Analysis on The Influence Mechanism of Corporate Stock Price Based on Lasso RBF Neural Network

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Abstract. In order to study the correlation between stock prices and financial indicators of Chinese listed companies, this paper selects representative and relevant data from CSMAR to study 12 indicators as input layers, which reflect the solvency, profitability and management ability of the companies. Based on the lasso algorithm, the data dimension is reduced to 5 indicators; a lasso RBF neural network is constructed and the neural network is trained to obtain the company's stock price simulation. The results show that the model has good robustness and the accuracy of the stock price fitting is 93%. Among them, the main contribution of net investment cash flow to stock price is 25.46, which provides some suggestions for stock price prediction analysis.

Keywords: RBF, Financial Indices, Stock Prices, Lasso Algorithm.

1. Introduction

As the Chinese stock market continues to grow, equity investment is an option for many investors. When it comes to equity investment, the share price is one of the key factors that investors need to pay attention to. There is currently a lot of research in this area. There are many different factors that contribute to the volatility of stock prices, all of which can be classified into two categories in terms of the extent of their influence: systematic and non-systematic factors. These refer to information such as GDP growth rates, interest rates, exchange rates and relevant macroeconomic policies that may affect most or all of the market. Non-systematic factors refer to information that only affects individual listed companies, mainly affecting the micro aspects themselves, such as issued share capital, total capital, earnings per share growth rate, earnings after tax per share and net asset growth rate, etc. Ren Chong Liu(2010) Bank stocks are considered to be significantly correlated with equity capital, net assets per share, profit after tax per share, GDP, and the market as a whole; based on statistical analysis. Zhou Li et al.(2001) found that the study found that earnings per share had the most significant impact on stock prices and the higher the earnings per share and the higher the turnover, the higher the stock price; Based on a multiple linear regression model, Li Ling(2021) finds that cash flow is positively correlated with the company's share price, and the more abundant the cash flow, the more robust the company's operation, and the company's share price will also increase; Xu Yubo and Li Ruifen(2016) believes that the stock prices of listed companies are influenced by their profitability, growth capacity and capital structure, with profitability and growth capacity having the most pronounced impact on the stock prices of listed companies; Yuan Qian(2018) through the analysis of domestic and international literature studies, it is found that there is a significant positive correlation between internal control and corporate financial performance, i.e., the improvement of the effectiveness of corporate internal control has a significant contribution to the improvement of the level of financial performance, which leads to a stable stock price; Meng Yuwei et al.(2021) taking the banking industry as an example, using factor analysis and regression analysis, it is concluded that indicators such as earnings per share and net profit growth rate have significant effects on stock prices; Dong Xinxin (2011) believes that solvency and basic technical indicators also have a positive effect on stock prices, but the correlation is weak; growth capacity also has a positive effect on stock prices, but the correlation is weak; operating capacity has a negative effect on stock prices; Wang, Dechun

and Liu, Jinjin (2018) argue that there is a positive moderating effect of institutional investors' shareholding on the relationship between corporate equity returns and share price growth rate when corporate equity returns are sustainable; Xue, Yuan (2018) concluded that the effect of stock repurchase is after all time-dependent, while the effect of stock repurchase on the growth ability of firms is not significant. Sun, Gang and Zheng Qi (2021) government intervention in the implementation of industrial policy significantly reduces the risk of stock price collapse, promotes the steady release of firm-specific information, and reduces the risk of future stock price information.

From the above analysis, it is clear that most studies on stock prices are stuck in the routine evaluation of the model and that the model has low generalization ability for prediction and less accurate prediction results. These problems can be solved by machine learning algorithms (e.g., neural networks). In this paper, we select indicators from various aspects of company's solvency, profitability, operational capability, growth capability and cash flow capability, and perform data dimensionality reduction based on Lasso algorithm, while training RBF neural network, and analyze the factors affecting the change of stock price of listed companies, which is beneficial to investors to make correct decisions and has some practical guidance.

2. Analysis of factors influencing stock prices

Stock prices vary with the influence of the overall economic environment, stock market, company operating conditions, investor psychology and other factors, which can be divided into external and internal factors according to their nature, and this paper focuses on the influence of internal factors on stock prices.

2.1. Solvency

Solvency refers to a company's ability to repay its long-term and short-term debts from its assets. Generally speaking, the stronger a company's solvency is, the less risky its operations will be, the more willing investors will be to buy the company's stock, and the more likely the stock price will rise. The solvency of an enterprise is also an important indicator of its financial condition and operating ability. Therefore, this paper selects current ratio (B1) and quick ratio (B2) as the input layer. Generally speaking, higher indices of current ratio and quick ratio reflect the good solvency of an enterprise.

2.2. Profitability

Profitability index is a measure of the actual business performance of the enterprise, and the price of the stock reflects the intrinsic value of the listed company. Profitability is a comprehensive reflection of the high level of production and operation activities, sales activities and financial management of the enterprise organization, and can fully reflect the company in value it determines the future profitability and investment value of the enterprise's stock. When the actual business performance of the enterprise is outstanding and the profitability is improved, the expected return of investors will also increase, and investors buy in groups, which eventually drives up the share price of the enterprise. Among the many indicators reflecting the profitability of listed companies, net sales margin (B3) and gross sales margin (B4) are selected as the input layer. Net sales margin and gross sales margin are efficiency indicators.

2.3. Operating ability

The higher the business capability of a company, the higher the return on capital. The higher the return on capital, the more capital the enterprise has and the higher its natural value. while inventory turnover (B5), accounts receivable turnover (B6) and total assets turnover (B7) can not only reflect the size of enterprise profitability but also affect the stock price can better reflect the enterprise's operating ability. Therefore, these three indicators are chosen as the factors affecting the share price

of listed companies. Inventory turnover ratio, accounts receivable turnover ratio and total assets turnover are efficiency indicators.

2.4. Economic growth capacity

Growth capacity determines a company's future profitability, and therefore a company's growth capacity will indirectly affect the stock price. Growth capacity mainly refers to a company's ability to expand its business scale and operations. The year-over-year growth rate of operating revenue reflects the growth of the total asset size of the enterprise, while the growth rates of basic earnings per share and net profit margin reflect the growth of the enterprise's revenue. Therefore, the year-on-year growth rate of operating income (B8), growth rate of basic earnings per share (B9) and growth rate of net interest rate (B10) are selected as factors affecting the share price of listed companies.

2.5. Cash Flow Processing Capability

The stock cash flow statement is a statement that reflects the business operation, investment, financing and other activities of the enterprise. A low cash flow statement of a company indicates a problem with operations or accounts receivable. This will bring follow-up business investment. And this will also reduce the enthusiasm of market investors, which in turn will have an impact on stock prices. Ability to analyze cash flow from operating activities in conjunction with corporate income to provide a better understanding of a company's operating conditions. In this paper, net cash flow from operations (B11) and net cash flow from investments (B12) are selected as input layers to investigate the relationship between cash flow capacity and stock price related indicators.

3. Exponential dimensionality reduction calculation method based on Lasso algorithm

The basic idea of Lasso is to generate a certain number of regression coefficients strictly equal to 0 under the constraint that the sum of absolute values of regression coefficients is less than the constant to generate an interpretable model. Its optimization objective function is:

$$\min_w \sum_{i=0}^{n} (y_i - x_i^T \theta)^2 + \lambda \| \theta \| \tag{1}$$

The penalty term is - norm, after selecting the parameter and then through the parameter reduction to achieve the purpose of dimensionality reduction, similar to the least squares method, the difference is to change the regular term from L2 to L1 normal, that is, the least squares method with multiplication constraints, and its parameter estimates are:

$$\beta^{lasso} := \arg\min_{\beta} \left\{ \| \tilde{y} - \tilde{X}\beta \|_2^2 + \lambda \sum_{j=1}^{p} | \beta_j | \right\} \tag{2}$$

Where $\lambda>0$ is the scale constraint parameter, which is used to adjust the weight of the penalty term. The Lasso algorithm reduces the insignificant coefficient to 0 and only retains the significant variables, which can weaken the influence of multicollinearity on the model to a certain extent, and is suitable for screening important technical indicators that affect the company's stock price in the stock market.

4. RBF neural network model

4.1. Introduction to Artificial Neural Networks

Artificial neural network (ANN) is a computational model that simulates the organization structure and operation function of biological neural network. It is adaptive and changes with the constant input of external information. At the same time, artificial neural network will also veer from its information

processing mechanism to optimize the information handing effect, so it has efficient processing ability for complex nonlinear information.

4.2. Introduction to the principle of RBF

The Figure 1 is shows that RBF is a three-layer neural ne, in which the input layer answer for activating signals, so that the neural network can connect with extraneous information, then transmit the input information to the hidden layer after extracting features.

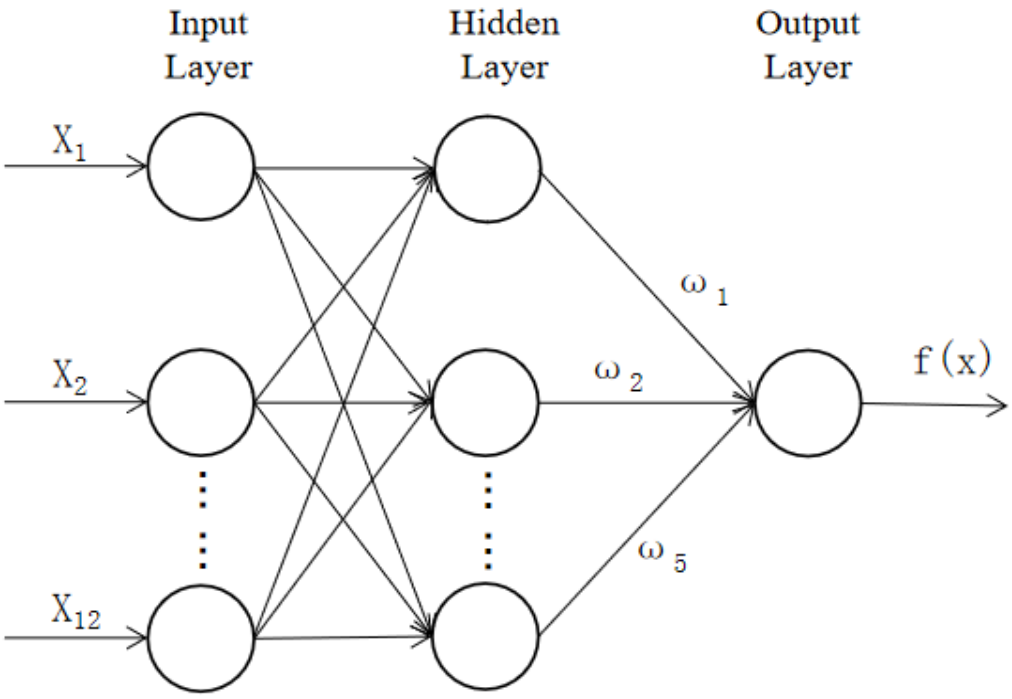

Figure 1. Structure of RBF Neural Network.

The ground floor is the input layer, which consists of signal nodes only for transmitting signals. When the input information is within a certain value range, n samples can be selected to group each sample according to the Euclidean distance, and then determine the cluster center until it changes within a certain range, and then use the maximum distance between the centers Cmax to calculate the width, h is the clustering Number of centers:

$$d = \frac{C_{\max}}{\sqrt{2h}} \tag{3}$$

Twelve indicators such as solvency, profitability, operating capacity and so on (A1-A5) are selected as input vectors, such as solvency, current ratio, sales net profit margin, and sales gross profit margin. The analysis index is the first layer in Figure 1, which is used as the output vector of the RBF neural network.

The second layer is the hidden layer, And the number of nodes in the hidden layer needs to be determined according to the needs of the research object, which is generally equate the number of input vectors. The radial basis function can be applied from the input layer to the hidden layer:

$$z_j = \exp(-\| \frac{X - C_j}{D_j} \|^2) \tag{4}$$

Among them, C_j is the center vector corresponding to the jth hidden layer neuron, which is comprised of the center components of all neurons in the input layer connected to the jth nerve fiber in the hidden layer, that is, $C_j = [C_{j1}, C_{j2}, \cdots, C_{jn}]$, D_j is the breadth phasor of the jth neuron in the

hidden layer, which has a great influence on the accuracy of the network. The larger the C_j, the larger the D_j, The wider the range of influence on the input vector, the better the smoothness between neurons. Usually for each C_j, the corresponding width Hj can be made to be the average of the distances between C_j and the training samples belonging to that class, namely:

$$H_j = \frac{1}{M}\sum_{x \in c_j}(x - c_j)^T (x - c_j) \tag{5}$$

The number of neurons output by the model results is 5, namely quick ratio (B2), gross profit margin on sales (B4), inventory turnover ratio (B5), basic earnings per share growth rate (B9), and net investment cash flow (B12)). For the sake of increasing the precision of the consequences, the count of neurons in the hidden layer is determined, and the number of neurons in the neural network established in this model is set to 12.

The third layer is the output layer, which is a linear neuron that responds to the input pattern. The calculation from the hidden layer to the output layer can transform the kernel function removal in the traditional neural network into a linear mapping relationship:

$$y_k = \sum_{j=1}^{p} \omega_{kj} z_j \qquad (k = 1,2,3,\cdots, \ m) \tag{6}$$

k_j is the output of the kth node of the output layer, m is the number of output nodes, z_j is the output of the implicit layer, and ω_{kj} is the link weight of the jth neuron node of the implicit layer and the mth neuron node of the output layer. Although the input-output mapping is nonlinear, the output of the network is linearly weighted according to hidden elements (namely network tunable parameters), and the weight of each element in the network can be solved directly by linear equations to avoid local small problems.

The significance P is selected as the index to measure the influence of the selected stock price influencing factors on the stock as the output vector. The index vector output by this model data through the RBF neural network is the net investment cash flow, which is the third layer in Figure 1.

After quantify the goodness of fit of the NN, the following formula to depict the goodness of fit is defined. The nearer the result is to 1, the higher the goodness of fit statistic is. Where, y_i and $\bar{y}$ represent the mean value of the actual value and assessed value respectively. Computed the following:

$$R^2 = 1 - \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 / \sum_{i=1}^{n}(y_i - \bar{y}_i)^2 \tag{7}$$

In summary, the flow chart of this research idea is as follows.

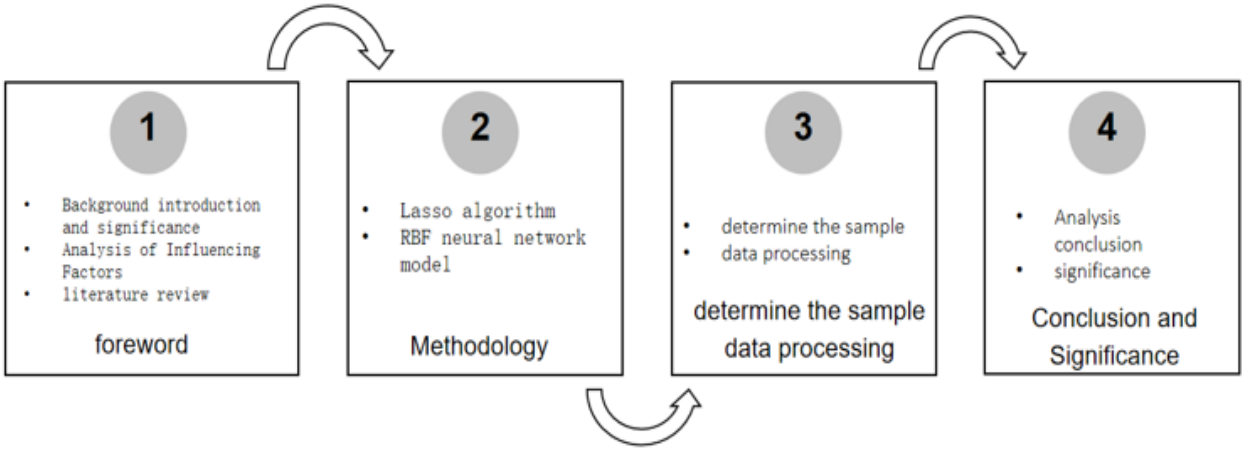

Figure 2. Research Technology Roadmap.

5. Analysis and Research on internal factors of stock price based on lasso RBF model

5.1. Data acquisition and lasso dimensionality reduction

This paper's empirical study section chooses representative Chinese listed companies as the research sample. The largest and most precise financial and economic database in China, CSMAR, serves as the primary source of data for the organization. The dimension of the data is decreased using the lasso technique, and the outcomes are as follows.

Table 1. Lasso Dimensionality Reduction Algorithm-Based Characteristic Indexes.

Primary index	Working direction of indicator light	Auxiliary indicator	Indicator name	P value	Select indicator	Extracted indicators
A1	Solvency	B1	Current ratio	0.064	B2	B2\B4\B5\B9\B12
		B2	Quick ratio	0.023		
A2	Profitability	B3	Net profit margin on sales	0.601	B4	
		B4	Gross profit margin of sales	0.002		
A3	Business capacity	B5	Inventory turnover ratio	0.037	B5	
		B6	Turnover rate of accounts receivable	0.083		
		B7	Total asset turnover	0.065		
A4	Economic growth capacity	B8	Year on year growth rate of operating revenue	0.343	B9	
		B9	Growth rate of basic earnings per share	0.001		
		B10	Net interest rate growth rate	0.089		
A5	Cash flow processing capacity	B11	Net operating cash flow	0.154	B12	
		B12	Net investment cash flow	0.025		

5.2. RBF neural network

We created an RBF learning network and imported the sample data used as the foundation for the data collection effort mentioned above. Specifically, the characteristic variables retrieved by lasso algorithm are employed as the input variables of RBF neural network. Additionally, the CNN neural network uses stock price-related data as its output variables. The total least squares is 0.894. There are 1 hidden layer, 12 nodes, and there are 1 hidden layer. Figure 3 illustrates a comparison between the simulation value based on an RBF neural network and the actual value.

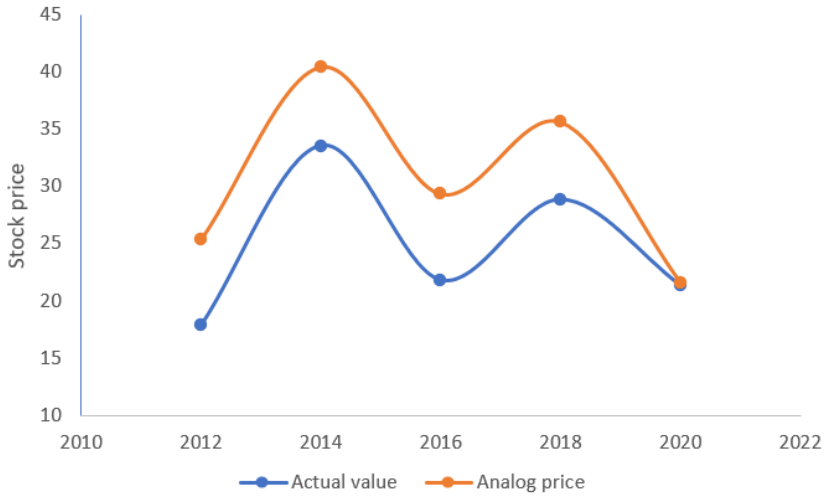

Figure 3. Diagram illustrating model fitting using RBF neural networks.

The image shows that these two curves' 93% fitting degree, which is high and suggests a stronger fitting effect. Additionally, it can be demonstrated that the chosen RBF network is more robust.

To gather information about the significance of each financial indicator and to help develop and optimize pertinent firms, we apply the importance contribution analysis function of neural networks. Additionally, Table 2 and Figure 4 display the analysis.

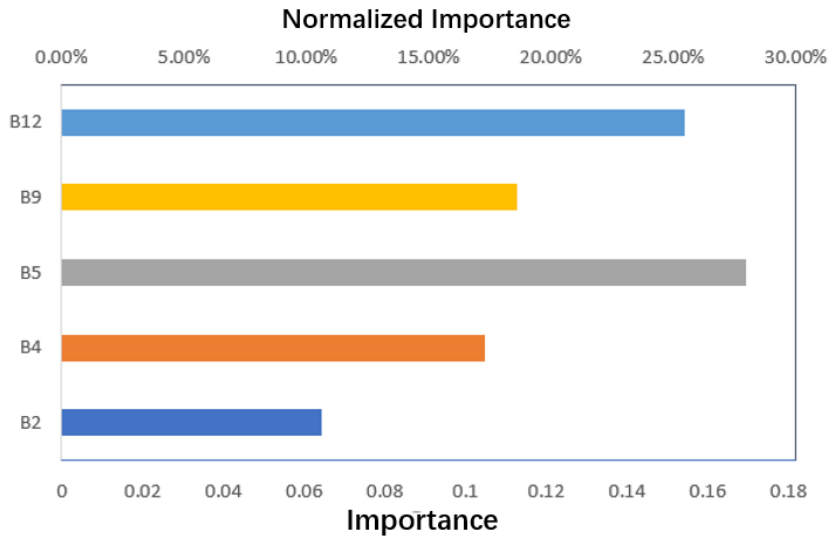

Figure 4. Importance Analysis of Internal Influencing Factors of Stock Price.

Table 2. Analysis of Importance of Standardization.

	B2	B4	B5	B9	B12
Importance	0.06	0.10	0.17	0.11	0.15
Importance of Standardization (%)	10.62	17.33	27.98	18.61	25.46

According to the findings, the inventory turnover rate has a 27.98% relevance value and has the largest effect on contingent stock price. The second item has an impact value of 25.46% and is the net cash flow of investment. Quick ratio, with a value of 10.62%, has the lowest value of all of them.

The report makes the following recommendations in light of the findings of the aforementioned data analysis:

(1) Improving the inventory turnover rate and net investment cash flow will continue to be the main priority in order to raise the company's share price and enhance operations. In order to boost the growth rate of various financial indicators and raise the firm's share price and market value, the company must strategically increase pertinent investments. The ability of businesses to grow should

also be taken into consideration and this can be macro-controlled by introducing people and technology.

(2) In order to prevent losses to their capital, investors typically pay attention to the risk tolerance and operating level of businesses. As a result, the business can enhance its ability to do business and tighten control over capital chain risk to boost the stock price.

6. Research Conclusion

This essay does statistical research into the variables that affect the share value of Chinese listed companies. For our research, we use the CSMAR database's representative Chinese Listed Companies and representative financial metrics. To reduce the dimensionality of the data, the Lasso technique is utilized. Based on this, an RBF neural network was created and trained using data from financial indexes. Finally, each index's relevance value is determined in this study. The analysis's findings show that the inventory turnover, the maximum index, has a 27.98% contribution to the overall impact, whereas the quick ratio, the minimum index, has a contribution of only 10.62%.

This study quantifies the influence of various financial indicators on stock prices using empirical data and a lasso RBF neural network model. It also offers a more creative way to measure the trend of stock prices and serves as a guide for investors' decision-making. The stock market's current state of development is imperfect, and it is important to continue researching the variables that affect stock price, particularly how the external environment and investor behavior interact. In the future, we need to design a model that can handle quantitative analysis better.

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