Evaluation on the Growth of Listed SMEs Based on Improved Principal Component Projection Method

Li Li, Ci Jinfeng
Shenzhen Graduate School, Harbin Institute of Technology, Shenzhen, P.R.China, 518055
(E-mail: ximlli@yahoo.com.cn, cijinfeng19830411@163.com)

Abstract Small and medium enterprises are an integral parts of economic development, and the growth of listed SMEs can be taken as an indicator. This paper sets up a growth index system to evaluate the growth of listed SMEs. Using a sample of 64 listed SMEs on the Shanghai and Shenzhen stock exchange, this paper empirically verifies the growth and current development situation of listed SMEs based on improved principal component projection method. Results show that growth of information technology industry is higher than manufacturing, the key elements of enterprise growth lie on current situation, profitability and fund operation ability. This paper also puts forward corresponding countermeasures and suggestions on small and medium enterprises growth.
Key words Listed SMEs; Enterprises growth; Growth index; Improved principal component projection

1 Introduction

SMEs(Small and medium listed enterprises) are integral part of the market economy, with the characteristics of faster development, more flexible and easier to implement innovation, plays a vital role in the development of the whole economy. SMEs also have the characteristics of poor ability of the resistance risk, development of instability and lower mortality rates. Therefore, the study of the SMEs growth is also extremely important. From previous studies' results, we can only find the consequence of all the enterprises, but we can not learn the real development situation of enterprises. In this paper, the improved principal component projection method will be used to study the listed SMEs growth. From the result of this paper, we can not only learn the consequence of the selected listed SMEs growth, but we also learn the development situation of enterprises.

2 Literature Review

Enterprise growth, a description of growth state, indicated the sustained growth capability and the overall expansion situation in a certain period, which were achieved through exploiting various resources of enterprise[1]. At present, researches on SME growth mainly focus on the establishment of evaluation index and the choice of evaluation method. Because of the great differences existing in different cultures, politics and economy of different countries and regions, we could not simply apply one index system to analysis their enterprises growth. So there still existed divergence in enterprises growth theoretical analysis[2].

Storey(1998), who proposed comparatively authoritative SME growth theory, held that the manager's quality, internal quality of SME and strategic scope of enterprises development were the three types of factors determining SMEs' growth[3]. Myers & Turnbull proposed the negative relationship between growth and the debt ratio based on the their relationship research[4]. Slevin and Covin(1990) established a model to explain connections lying in time, complexity of the external environment and SME growth[5].

The evaluation index system, totally adopting financial indexes, were co-established by SME Division of former State Economy and Trade commission, Industry and Transport Statistics Division of National Bureau of statistics and CRCM, included six indexes' evaluation system divided into three types. BBA financial performance evaluation system included the analysis of debt-paying ability, operational efficiency, profitability, stock investors profitability, cash flow ratio, growth ability, structural factor and other indicators. Cong (1997) proposed the financial evaluation index system of enterprise growth composed by six indexes, growth rate of net asset return, the main business profit ratio, the main revenue and profit synchronous growth, capital maintenance and appreciation ratio, profit reserved retention rate, and acceleration rate of capital turnover[6]. For the researches on evaluation method, there are progression method, principal component analysis, gray correlation analysis (GRA), beta coefficient method of conciliation and other research methods and so on. Chen, et al.(2006) built the index system of evaluating the SME growth and used catastrophe method and gray relation analysis

(GRA) respectively to carry out the growth of SME which were listed on Shenzhen and Shanghai stock exchange, whose effectiveness of evaluation results were inspected through regression model[7]. Zhang, et al.(2009) constructed the evaluation indexes of SMEs from the endogenous and exogenous, and confirmed the rationality about the index through using the samples in Shandong province[8]. Mu, et al. (2005) built SME growth evaluation model with the application of principal component analysis and made empirical analysis accordingly[9].

Those SME growth research results obtained through the above methods have little practicability, for they can only reflect SMEs' growth consequence, but the actual development situation of SMEs can not be reflected. This paper will use the improved principal component projection method to study the growth of SMEs listed on Shenzhen and Shanghai stock exchange and the result can not only reflect the SMEs' growth consequence, but also reflect the truthfully development situation of enterprise and present reference value to the enterprises managers, investors and relevant policy makers and so on.

3 Research Method

3.1 Determining the analysis matrix

The analysis matrix of improved principal component projection method includes two parts. One part is the evaluated index matrix; the other part is constructed by k +1 endpoints of k intervals of each index. It is:

$$\boldsymbol{X} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n-k+1,1} & x_{n-k+1,2} & \cdots & x_{n-k+1,m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}_{n\times m} \tag{1}$$

X_{ij} is the j_{th} ($1 \le j \le m$) evaluation index number of the i_{th} ($1 \le i \le n$) evaluation object.

3.2 Standardizing the data

Maximal index

$$y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max\limits_{0<i<n}(x_{ij}) - \min\limits_{0<i<n}(x_{in})} \tag{2}$$

Minimal index

$$y_{ij} = \frac{\max\limits_{0<i<n}(x_{ij}) - x_{ij}}{\max\limits_{0<i<n}(x_{ij}) - \min\limits_{0<i<n}(x_{in})} \tag{3}$$

$y = (y_{ij})nm$ ($0 \leqslant y_{ij} \leqslant 1$) is the standardized evaluation matrix.

3.3 Determining the index weight

This paper adopts the method of objective weighting—variation coefficient method. The coefficient of variation of the j_{th} index is $V_j = \sigma_j / X'_j$, and σ_j is the standard deviation of the j_{th} index, whereas X'_j is the mean of the j_{th} index. The weight of the j_{th} index is

$$w_j = \frac{v_j}{\sum\limits_{j=1}^{m} v_j} \tag{4}$$

$Z = (Z_{ij})_{nm} = (W_j \times Y_{ij})$ is the weighted index matrix.

3.4 Orthogonal transformation of index

Evaluation matrix orthogonalization can filter out duplicate information between indicators, avoid duplication of information, mutual interference, and more objective reflects the degree of importance of each index. Ordering $U=Z\times A$, we can get the orthogonal decision-making matrix $U=(u_1,u_2,\ldots u_m)$ and U satisfies the following condition:

$$U'U = A'(Z'Z)A = \begin{bmatrix} \lambda_1 & & & \\ & \lambda_2 & & \\ & & \ddots & \\ & & & \lambda_m \end{bmatrix}_{n\times m} \quad (\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_m) \tag{5}$$

In the equation, $A(\alpha_1, \alpha_2, \ldots \alpha_m)$ is orthogonal matrix, α_j is the j_{th} eigenvector of the matrix $Z'Z$, λ_j is the j_{th} eigenvector of the matrix $Z'Z$.

3.5 Constructing ideal decision-making object and calculating the projection value

Ordering $d_j = \max(u_{ij})$ $(1<i<n)$, we can construct the ideal decision-making object $d^* = (d_1, d_2 \ldots d_m)$. Then we can calculate the projection value D_i, which is the projection value of the i_{th} evaluated vector in the ideal decision-making object.

$$D_i = \bar{u} \cdot d_o^* = \frac{\sum_{j=1}^{m} d_j u_{ij}}{\sqrt{d_1^2 + d_2^2 + \cdots d_m^2}} \tag{6}$$

3.6 Ordering the projection values and determining the level

Through above calculating, we can get those projection values of all the indexes. And the projection values of the latter (k+1) endpoints will form k intervals. Those intervals correspond to different criteria level. Those projection values of the former (n-k+1) objects must fall into those k intervals. Eventually, we can get the situation of the evaluated object according to the level of the interval which its projection value fall into[10-11].

4 Empirical Analysis

4.1 Data and index system construction

(1) Sample Selection

According to the standard set up by the National Bureau of Statistics, the State Economic and Trade Commission and the Ministry of Finance, those enterprises which meet the condition that the annual sales revenue or total assets value is less than 500 million will be defined as SMEs. According to that condition, this paper selected 64 small and medium-sized enterprises which are listed on the Shanghai and Shenzhen Stock Exchange, and collected three-year data from 2006 to 2008 for the empirical analysis. All the data are from Wind Info.

(2) Endpoint Value Determination

When determining the endpoint value, the paper takes all the listed SMEs as the research objects. The difference value of the standard value between two adjacent grades is the difference between maximum and minimum value of the index of all the listed SMEs divided by 5.

(3) Evaluation Index System

Based on researches of Chen Xiaohong and Yu Jian (2005), Ci Renyong and RenJie (2009), Bai Zuwen (2009), this paper establishes an index system which includes four levels and eleven final indicators. The index system includes two dimensions, the current situation of the enterprise and the development potential of the enterprise. The current situation of the enterprise includes the growth ability which includes average sales net profit ratio of enterprise in nearly three years(c1), average sales gross profit ratio of enterprise in nearly three years(c2), net capital increasing ratio(c3) and total capital increasing ratio(c4), fund operation ability which includes asset-liability ratio(c5) and profitability which includes major business profit ratio(c6), net assets gain(c7), and assets return ratio(c8). The development potential of the enterprise includes market expectation which includes multiple rates of net assets(c9) and development driving capacity which includes undistributed profit in this year/shareholders equity(c10) and surplus accumulation increasing in this year/ net assets(c11).

The test result which is calculated through principal component analysis is listed in table 1.

Table 1 KMO and Bartlett's Test

Kaiser-Meyer-OlkinMeasure of Sampling Adequacy.		.777
Bartlett's Test of Sphericity	Approx. Chi-Square	1.227E3
	df	55
	Sig.	.000

Form the table l, we can learn that the value of the KMO was 0.777>0.6 which suggested that the indicators used in the study had higher degree of the information overlap and the principal component

could be used. The result of the Bartlett Sphericity test, accompanied given probability was 0 which was less than 0.05, showed that the indicators used in the study had a strong correlation; therefore, the result of the principal component analysis was effective. And we also found the cumulative contribution value of all the variances was about 88.97% which was more than 80%, which suggested that all the chosen evaluation indexes could reflect the growth of all the listed enterprises. All the results of the test mean that we could use the principal component method to study the listed SMEs growth.

4.2 Results Analysis

This paper adopted the Matlab software and the excel software to carry on the related operation and the calculation. Results were listed in the table 2. From the table 2, we can clearly learn that most of the selected listed SMEs were high growth enterprises.

We can use the basic operational situation of enterprises of the next year to judge the effect of rank. Measurement indexes are divided into positive, promoting business growth and negative indicators, inhibiting business growth. Positive indicators include: corporate main business income exceeded (the enterprise which the main business income is more than 500 million Yuan will no longer applies evaluation system for SMEs), total capital stock exceeded (the enterprise which the total capital stock is more than 5000 shares of equity does not apply evaluation system of small and medium sized companies) and earnings growth. Negative indicators include: flat performance, earnings decline and loss. Evaluation results are as follows.

Table 2 The Evaluation Results of SMEs Growth

Grade	Excellent	Good	Generally	Low	Poor
Sample quantity	1	56	7	0	0
Sample percent	1.56%	87.5%	10.94%	0	0

Table 3 The Evaluation Results of Measurement Index and Effectiveness

Sample quantity	Top 20	Top 40	Total
Income exceeded	1	7	10
stock exceeded	8	11	19
earnings growth	8	14	21
flat performance	2	4	7
earnings decline	1	4	7
Loss	0	0	0
Effectiveness	85%	80%	78%

The results which can be seen from the evaluation results are good. The effectiveness of the top 20 enterprises is 85%, the effectiveness of the top 40 enterprises is 80%, and the effectiveness of the overall is 78%. All the evaluation results are more than 75%, so the evaluation result calculated by the improving principal component projection method is satisfactory.

From the empirical results, we can learn that the ranked of the 12 information technology companies of the selected 64 companies were the forefront, of which one is the fast-growing enterprise. And the latter six companies which are placed at the bottom surface of are manufacturing. And we found that the growth index has positive correlation with c1, c2, c3, c4, c5, c6, c7, c10, c11 and has negative correlation with c8; and c9 is positively correlated with the growth index, but not obvious. Through studying the overall listed SMEs, we found that the average of the indicator (c1, c2, c3, c4, c5, c6, c7, c10 and c11) of the information technology industry is higher than the corresponding average of the manufacturing, and the average value of the 8th index is lower than the corresponding average of the manufacturing. The result is showed in Figure 1.

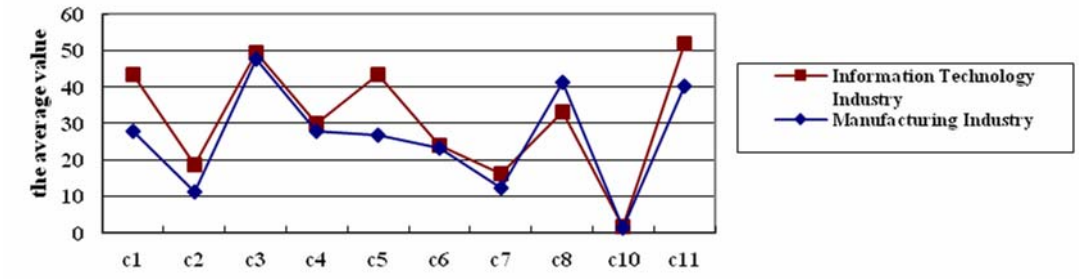

Figure 1 Indexes Average Value Comparison

5 Conclusions and Suggestions

SMEs play an important role for a country or a region's economic development. Therefore, government should attach importance to the development of SMEs. First of all, government should create a favorable market environment for SMEs' operation as well as the coordination between various industries and enterprises .To achieve this goal, government should develop and improve the legal system of SMEs to make SMEs under the legal protection, and a favorable social environment trough optimizing the administration is also necessary. Secondly, government should create an appropriate support services to know effectively and smoothly the difficulties that SMEs faced. Government can provide targeted services for them. It can not only improve the accuracy and effectiveness of government policy, but also make SMEs gets better support and help. Thirdly, funds are the strong support for enterprise growing and development. Government should actively promote SMEs credit guarantee system, and encourage medium and small financial institutions to offer financial services to SMEs in order to let them gain finance smoothly. Government should also attach importance to SMEs cluster development; they can set up a corresponding system to organize the scattered SMEs in order to improve the technical level and structure of SMEs. The measures solve many problems that SMEs faced such as limited resources, lack of funds, low technology and technological innovation ability and lack of scale of the economy. At the same time, government should actively promote the building of SMEs networks, to strengthen inter-regional cooperation among SMEs to achieve the sharing of business, technology and information, and effectively promote cluster development of SMEs.

As to enterprise alliance, enterprises should accord to their own as well as other enterprises' circumstances to establish strategic alliances, such as production alliances, market knowledge and union league alliances. Through these alliances enterprises will not only learn from each other, reduce conflict among enterprises, but also can achieve risk-sharing, rational distribution and use of resources as well as the ideal of multi-benefit. In addition, SMEs can establish and strengthen the coordination with large enterprises to make effective use of external resources to let they survive. At the same time, SMEs can strengthen scientific and technological cooperation with universities, because universities have a lot of R&D talents and R&D projects, what's more, they can transfer their technology at a low cost, which will be beneficial to the development of SMEs.

Innovation is an inexhaustible motive force for enterprise development. Therefore, SMEs should encourage and foster staffs' awareness of innovation, strengthen the training of high-tech enterprise technology to improve their staffs' technological innovation ability and R & D capability. In addition, SMEs can improve managers' management capacity by training. Different levels of manager need different training methods. Long-term management training should be conducted for senior manager and key manager, while middle managers and administrative personnel only need short-term training. At the same time, the financial management of SMEs is inefficient, so SMEs should strengthen financial management.

References

[1] Li X., Zhao X., Gao J. Study on Growth Characteristics of High-Tech Enterprise Based on Factor Analysis[J]. Statistics & Information Forum, 2008, 23(9): 81-84 (In Chinese)

[2] Chen J. A Cross-National Comparison of Critical Success Factor of Small Enterprises[J]. Chinese Journal of Management Science, 2001, (9): 68-73 (In Chinese)

[3] Storey D.J., Tether B. S. New Technology-based Firms in the European Union: An introduction[J]. Research Policy, 1998, (1): 933-946

[4] Myers J., Turnbull M. The Capital Budgeting and the Capital Asset Pricing Model:Good News and Bad News[J]. Journal of Finance, 1977, (1): 321-333

[5] Covin J. G., Slevin D. P. New Venture Strategic Posture, Structure and Performance:An Industry Lifecycle Analysis[J]. Journal of Business Venturing,1990, (5): 123-125

[6] Cong P. The Business Growth Evaluation[M]. China Academic Journal Electronic Publishing House, 1997: 25-26(In Chinese)

[7] Chen X., She J., Zou X. The Comparative Research on Evaluation of the Growth of the Listed SMEs[J]. Science Research Management, 2006, 27(1): 145-151(In Chinese)

[8] Zhang Y., Liu D. Evaluation on the Growth Mechanism of Small and Medium-Sized Technology Enterprises-Based on Index Construction and Empirical Analysis[J]. Soft Science, 2009, 23(11): 107-113(In Chinese)

[9] Mu J., Han W., Li Q. Model and Application of Small-Medium Enterprise's Growth Assessment

Based on Principal Component Analysis[J]. Systems Engineering-Theory Methodology Applications, 2005, 14(4): 369-371(In Chinese)

[10] Li L., Zhou P., Li Z. Dalian High-Tech SMEs Growth Evaluation Based on Catastrophe and Principal Component Projection Method[J]. Service Science&Management, 2009, (2): 282-288(In Chinese)

[11] Xu J., Zhang Q., Wu J. Application of Efficacy Coefficient Method to Determination of Rock Preferred Structural Plane[J]. Journal of Hohai University, 2008, 36(4): 538-541(In Chinese)