-side effects on output, and they can be explained by a vector of observable variables. The rest of the paper is organized as follows. Section 2 put forward the hypotheses based on the related researches. Section 3 describes the model and data of the paper. Section 4 describes the estimation results. Section 5 concludes the article.

2. Literature Review

Above all, firms cannot make the best investment decision because of the problems of financing constraints and principal-agent, thus the firms' resource cannot achieve effective disposition and the production efficiency will be decreased.

Nickell and Nicolitsas (1999) [13] chose the ratio of interest payment to cash flow to measure financial pressure, and studied its effect on the United Kingdom enterprise productivity, the results showed that financial pressure has a small positive effect on productivity. Gatti and Love (2008) [14] used a cross-section of Bulgarian firms' data, and estimated the impact of access to credit on productivity, and the results showed that credit is positively and strongly associated with productivity. Nucci (2005) [15] used Italian firms' data, and studied the relationship between the capital structure and Total Factor Productivity (TFP), the results showed that debt financing has no help to

productivity. Chinese scholar Xiaojun Shi and Shunming Zhang (2010) [16] argued that trade credit can ease financing constraints and can significantly improve efficiency. Guanhui He and Xianyue Yang (2012) [17] have found that the productivity of listed firms as a whole is not influenced by the internal finance, but the private-owned firms are financially constrained and affected their output.

On the basis of the review of the literatures, **hypotheses 1** has been settled in the study: Financing constraints affects the Chinese listed firms' output efficiency.

Darius Palia (1999) [18] found a positive correlation between the ownership stake of a firm's managers and TFP, and the change of TFP is strongly sensitive to the ownership stake of managers. Claessens(2000) [19] found that the major shareholder would obtain personal benefits from inefficient investment, and that would harm medium and small shareholders' benefits. Inefficient investment will cause inefficient output finally. Some Chinese scholars have found that because of the principal—agent problems, firms' resources could not be used effectively, thus cannot ensure an increase of the efficiency of the firms (Qingsong Lin, 1996; Xiang Kong, 1999) [20-21]. Zhaobin Sun (2006) [22] found that ownership concentration and the holding ratio of controlling shareholder have a significant positive relationship with the firms' technical efficiency, but the equity restriction ratio have a significant negative relationship with the technical efficiency. Peng Wang (2006) [23] studied the controlling shareholder's effect on company performance, the results showed that under the control of the controlling shareholder, the controlling shareholder would occupy medium and small shareholders' benefits from inefficient investment, and decreased the output efficiency.

On the basis of the review of the literatures, **hypotheses 2** have been settled in the study: Principal—agent affects the Chinese listed firms' output efficiency.

3. Model and Data

3.1. Model Specification and Estimation Method

There are two different methods which can be used to measure technical efficiency, Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). SFA can set heterogeneity and can be used to analyze the effects of all the influencing factors quantitatively. Consider that the aim of this paper is to analyze the influence on the output efficiency of Chinese listed firms, which caused by financing constraints and principal-agent, so we choose SFA as the method of this paper. Using SFA, we must assign the type of production function. The structure of C-D production function is simple and its economic meaning is intuitive. So the empirical analysis of this paper uses stochastic frontier model which based on C-D production function.

When just consider capital (K) and labor (L), the structure of C-D production function is (1):

$$\ln Y = \beta_0 + \beta_1 \ln K + \beta_2 \ln L \quad (1)$$

where Y is output, β_0 , β_1 and β_2 are coefficient.

In order to show the character of panel data and the heterogeneity of financing constraints and principal-agent in different firms, based on (1) we assume that:

$$\ln Y_{it} = X_{it}'\beta + \varepsilon_{it} \quad \varepsilon_{it} = v_{it} - \mu \quad (2)$$

Where, $X_{it} = (1, \ln K_{it}, \ln L_{it}, \theta_j, \gamma_t)'$, θ_j and γ_t are dummy variables which represent industry effect and time effect; β is coefficient; the composite deviation ε_{it} consist of two parts, a white noise deviation $v_{it} \sim i.i.d.N(0, \sigma_v^2)$, and a nonnegative truncation of a

normal random variable with observation-specific mean and variance $\mu_{it} \sim N^+(\omega_{it}, \sigma_{\mu}^2)$. The heterogeneity of μ_{it} has been set as follow:

$$\omega_{it} = \exp(b_0 + \delta r_{it}' + \xi z_{it}') \quad (3)$$

Where b_0 is constant, $r_{it} = (CFLOW_{it}, EQUI_{it}, DEBT_{it})'$, $z_{it} = (GPAY_{it}, GSTK_{it}, HEYI_{it}, TOP1_{it}, ZDEX_{it}, HH15_{it})'$, δ and ξ are coefficient. We choose variables, $CFLOW_{it}$, $EQUI_{it}$ and $DEBT_{it}$, as the measurement of financing constraints, and choose variables, $GPAY_{it}$, $GSTK_{it}$, $HEYI_{it}$, $TOP1_{it}$, $ZDEX_{it}$ and $HH15_{it}$, as the measurement of principal—agent. The variables in the model reference to other related research, the meaning and computing method have been showed in Table 1.

Table 1. Meaning and Computing Method of Variables

Variable	Variable meaning	Computing method
$\ln Y$	the outputs of the firm	natural logarithm of operating income
$\ln K$	capital input	natural logarithm of net value of fixed assets
$\ln L$	labor input	natural logarithm of number of workers
$CFLOW$	cash flows of the firm	net cash flows generated from operating activities / net value of fixed assets on initial balance
$EQUI$	equity financing	the difference between the ending and beginning sum of capital reserve and paid-in capital/total assets of the end of the year
$DEBT$	debt financing	the difference between the ending and beginning debt/total assets of the end of the year
$GPAY$	executive salary	natural logarithm of the top three executive salary
$GSTK$	executive stockholding	executive stockholding/ total equity
$HEYI$	the general manager of company is hold concurrently by the President or not	yes is 1, no is 0
$TOP1$	the first major stockholder owns the proportion of shares	the first major stockholder owns the proportion of shares
$ZDEX$	equity restriction ratio	the first major stockholder owns the proportion of shares/ the second major stockholder owns the proportion of shares
$HH15$	equity concentration	sum of squares of the top fifth stockholder own the proportion of shares

(2)-(3) constitute the heteroscedastic stochastic frontier model, which can measure the loss of output efficiency quantitatively, caused by financing constraints and principal-agent. The estimation method of stochastic frontier model is Maximum Likelihood Estimation (MLE), and the logarithmic likelihood function is:

$$\ln L = -0.5 \ln(\sigma_v^2 + \sigma_{\mu}^2) + \ln \left[\varphi \left(\frac{\varepsilon_{it} + \omega_{it}}{\sqrt{\sigma_v^2 + \sigma_{\mu}^2}} \right) \right] - \ln \left[\Phi \left(\frac{\omega_{it}}{\sigma_{\mu}} \right) \right] + \ln \left[\Phi \left(\frac{\omega_{it}}{\sigma_{\mu}} \right) \right] \quad (4)$$

where $\omega_{it} = (\sigma_v^2 \omega_{it} - \sigma_\mu^2 \varepsilon_{it}) / (\sigma_v^2 + \sigma_\mu^2)$, $\sigma_\mu = \sigma_v^2 \sigma_\mu^2 / (\sigma_v^2 + \sigma_\mu^2)$, $\varphi(\cdot)$ and $\Phi(\cdot)$ are density function and cumulative distribution function of standard normal distribution.

All hypotheses in SFA could be test by the likelihood ratio (LR). The original hypothesis is $H_0: \mu_{it} = 0$, this means that financing constraints and principal-agent do not exist. The alternative hypothesis is $H_1: \mu_{it} \neq 0$. The likelihood ratio is $LR = -2\{\ln L(H_0) - \ln L(H_1)\}$, where $L(H_0)$ and $L(H_1)$ are the log likelihood value of H_0 and H_1 . LR is mixed Chi-Square distributed, the degrees of freedom is the number of independent variables. And we can test the correctness of the heteroscedastic stochastic frontier model by the likelihood ratio. Therefore we choose MLE to test the heteroscedastic stochastic frontier model in this paper.

The paper defines OEI_{it} as the output efficiency index.

$$OEI_{it} = \frac{\exp(X_{it}'\beta - \mu_{it})}{\exp(X_{it}'\beta)} = \exp(-\mu_{it}) \quad (5)$$

The value of OEI_{it} is between 0 and 1, with 0 indicating the least efficient, and 1 the most efficient. To make the measure operational, the expectation of the index conditional on the estimates is (Battese and Coelli 1988):

$$OEI_{it} = E[\exp(-\mu_{it}) | \varepsilon_{it} = \varepsilon_{it}] = \exp(-\omega_{it} + 0.5\sigma_\mu^2) \frac{\Phi(\omega_{it} / \sigma_\mu - \sigma_\mu)}{\Phi(\omega_{it} / \sigma_\mu)} \quad (6)$$

As the explained variable is logarithmic form, OEI_{it} in (6) is a relative percentage, which is the company actual outputs deviate from the optimal outputs.

3.2. Sample Selection and Data Sources

The empirical data are from Chinese CSMAR Solution, which contains data of Chinese listed firms. The sample period covered in this study is from 2007 to 2013, but as lags were used in constructing estimation variables, the actual estimation period is from 2008 to 2013. In the acquisition of the specific sample data, the data are filtered according to the following criteria:

- (1) Exclude financial industry, for the accounting system of financial industry is different from other industries, our research would be affect by it.
- (2) Exclude the special treatment (ST, *ST) firms, for these firms are mostly in the abnormal operating state.
- (3) Exclude firms which revenue growth is much than 150%, for these firms may have acquisitions.
- (4) Exclude incomplete data samples. Due to the problem of data disclosure, some of the company's financial data is missing, this type of companies would be eliminated.
- (5) All variables are winsored at 0.5 and 99.5 percentiles to avoid the influence of outliers.

Ultimately, we select 6031 sample. The descriptive statistics of variables are shown in Table 2.

Table 2. Descriptive Statistics of Variables

Variable	Mean	Standard Error	Maximum	Minimum
<i>lnY</i>	18.773	1.578	22.923	14.746
<i>lnK</i>	20.290	1.511	24.909	16.754
<i>lnL</i>	7.769	1.229	11.147	4.779
<i>CFLOW</i>	0.356	1.431	8.339	-6.096
<i>EQUI</i>	0.021	0.062	0.313	-0.075
<i>DEBT</i>	0.063	0.103	0.356	-0.217
<i>GPAY</i>	14.057	0.686	15.784	12.331
<i>GSTK</i>	0.038	0.104	0.549	0.000
<i>HEYI</i>	0.188	0.391	1.000	0.000
<i>TOP1</i>	36.216	15.119	74.451	9.000
<i>ZDEX</i>	15.011	26.371	165.731	1.011
<i>HH15</i>	0.171	0.119	0.561	0.013

4. Empirical Results and Analysis

4.1. Empirical Results of All Firms

The empirical results of different models have been shown in Table 3. The parameters of SFA in Model 1 is unrestraint, it means that financing constraints and principal-agent have influence on the output efficiency. And the effect of time and industry in Model 1 has been controlled. Model 2 to Model 5 are models based on Model 1, but appending some constraints. Model 2 supposes that principal-agent do not have influence on the output efficiency. Model 3 supposes that financing constraints do not have influence on the output efficiency. Model 4 supposes that financing constraints and principal-agent neither have influence on the output efficiency. Model 5 is the same as Model 4, but does not control the effect of time and industry.

Table 3. Empirical Results of Different Models

	Model 1: unrestraint	Model 2: $\xi=0$	Model 3: $\delta=0$	Model 4: $\mu_{it}=0$	Model 5:
Production Function					
<i>LnK</i>	0.382*** (24.18)	0.427*** (23.81)	0.370*** (23.12)	0.425*** (23.23)	0.402*** (24.34)
<i>LnL</i>	0.236*** (11.55)	0.319*** (15.24)	0.247*** (12.11)	0.326*** (15.16)	0.312*** (15.40)
<i>Time Effect</i>	control	control	control	control	—
<i>Industry Effect</i>	control	control	control	control	—
<i>Cons</i>	10.850*** (33.54)	8.256*** (29.16)	10.940*** (32.89)	8.075*** (27.16)	8.994*** (35.89)
Financing Constraints					
<i>CFLOW</i>	-0.142*** (-8.99)	-0.359*** (-7.56)			
<i>EQUI</i>	-0.969*** (-3.68)	-3.352*** (-2.66)			
<i>DEBT</i>	-0.365** (-2.61)	-2.023*** (-3.28)			
Principal-agent					
<i>GPAY</i>	-0.830*** (-23.48)		-0.864*** (-22.97)		
<i>GSTK</i>	-0.461**		-0.467***		

	(-2.44)		(-2.38)		
<i>HEYI</i>	0.112**		0.119***		
	(2.46)		(2.61)		
<i>TOPONE</i>	0.017***		0.018***		
	(3.95)		(3.77)		
<i>ZDEX</i>	0.006***		0.007***		
	(8.09)		(8.01)		
<i>HHI5</i>	-4.408***		-4.625***		
	(-7.53)		(-7.10)		
<i>Cons</i>	13.668***	-0.356	13.978***	-4.830**	-14.086
	(31.05)	(-0.61)	(29.97)	(-2.23)	(-0.14)
Log-likelihood value	-8829.924	-9390.201	-8900.999	-9450.419	-9992.346
LR1	2324.844	1204.290	2182.694	1083.855	-
P Value	0.000	0.000	0.000	0.000	-
LR2	-	1120.554	142.151	1240.990	2324.844
P Value	-	0.000	0.000	0.000	0.000

NOTE: *** Significant at the1% level. ** Significant at the5% level. * Significant at the10% level. Numbers in parentheses are t value. The number of observations is 6031. LR1 and LR2 are the chi-square value obtained by likelihood ratio test of Model 5 and Model 1. The empirical results are robustness based on Bootstrap 1000 times.

As shown in Table 3, in all models, the influence of the input of fixed assets and labor on output efficiency is significant. Time effects and industry effects are significant, due to limited space, the results have not been listed. The Log-likelihood value of Model 1 is the largest, so Model 1 is superior than other models, especially than Model 5, this means that financing constraints and principal-agent have significant influence on the output efficiency. Therefore, the following analysis is based on Model 1.

From the results of Model 1, we can see that cash flow, equity financing and debt financing all have positive influence on output efficiency of Chinese listed firms. As the representative of the ability of internal financing, the increase of cash flow can relieve the problem of financing constraints obviously, the result is the same as the result of pre-literature research about the relationship of financing constraints and cash flow, such as Yujun Lian (2009) [6]. And the dependency on internal financing also means that the problem of external financing constraints is serious. As the representatives of the ability of external financing, the increase of equity financing and debt financing can also relieve the problem of financing constraints. The major resource of Chinese listed firms' loan is the bank loan and as a whole the listed firms have equity financing preference, so the results are reasonable. These results demonstrated that financing constraints have significant influence on the output efficiency of Chinese listed firms, so the Hypothesis 1 has been verified.

Pay of the top three executives and executives' shareholding has significant influence on output efficiency of listed firms. It means that the problem of principal-agent exists between managers and owners. Increasing pay and shareholding of executives can relieve the problem of principal-agent and enhance the efficiency of output. The empirical results show that when the general manager of company is hold concurrently by the President, there will be a negative impact on output efficiency. The reason may be that the independence of the board has been affected. The sum of squared shareholding ratio of the top five major shareholders has positive influence on output efficiency. It means that equity focus on the top five major shareholders will reduce the cost of principal-agent and increase output efficiency. The proportion of the first largest shareholder and the ratio between proportion of the first largest shareholder and proportion of the second largest shareholder has a negative impact on output efficiency. This indicates that an excessive proportion of the first largest shareholder will make the largest shareholder controlling the firm excessively, so that the second kind of principal-agent will be existed in listed firms

and thus the output efficiency will be decreased. From the proportion of shareholders, we can see that if firms want to increase the output efficiency, they need to raise equity concentration but should avoid an excessive proportion of the first largest shareholder. These results demonstrated that principal-agent has significant influence on the output efficiency of Chinese listed firms, so the Hypothesis 2 has been verified.

4.2. Empirical Results of Firms in Different Regions

Different areas have their own development modes for China's vast land and larger difference of regional economic development. In order to explore the influence on the output efficiency in different places, the samples are divided into three parts, eastern firms, middle firms and western firms, and then estimated separately. The results are shown as Table 4.

Table 4. Empirical Results of Different Regions

	Eastern Region	Middle Region	Western Region
Production Function			
<i>LnK</i>	0.364*** (19.36)	0.386*** (7.44)	0.464*** (9.53)
<i>LnL</i>	0.258*** (11.35)	0.332*** (3.76)	0.169*** (3.32)
<i>Time Effect</i>	control	control	control
<i>Industry Effect</i>	control	control	control
<i>Cons</i>	11.186*** (29.87)	8.805*** (11.84)	11.493 (0.00)
Financing Constraints			
<i>CFLOW</i>	-0.116*** (-7.25)	-0.499*** (-4.24)	-0.369*** (-4.02)
<i>EQUI</i>	-1.559*** (-4.13)	-1.817 (-1.43)	-0.084 (-0.15)
<i>DEBT</i>	-0.518** (-2.27)	-0.078 (-0.11)	0.289 (0.79)
Principal-agent			
<i>GPAY</i>	-0.804*** (-18.69)	-1.372*** (-6.44)	-0.775*** (-10.57)
<i>GSTK</i>	-0.423* (-1.91)	-7.312** (-1.99)	0.057 (0.09)
<i>HEYI</i>	0.190*** (3.21)	-0.310 (-1.14)	-0.099 (-0.76)
<i>TOPONE</i>	0.012** (2.16)	0.066** (2.27)	0.018* (1.91)
<i>ZDEX</i>	0.005*** (5.99)	0.015*** (4.03)	0.006*** (3.81)
<i>HHI5</i>	-3.776*** (-4.94)	-13.145*** (-3.08)	-3.813*** (-3.06)
<i>Cons</i>	13.235*** (23.41)	19.318*** (7.67)	14.749 (0.00)
sample number (N)	4067	1072	892
Log-likelihood value	-5838.459	-1534.344	-1304.529

NOTE: *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. The empirical results are robustness based on Bootstrap 1000 times.

As shown in Table 4, the problems of financing constraints and principal-agent vary in different regions. The increase of cash flow can relieve the problem of financing constraints in all regions. The increase of equity financing and debt financing can relieve the problem of financing constraints in eastern region, but have no significant influence

on middle and western regions. Pay of the top three executives has significant influence on all regions, but executives' shareholding has significant influence only on eastern firms. It means that compared with equity incentive, salary incentives is more suitable for relieving the problem of principal-agent in middle and western regions. The proportion of the first largest shareholder, the ratio between proportion of the first largest shareholder and proportion of the second largest shareholder and the sum of squared shareholding ratio of the top five major shareholders have significant influence on all regions. The empirical results also show that when the general manager of company is hold concurrently by the President, it will has significant influence on eastern region, but has no significant influence on middle and western regions.

4.3. Analysis of Output Efficiency

One of the benefits of using the stochastic frontier model is that we can obtain the output efficiency of firms, from which the conditions of output efficiency of listed firms in China can be shown intuitively. Meanwhile it can show the severity of the problems of financing constraints and principal-agent indirectly. Table 5, shows the descriptive statistics of the output efficiency and Figure 1, plots the frequency distribution of the output efficiency index (OEI) of nationwide and the frequency distribution of the OEI of eastern, middle and western regions. The horizontal axis shows the outputs efficiency index and the vertical axis shows the frequency.

Table 5. Descriptive Statistics of the Output Efficiency Index

Place	Mean	Standard Error	Maximum	Minimum	Sample Number
Nationwide	0.779	0.177	0.997	0.131	6031
Eastern	0.762	0.180	0.996	0.157	4067
Middle	0.809	0.158	0.997	0.179	1072
Western	0.825	0.169	0.994	0.131	892

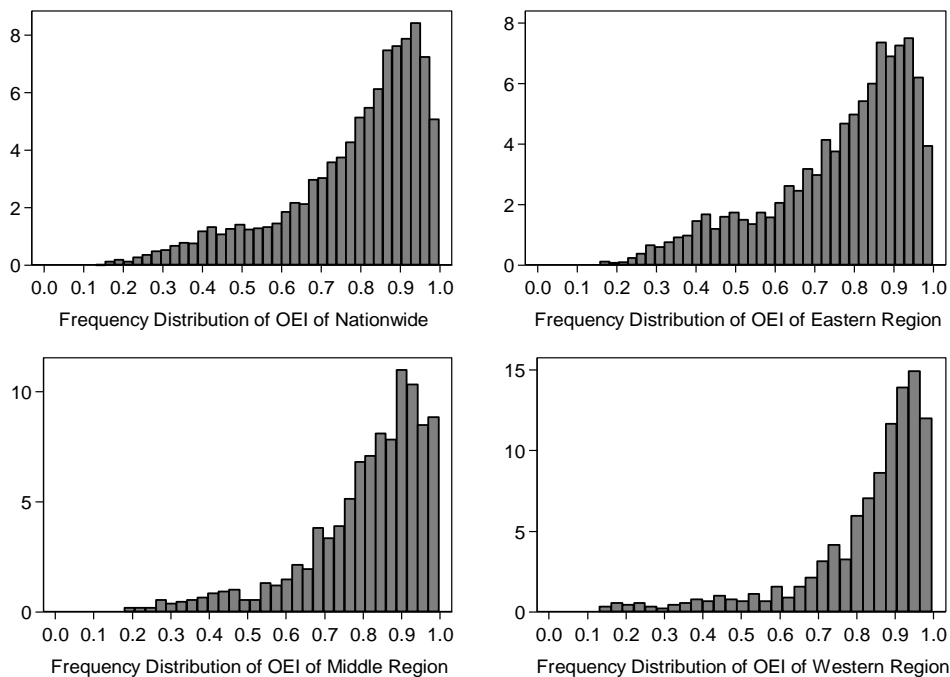


Figure 1. The Distribution of OEI

As shown in Figure 1, the output efficiency of Chinese listed firms varies in different firms, some of them have a relative high level of the output efficiency, but few of them are facing serious problems of financing constraints and principal-agent and the output efficiency is less than 0.5. From Table 4, we can see that the mean output efficiency is 0.779, and the standard deviation is 0.177, it means that the problems of financing constraints and principal-agent have significantly affected the output efficiency of Chinese listed firms.

Combine with Table 4, we can see that the mean output efficiency of eastern region is 0.762, the mean of middle region is 0.809 and the western region is 0.825, the standard deviation of the three regions are 0.180, 0.158 and 0.169, the sample number of the three regions are 4067, 1072 and 892. This indicates that though the number of firms in eastern region is large, the output efficiency varies greatly, and the problems of financing constraints and principal-agent are extremely serious in some of the firms, thus the output efficiency is lower in general. The number of listed firms in west China is few, and the firms must be outstanding so that they can have the opportunity to be listed, thus the output efficiency is higher in general. So the empirical results are reasonable.

5. Conclusion

As two of the most important governance mechanism, the influence of financing constraints and principal-agent on listed firms has always been a hot research area in academia.

By using the heteroscedastic stochastic frontier model, the paper chose the past 6 years' panel data of Chinese listed firms, and studied the influence of financing constraints and principal-agent on the output efficiency. The main conclusions are:

(1) As a whole, the mean output efficiency of Chinese listed firms is 0.779, the maximum is 0.997, but the minimum is just 0.131. And from the frequency distribution of OEI, we can see that the output efficiency varies, and skewed to the right in general. This means that the output efficiency of listed firms has a relatively high standing in general, but has been very low in partial. The highest mean output efficiency is western region, followed by middle region and eastern region. Previous studies have shown that the economic development in eastern region is better than middle and western regions. But the results in this paper show that the mean output efficiency in eastern region is the lower than western region and middle region. The reason may be that: the sample number in east China is 4067, significantly more than middle and western regions, and the standard deviation of eastern region is larger than middle and western regions, this means that the number of listed firms is large in east China but the output efficiency level varies greatly, which led to lower mean efficiency than middle and western regions. From the distribution figure, we also can find that the number of low output efficiency firms in eastern region is larger than middle region, and the number of low output efficiency firms in western region is the fewest.

(2) The problem of financing constraints has influence on the output efficiency of Chinese listed firms. As the representative of the ability of internal financing, the increase of cash flow can relieve the problem of financing constraints obviously, and have a positive impact on the output efficiency. As the representatives of the ability of external financing, the increase of equity financing and debt financing can also relieve the problem of financing constraints and enhance the output efficiency.

(3) The problem of principal-agent has influence on the output efficiency of Chinese listed firms. Salary incentive and equity incentive on executives can relieve the problem of principal-agent, and improve the output efficiency. When the general manager of company is hold concurrently by the President, the output efficiency will be affected negatively. The excessive shareholding ratio of first major shareholder has a negative

influence on the output efficiency. Raising the equity concentration of the firms can reduce the cost of principal-agent and enhance the output efficiency. In order to enhance the output efficiency, the firms should raise equity concentration but avoid an excessive proportion of the first largest shareholder.

(4) The problems of financing constraints and principal-agent in different regions have different influence on firms. Cash flow has significant effect on the output efficiency in all regions. The increase of equity financing and debt financing can relieve the problem of financing constraints in eastern region, but have no significant influence on middle and western regions. Salary incentive on executives has significant effect on all regions. Equity incentive on executives only has significant effect on eastern region. This means that compared with equity incentive, salary incentives is more suitable for relieving the problem of principal-agent in middle and western regions. The general manager of company is hold concurrently by the President has a significant negative effect on the output efficiency of eastern region, and but has no significant effect on middle and western regions. Equity structure and equity concentration has significant effect on output efficiency in all regions. In order to increasing the output efficiency of firms, we should raise equity concentration but should avoid an excessive proportion of the largest shareholder.

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