

Research on the Influences of Private Equity on Small and Medium-sized Enterprises in Big Data Era

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Small and medium-sized enterprises (SMEs) have an important position in China's economic structure. However, comparing to the large state-owned monopoly enterprises, the SMEs still stays in an inferior position due to the existing economic system, this position makes the SMEs hard to utilize the traditional way of financing. The present evaluation system can't meet the demands of the SMEs because the environment has a great impact on SMEs and these enterprises have a high possibility to transform. In order to evaluate the value of the enterprise, this paper takes the objective environment that may affect the development of enterprises into consideration, combines with the latest research results, proposes an emotional neural network for the investment agency to evaluate the value of the SMEs.

1. Introduction

Small and medium-sized enterprises (SMEs) as the main force of China's economic transformation and innovation, play an important role in the economic development and social progress. Fortunately, in addition to the traditional way of financing, new means of financing private equity investments provide a new opportunity and way out for the SMEs, Yu, Y., Liang, L., & Gao, Y. (2013) reported. Private equity (PE) mainly for private company equity investment, it originated in the United States, is a product of financial innovation. Private equity's history can be traced back to 1946 years of research and development companies in the United States (ARDC) was set up, it was created to provide financing support technology-based start-ups, and after growth, the company to earn profits by equity exit, Zhu, X. (2012) reported. Private equity funds in China only have a short history, with the rapid development of economy and expanding of relevant industry in our country, the total capital the economy and industries provided grow to a big amount, which form a new solution to the problem of SMEs' financing. Private equity investment funds, after all, its purpose is gaining profits, how to choose good projects become an important issue. However, at present, our country's related investment evaluation and project selection system is not perfect, the current evaluation models' applicable scope is too narrow. Moreover, SMEs are easily affected by environment and policy, with the advent of the era of big data, more and more factors are generated, the traditional evaluation model based on the project's own financial status is difficult to satisfy the expected forecast.

In order to effectively examine the profitability and investment expectations of the enterprises under the environment of big data. This paper puts forward an emotional neural network model which can excavate various kinds of information comprehensively.

2. SMEs financing and private equity investments

Private equity funds can be earliest traced back to the American Research and Development Company (ARDC) established in 1946, its original purpose was to provide support for some technology start-ups through equity investment to help them overcome the financing obstacles, and benefit from equity withdrawal. The establishment of the private equity funds in the United States has quickly become the solid power of the expansion of SMEs, and in a period of time, the funds greatly promote the development of the U.S. economy. China's private equity funds was originated from the risk investments in the 1980s. In January 1985, the central committee of the communist party of China issued the "Decision of reform on the system of science and technology", the document clearly put forward the promotion of high technology and support of venture investment, in the same year in September, the first venture investment of private equity fund in Chinas was

set up, Larrañeta, B., Zahra, S. A., & González, J. L. G. (2012) reported. With the development of world economy and evolution, newly emerging country markets, including China, have become the hot spot of private equity investment, the huge amount of flowing in money alleviate the financing difficulties of SMEs, but the money also cause the problem of lack of good projects. Although the cost evaluation method can evaluate the parameters and the relevant inputs data are easy to obtain, but this method only applies to single enterprise assets, and it does not consider the effect of intangible old depreciation of assets, Rosenbusch, N., Brinckmann, J., & Müller, V. (2013) reported. Although the operation of relative evaluation method is easier and the contrast relationship is also very clear. But to find a completely similar company to the target enterprises from the listed companies is very difficult and at the same time, it also does not apply to the strong-periodic enterprises and diverse-development enterprises.

Finally, this method doesn't consider the changes of private enterprise in the IPO stage, this is a potential risk factors in relative evaluation method, Brewer, R. M., & Pedersen, P. M. (2013) reported. Discounted cash flow technique is a commonly used method in enterprise value evaluation. This method heavily relies on the accurate prediction of the enterprises' future free cash flow which is almost impossible. In addition, this method only considers the financial accounting information, therefor the results of the evaluation are too simple and have certain limitation. Option valuation method puts the time value and possible opportunities of the cash flow method into consideration, but the option valuation method is still limited due to multiple assumptions and high requirement on the market, and parameters in the option valuation is hard to estimate, Garg, A. K., & Kumar, K. (2014) reported. Based on the analysis above, these commonly used evaluation methods aren't suitable for the SMEs value evaluation in big data era. Therefore, a more suitable evaluation process is designed in the next chapter.

3. SMEs equity investment strategy based on big data

3.1 The big data and equity investment

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Small and medium-sized enterprises (SMEs) as the main force of China's economic transformation and innovation, play an important role in the economic development and social progress. Fortunately, in addition to the traditional way of financing, new means of financing private equity investments provide a new opportunity and way out for the SMEs. With the coming of information age, technology of data acquisition, storage and processing develop in a fast speed. Big data era can impact many areas, including the academic area.

Many top grade journals have published special issues on big data, the US government issued the "big data research and development plan" to elevate the development of big data and research to the state level, and the plan is treated as a major development strategy of US.

Big data doesn't equal to simple accumulation of data, at the same time of information explosion, the data mining technology are developing rapidly, big data mainly collects the objects' multidimensional data through various channels, then with analysis and mining of huge amounts of data, finds out the potential patterns of behaviors or related information. Big data mining has a very wide range of applications, it also brought us a lot of unexpected harvest.

At present, however, based on the enterprise equity evaluation, big data related research is very few, therefore, this article hopes to make some attempt to extract useful information from vast amounts of information, and use that information to evaluate investment projects.

3.2 The basic process of big data method

Big data, as the current research hot spot, has been widely known. The era of big data points out that the big data has the characteristics of 4v: Volume, Velocity, various and Value [3]. Big data does not mean the simple accumulation of data, Big data means selection, analysis and processing of meaningful data, so as to solve practical problems.

In order to present the process of data mining more intuitively, table 1 lists the basic process and common methods of data analysis, through the cobwebs of the data, step by step analysis, we can find useful information of complex data.

Control problems in this paper, the birth and development of the financial industry, Internet itself is closely connected with the advent of the era of big data, and for small and medium-sized enterprises, large data in their survival and development of the information as well.

Next, we will combine the Internet platform for developing and small and medium-sized enterprise financing configuration and selecting the two specific problems in specific description, and puts forward the solutions and thinking.

Table 1. The basic process of big data analysis

Steps	Purposes	Method
Data collection	Data mining	1.Find data source 2.Crawl the web to build database 3.Analyze co-linear relationship, build up related database 4.Generate data through questionnaires and interviews
Data pre-possessing and standardization	Possess on the source data	1.Data transform 2.Z-score or other methods of standardization
Select on data characteristics	Find meaningful variables through the source data	1.Statistical methods 2.Intelligent algorithms
Data fitting and analysis	Get conclusion	1.Decision tree 2.Neural network 3.SVM

3.3 Return on investment model based on the emotional neural network

In order to better fit for input and output ratio of SMEs, this article attempts through the neural network to fit private-equity investment and income. The most commonly used neural network model is the BP neural network model, through the fitting of input and output, we can get an approximation model though the investment income in the black box, Niendam, T. A., Laird, A. R., Ray, K. L., et al (2012) reported.

In the process of our investment, in addition to some objective factors, such as the public's attitudes towards the enterprise and so on. The investment process has a lot to do with human emotion, both of these two procedure have same mode of thinking, for example, the subjective impression may not be accurate, but it can be very intuitive to affect the final result, Lotfi, E., & Akbarzadeh-T, M. R. (2014) reported. However, this new type of neural network is often used in image processing, Lotfi, E., Setayeshi, S., & Taimory, S. (2014) reported, or audio data. In this article, we will use experts' subjective item score as the emotional value. We can promote the method to this new field.

In order to facilitate understanding, figure 1 shows the general structure of the emotional neural network, each variables' annotations may refer to the picture:

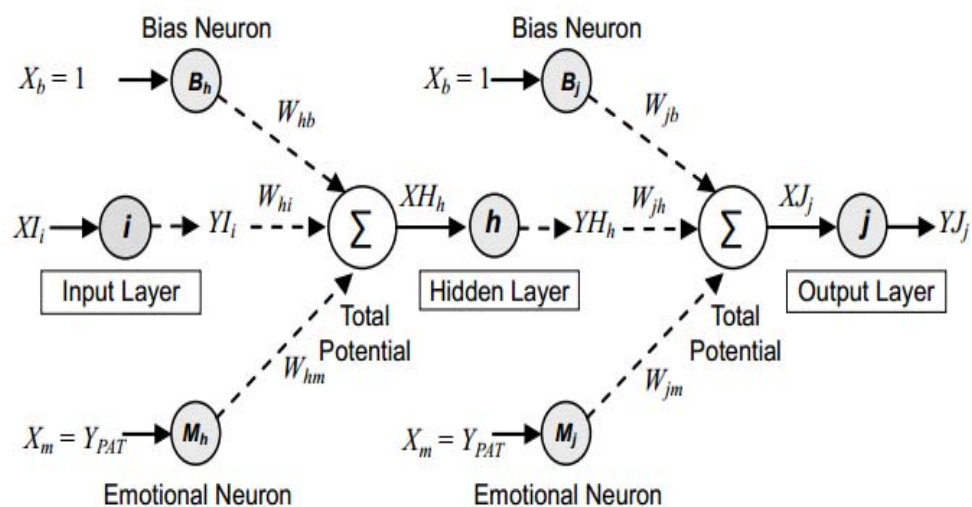


Figure 1: The structure of the emotional neural network and its related parameters

The input in the input layer is XI_i , after an untreated neurons, then:

$$YI_i = XI_i \quad (1)$$

And after a step function of hidden layer:

$$YH_k = \left(\frac{1}{1 + \exp(-XH_k)} \right) \quad (2)$$

Because we add new paranoid quantity, set the input of three parts respectively as: $TP_{hb}, TP_{hc}, TP_{hm}$. When the input is r , they respectively equal to:

$$TP_{hb} = W_{hb} \cdot X_b \quad (3)$$

$$TP_{hc} = \sum_{i=1}^r W_{hi} \cdot XI_i \quad (4)$$

$$TP_{hm} = W_{hm} \cdot X_m \quad (5)$$

then:

$$XH_h = TP_{hc} + TP_{hb} + TP_{hm} \quad (6)$$

In this article, the emotional value we selected is the average number of number k emotional value, then:

$$X_m = Y_{PAT} = \sum_{x=1}^k \frac{p(x)}{k} \quad (7)$$

By such analogy:

$$YJ_j = \left(\frac{1}{1 + \exp(-XJ_j)} \right) \quad (8)$$

Because we add new paranoid quantity, set the input of three parts respectively as: $TP_{jb}, TP_{jc}, TP_{jm}$. The calculation process of error is as follows:

$$E_p = \sum_{j=1}^{N_j} (T_{pj} - YJ_{pj})^2 \quad (9)$$

$$YJ_j = f(XJ_j) \quad (10)$$

Finally, it is the weights update from input layer to hidden layer:

$$\begin{aligned} \Delta_h &= f'(XH_j) \cdot \sum_{j=1}^{N_j} W_{jh} \Delta_j \\ &= YH_j \cdot (1 - YH_h) \cdot \sum_{j=1}^{N_j} W_{jh} \Delta_j \end{aligned} \quad (11)$$

$$W_{hi}(\text{new}) = W_{hi}(\text{old}) + \eta \cdot \Delta_h \cdot YI_i + \alpha \cdot [\delta W_{hi}(\text{old})] \quad (12)$$

$$W_{hb}(\text{new}) = W_{hb}(\text{old}) + \eta \cdot \Delta_h + \alpha \cdot [\delta W_{hb}(\text{old})] \quad (13)$$

$$W_{hm}(\text{new}) = W_{hm}(\text{old}) + \eta \cdot \Delta_h \cdot Y_{AvPAT} + k \cdot [\delta W_{hm}(\text{old})] \quad (14)$$

Through the above process, repeatedly, by debugging of testing and validation group, we can obtain a neural network which can fit the ratio of input and output of the industry.

4. The experimental data and results

Based on the model in the previous section, we can carry out the experiment. In this article, we have integrated several data provided by the partners' private equity firms, including 45 home small business investment and income data, and related information. In addition, we also to search on the Internet and collect related index of enterprise and industry. And we invited 10 experts to grade some subjective reference quantity.

Eventually, our data set, including the indexes of 8 financial indicators, 9 production indicators, 6 technical indicators, 5 management indicators, 6 market indicators, 5 experts' impression indicators, 1 Internet tendency indicators, as a total of 40 indicators. Network orientation indicators and experts; impression indicators, appear as the amount of emotion in this paper's neural network. In this article, the enterprise of input and output ratio $P = out/in$ is our goal, also it's our network output, p is expressed successful investment. As a result, our network consists of 34 input layer nodes, a comprehensive amount of emotion, 1 output layer node. By convention, 17 samples are treated as the training set, 14 samples as validation set and test set, and a cross validation is carried out.

In table 2, the mean square error represents the differences between the output result and real result of neural network. Based on the output of the case, we also concentrate on equity investment benefit of the test case for sorting, of which, the sorting accuracy rate shows the accuracy rate between the output ranking and the real ranking in contrast. The biggest difference was expressed our ranking and the biggest difference between real ranking. In addition, we also choose the traditional BP network, and discount cash flow method and the relative valuation method to compare the results.

Table 2. The input and output ratio of the private equity investment based on the emotional neural network

	Expected Error	Rank Accuracy (%)	Max Error
Discounted cash flow method	—	64.29	6
Relative valuation method	—	57.14	9
BP Neural Network	0.1257	71.43	5
Emotional Neural Network	0.0732	85.71	3

According to the chart above, the emotional neural network accurately analyzes the investment value of enterprises, and a preliminary compare of the advantages and disadvantages of the target enterprise are provided to the policy makers.

5. The outlook and summary

The present evaluation system can't meet the demands of the SMEs because the environment has a great impact on SMEs and these enterprises have a high possibility to transform. In order to evaluate the value of the enterprise, By using the improved emotional neural network, this paper completes the modeling process of the private equity investment process of SMEs. The emotional neural network reforms the traditional network model, it focuses on the research on the factors may affect the investment value of the enterprise. In the end, it is verified by examples that the method can provide a reliable basis for the analysis of target enterprise value. By means of multivariate fitting, this paper demonstrates the artificial intelligence can help us further in

the era of big data, and successfully obtain information which hard to get by human power. Therefore, with the rapid development of information and continuous accumulation of data, in the process of enterprises evaluation, artificial intelligence data mining will become an important research topic, this is what we strive to move forward to.

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