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An Empirical Study on the Correlation between Stock Prices and Financial Indexes Based on Regression Analysis—Take the Education Industry as an Example

Jing Chen[1,a], Chenxi Tian[1,b], Xuan Gou[2,c,*]

[1]Geely University, Shengbao Institute of Financial Technology, Sichuan, Chengdu, 610000, China
[2]School of Shengbao Financial Technology, Geely University of China, Chengdu, Sicuan, 610000, China
[a]jingc0278@gmail.com, [b]912343483@qq.com, [c]15228005256@163.com
[*]Corresponding author

Abstract: *This paper divides the financial indicators into five categories by collecting the financial data of listed companies in the education industry in the past three years. The stepwise regression method empirically analyzes the relationship between financial indicators and stock prices of listed companies in the education industry. The analysis results show that: among listed companies in the education industry, financial indicators such as earnings per share, net assets per share, ROE(return on equity), the gross profit margin on sales, total asset turnover, and equity multiplier have a significant impact on stock price changes.*

Keywords: *Stock price; Financial index; Education industry; Stepwise regression method*

1. Introduction

The financial statements of listed companies are an important source of stock market information, which can not be ignored on the stock market price, and the financial index data of enterprises often directly affect investors' decision-making. Foreign researchers have used empirical methods earlier to study and prove the correlation between financial information and stock prices. Ball (1968) conducted a study on the correlation between financial indexes and stock prices. In the same year, Beaver (1968) also used empirical research to link financial disclosure with stock price changes, demonstrating the relevance of financial information. The theory of Ohlson and Feltcham (1995) provides a detailed theoretical demonstration of the working mechanism between financial information and stock prices. Research results of Subramanyam et al. (2007) show that the correlation between free cash flow and stock price is significantly stronger than between operating cash flow and stock price. In the West, whether it is an information or measurement view, empirical evidence shows that financial information has explanatory power to stock prices and is most useful in the securities market. But in China, related studies have only appeared since the mid-1990s, and now there is a big difference among domestic researchers in studying the correlation between financial situation and stock prices. Wang Jining (2008) believes no proportional relationship exists between the rise and fall of listed companies' stock prices and financial capabilities. Zhang Yaya (2013) estimates that the explanatory power of the financial index for company stock prices is weakening year by year [1]. Dai Liping (2004) found that the financial indicators of listed companies will greatly impact stock prices. Mei Shiqiang and Wang Tianyang (2014) used the Pearson correlation coefficient and regression model to analyze the impact of the three indexes of earnings per share, net assets per share, and operating cash flow per share on stock prices. Starting from the relationship between stock prices and financial indexes, using empirical research methods and annual time-series data, we selected the financial indexes and stock prices of 17 listed companies in the education industry as specific targets and investigated the impact of financial indexes to study stock price movements. It is expected to find the financial index with the strongest explanatory ability to the stock price of listed companies in the education industry through stepwise regression analysis.

2. Selection of Financial Indexes

In this paper, the indexes that reflect the financial status of listed companies are divided into five

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categories: the per share index, profitability index, growth ability index, operating ability index, and capital structure index. Then select 2-3 most representative financial indexes from each category as explanatory variables. The indexes per share mainly include earnings per share, net assets per share, and operating profit per share. Profitability indexes include ROE net sales margin, and gross profit margin. Growth capability indexes include operating income growth rate and operating profit growth rate. Operating capacity indexes include current asset turnover rate and total asset turnover rate, and capital structure indexes include asset-liability ratio and equity multiplier [2].

Table 1: Summary of Relevant Financial Indexes

Attribute	Indexes	Calculation formula and application
Per share index	Earnings per share	The weighted average of current net profit attributable to common shareholders / current issued common shares. This index reflects the net profit of the enterprise or the net loss of the enterprise that the common shareholders can enjoy for each share.
	Net assets per share	The total amount of shareholders ' equity / total number of shares of equity, this index reflects the current value of assets owned by each share.
	Operating profit per share	(Net profit - net operating income) / total equity, reflecting after-tax profit per share of common stock.
Profitability index	ROE	(Net profit / net assets) × 100 %, reflecting the efficiency of using the capital invested by shareholders and the ability of enterprises to make profits by using their own capital.
	Net profit on net sale	(Net profit/sales revenue) × 100 %, reflecting each time the sales revenue, how much net profit can bring to the enterprise, is the performance of the level of sales revenue income.
	Gross profit margin	(Net sales revenue-product cost) / net sales revenue × 100 %, reflecting the competitiveness and profit potential of the company's products.
Growth ability index	Operating income growth rate	(Operating income growth / total operating income of the previous year) × 100 % is an important index to measure enterprises' operating status and market share, which reflects the growth rate of operating income and the market prospect of enterprises.
	Operating profit growth rate	(The growth of operating profit in this year / the total operating profit in the previous year) × 100 %, reflecting the change in operating profit.
Operational capability index	Turnover of current assets	(Sales revenue / average balance of current assets) × 100 %, reflecting the utilization efficiency of all current assets of enterprises.
	Turnover of total assets	(Sales revenue/total assets) ×100%, which reflects the turnover speed of all assets from input to output during the operation period of the enterprise, and reflects the management quality and utilization efficiency of all assets of the enterprise.
Capital structure index	Assets-liability ratio	(Total liabilities / total assets) × 100 %, indicating how much of the company's total assets are raised through liabilities.
	Equity multiplier	Total assets/equity reflects the degree of debt of the enterprise.

3. Empirical Research Design

3.1 Sample Selection

In this paper, the listed companies that continue to operate between 2020 and 2022 from A-share companies in the education industry are selected, and ST, *ST companies, listed companies with incomplete financial data and abnormal financial indexes in the past three years are excluded [3]. Finally, the remaining 17 listed companies are taken as the research samples of this paper. At the same time, this paper's financial and stock price data are all from the RIS financial database [4].

3.2 Variable Selection

Explained variable: The stock's closing price from 2020 to the end of 2022 is used as the explained variable.

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Explanatory variables: Financial indexes can be classified from five aspects, and 2-3 most representative financial indexes are selected from each category as explanatory variables, including earnings per share, net assets per share, operating profit per share, ROE, net profit margin on sales, gross profit margin on sales, growth rate of operating income, growth rate of operating profit, turnover of current assets, turnover of total assets, assets debt ratio, equity multiplier.

3.3 Research Hypothesis

Hypothesis 1: Represents the earnings per share, net assets per share, and operating profit per share of the index per share are positively correlated with the stock price.

Hypothesis 2: Represents ROE, gross profit margin on sales, and net profit margin on sales of profitability index are positively correlated with stock prices.

Hypothesis 3: Represents the operating income growth rate and operating profit growth rate of the growth capability indexes are positively correlated with the stock price.

Hypothesis 4: Represents the turnover ratio of total assets, the turnover ratio of current assets, and the stock price of the operational capability index are positively correlated.

Hypothesis 5: Represents the asset-liability ratio and equity multiplier of the capital structure index are positively correlated with the stock price.

3.4 Model Setting

Assume that the overall regression model of explanatory variables containing explained variables Y and k is:

$$Y = b0 + b1X1 + b2X2 + \ldots + bkXk + Ut$$

Where,k = 1,2,…,12.

In the above formula, X1 is earnings per share; X2 is net assets per share; X3 is operating profit per share; X4 is ROE; X5 is net sales margin; X6 is gross profit margin; X7 is the growth rate of operating income; X8 is the growth rate of operating profit; X9 is the current asset turnover ratio; X10 is the total asset turnover ratio; X11 is the asset-liability ratio; X12 is the equity multiplier [5].

4. Empirical Research Process

4.1 Preliminary Regression and Collinearity Test

Table 2: Preliminary regression results

Linear regression analysis results n=20									
	Unstandardized coefficient		Standardized coefficient	t	P	VIF	R^2	AdjustR^2	F
	B	Standard error	Beta						
Constant	-16.158	7.169	-	-2.254	0.059*	-	0.946	0.854	F=10.277 P=0.002***
Earnings per share X1	16.743	17.584	1.47	0.952	0.373	310.534			
Net assets per share X2	3.5	0.765	0.611	4.574	0.003***	2.326			
Operating profit per share X3	-15.67	19.811	-1.333	-0.791	0.455	369.863			
ROE X4	0.048	0.014	0.988	3.44	0.011**	10.757			
Sales margin X5	-0.035	0.042	-0.111	-0.847	0.425	2.229			
Gross profit margin X6	0.111	0.079	0.171	1.408	0.202	1.93			
Operating income growth rate X7	0.092	0.146	0.164	0.63	0.549	8.875			
Operating profit growth rate X8	0	0.008	0.002	0.011	0.991	2.674			
Current assets turnover X9	-2.64	6.406	-0.131	-0.412	0.693	13.212			
Total asset turnover X10	25.478	9.945	0.453	2.562	0.037**	4.07			
Assets-liability ratio X11	0.131	0.181	0.214	0.724	0.493	11.355			
Equity multiplier X12	1.574	0.475	0.979	3.316	0.013**	11.354			
Dependent variable : closing price Y									
Note : * * *, * *, * represents the significance level of 1 %, 5 %, 10 % respectively									

With the stock price as the dependent variable and the 12 financial ratios as the explanatory variables and using SPSS 27.0, preliminary regression and collinearity tests were performed on the 2020-2022 data, and the analysis results are shown in Table 2.

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The formula of the model is as follows:

y=-16.158 + 16.743*X1 + 3.5*X2 - 15.67*X3 + 0.048*X4 - 0.035*X5 + 0.111*X6 + 0.092*X7 + 0.0*X8 - 2.64*X9 + 25.478*X10 + 0.131*X11 + 1.574*X12 .

4.2 Economic Significance Test

According to the estimated results of the linear regression equation, it can be seen that the stock price has a positive relationship with earnings per share, net assets per share, gross profit margin, operating income growth rate, operating profit growth rate, total asset turnover rate, asset-liability ratio, and equity multiplier [6]. It has an inverse relationship with operating profit per share, net sales margin, and current asset turnover [7].

4.3 Statistical Test

(1) Goodness-of-fit Test

The goodness of fit R2 represents the proportion of the regression sum of squares to the total sum of squares. The closer it is to 1, the better the goodness of fit of the model is. According to the preliminary regression results, the adjusted R2 of the model is 0.854, indicating that X can explain 85.4 % of the Y value and has good goodness of fit.

(2) Significance Test

It can be seen that the significant P value is 0.002*** from the analysis of the F test results, which is significant at the level, and the null hypothesis that the regression coefficient is 0 is rejected, so the model meets the requirements.

(3) Collinearity Test

The VIF value (variance inflation factor) represents the severity of multicollinearity and is used to test whether the linear regression model exhibits collinearity, i.e., a highly correlated relationship exists between explanatory variables. If there is a variance inflation factor VIF ≥ 10 for one or more explanatory variables, it is considered that the linear regression model has serious multicollinearity. Preliminary regression results show that the coefficients of variance expansion for variables X1, X3, X4, X9, X11, and X12 are all above 10, indicating a significant collinear relationship between the explanatory variables in the model.

4.4 Stepwise Regression

Multiple linear regression cannot be performed directly due to severe collinearity between variables. Therefore, this paper will adopt the stepwise regression method to construct the linear regression model. Put all the variables into the model first, and then try to remove a variable to see if there is a significant change to the entire model after removal (F test). If there is no significant change, remove it; If there is, keep them until all the factors that have significant changes to the model are left.

In other words, the independent variables are classified in order of increasing contribution, but the specific steps are as follows.

(1) Establish the regression equation of all X1, X2, X3, . . , X12 on the dependent variable Y, perform the F test on the m independent variables in the equation, and take the minimum value: $F_{k1}^{1}=\min\left\{F_{1}^{1},\ F_{2}^{1},\ F_{3}^{1},\ldots,F_{m}^{1}\right\}$. If $F_{k1}^{1}>F_{\alpha}(1,\ n-m-1)$, then there is no independent variable to be eliminated, and the regression equation is optimal at this time; Otherwise, remove Xk2. At this time, Xk1 can be set to Xm, and enter step (2).

(2) Establish a regression equation with the dependent variable Y, perform an F test on the regression coefficient in the equation, and take the minimum value $F_{2}^{k2}=min\left\{F_{2}^{1},\ F_{2}^{2},\ F_{2}^{3},\ldots,F_{2}^{m-1}\right\}$, if $F_{k2}^{2}>F_{\alpha}(1,\ n-(m-1)-1)$, then there is no variable to be eliminated, and the equation is optimal at this time. Otherwise, Xk2 is eliminated. At this time, set Xk2 as Xm-1, and iterate until each variable's regression coefficient F values are greater than the critical value. That is, there is no variable in the equation that can be eliminated, the regression equation is the optimal regression equation .

The results of the stepwise regression method are shown in Table 3.

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Table 3: Summary of stepwise regression results

Method	Backward
Total variables	Earnings per share, net assets per share, operating profit per share, ROE, net sales margin, gross profit margin, operating income growth rate, operating profit growth rate, current asset turnover, total asset turnover, asset-liability ratio, equity multiplier
Retain variables	Earnings per share, net assets per share, ROE, gross profit margin, total asset turnover, equity multiplier
Abandon variables	Operating profit per share, net profit margin on sales, operating income growth rate, operating profit growth rate, current asset turnover rate, asset-liability ratio

Table 4: Results of the stepwise regression model

Linear regression analysis results n=20									
	Unstandardized coefficient		Standardized coefficient	t	P	VIF	R^2	Adjust R^2	F
	B	Standard error	Beta						
Constant	-11.408	3.702	0	-3.081	0.009***	-	0.931	0.90	F=29.413,P=0.000***
Earnings per share X1	2.349	4.031	0.206	1.279	0.040**	1.552			
Net assets per share X2	3.282	0.177	0.573	1.876	0.000***	1.316			
ROE X4	0.038	0.007	0.774	2.048	0.000***	3.437			
Gross profit margin X6	0.096	0.052	0.147	1.837	0.089*	1.22			
Turnover of total assetsX10	28.135	4.908	0.5	0.835	0.000***	1.441			
Equity multiplierX12	1.324	0.225	0.823	0.788	0.000***	3.702			
Dependent variable: closing price Y									
Note : * * *, * *, * represents the significance level of 1 %, 5 %, 10 % respectively									

The final retained variables are earnings per share, net assets per share, ROE, gross profit margin, total asset turnover, and equity multiplier. After building a regression model using the selected variables, the analysis results are as follows.

It can be seen from the Table 4 that the adjusted coefficient of determination R^2 is 0.90, indicating that earnings per share, net assets per share, ROE, gross profit margin, total asset turnover, and equity multiplier have a high explanation rate for stock prices. From the analysis of the results of the F test, it can be seen that the significant P value is 0.000***, the level is significant, and the null hypothesis of regression coefficient of 0 is rejected, indicating that the model construction is meaningful. From the t-test results of a single variable, at the 5% significance level, the t values of each explanatory variable are less than 2.132, indicating that earnings per share, net assets per share, return on equity, gross sales margin, total asset turnover, and equity multiplier of the explanatory variables will all have a significant impact on the stock price of the explanatory variable. For the collinear performance of variables, the VIFs of the explanatory variables are all less than 10, so the model has no multicollinearity problem and is well-built. The equation of the modified regression model is as follows:

$$y=-11.408+2.349*X1+3.282*X2+0.038*X4+0.096*X6+28.135*X10+1.324*X12$$

5. Conclusion

The analysis results show that earnings per share, net assets per share, ROE, gross profit margin, turnover of total assets, and equity multiplier positively correlate with the stock price. It shows that when other factors remain unchanged, the stock price of listed companies in the education industry will rise with the increase in earnings per share, net assets per share, return on net assets, gross margin on sales, total asset turnover, and equity multiplier, and vice versa. Among them, the most significant impact on the stock price is the total asset turnover ratio, which represents the company's operating ability, reflects the cyclical speed of all assets from input to output during the company's operation, and reflects the management quality and utilization efficiency of all assets of the enterprise. In other words, during the accounting period from 2020 to 2022, the management quality and utilization efficiency of listed companies' assets have a greater impact on stock price changes. In addition, earnings per share and net assets per share have a greater impact on stock price changes. They both represent the per-share index, reflecting the profitability of the company and the current value of assets owned by each share. Return

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on net assets and gross profit margin directly reflect the company's profitability, and the larger the value, the stronger the company's profitability. The equity multiplier refers to how many times the company's total assets available for use are the owner's equity. The greater the equity multiplier, the greater the financial leverage ratio of the company's outward financing, and the company will bear greater risks. However, suppose the company's operating conditions are just upward. In that case, a higher equity multiplier can create higher company profits, and increasing the company's return on shareholders' equity will have a positive incentive effect on the company's stock value.

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