Relative Valuation of Firms - A Markov Chain-Based Method

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Abstract: Through company valuation, we can evaluate and predict the value of a company, thus determining the basis of its transaction value. Corporate valuation is not only an important research method, but also a good way for the industrial practitioners to know how to evaluate the company appropriately, which can help them better translate their understanding of the industry and the company into more specific investment proposals.

1. Introduction

Corporate valuation refers to the evaluation of the economic value of listed companies or non-listed companies by focusing on their capital structure and market performance. In other words, the value of a company is usually determined by its total assets and profitability.

2. Literature Review

In the literature, many researchers have studied corporate valuation from different perspectives. Hartman (2000) have studied the concept of market value added (MVA) and its economic significance. In addition, by explaining the procedures of capital and income distribution of investment projects, he delved into the basic principles behind the EVA analysis. The relationship between economic value added (EVA) and stock market performance of 17 Listed Companies in Canadian food processing industry was studied(Turvey et al., 2000). Griffith (2004) evaluated the performance of companies by implementing an EVA-based payment system and discussed whether analysts should use EVA performance to predict stock performance. Damodaran (2007) compared the accuracy of relative valuation and intrinsic valuation, and linked corporate valuation to global trends. Kee (2010) focused on the target cost method and studied the traditional target cost model. He pointed out the shortcomings of the traditional target cost model. Richardson (2010) integrated the prediction of future earnings and returns into an organizational framework. Further, he critically assessed the information disseminated over the past decade on accounting anomalies. He also made recommendations for future research on accounting anomalies. As for the management accounting, Woods et al. (2012) analyzed how to introduce EVA into its target cost accounting system. Sharma (2015) outlined the trends for cloud computing and its challenges in recent years. Based on the real option approach (ROA) stemming from Black and Scholes's methods, some authors studied the structural capital (Lombardi et al., 2016). Elkins and Entwistle (2018) proposed that the necessary supplementary disclosure information should be used to correct major misstatements in financial statements.

3. Basic Concept of Multiples

First, we would like to introduce Discrete Markov Chain.

Markov Chain describes a sequence of states, each of which depends on the preceding finite states. Markov chain is a sequence of random variables$X1, X2,\ldots, Xn$ with Markov property. The range of these variables, that is, the set of all their possible values, is called "state space", while the value of Xn is in the state of time n. If the conditional probability distribution of Xn+1 for past states is only a function of Xn, then $Pr(Xn+1=x|X1=x1,X2=x2,...,Xn=xn) = Pr(Xn+1=x|Xn=xn)$.

Here x is a state in the process. The above identity can be regarded as a Markov property.

πj is the probability that the state is j after n transitions, and $n \to \infty$.

P is the transition matrix obtained by arranging the transition probabilities of all States in a matrix in a single-step evolution when the state space of Markov chain is finite.

Now, the basic concept of multiples is introduced.

PE (price earning ratio) is one of the most commonly used indicators to evaluate whether the stock price level is reasonable or not.

Generally, the lower the PE ratio of a stock is, the lower the profitability of its market price relative to the stock will be. Meanwhile, lower PE ratio leads to shorter payback period, smaller investment risk, and greater investment value.

Next, the EV/EBITDA is introduced. EV/EBITDA, also known as enterprise value multiplier, is a widely used company valuation multiple. EV refers to enterprise value, and EBITDA refers to earnings before interest, tax, depreciation and amortization.

Higher multiples relative to industry average or historical levels usually indicate that the company is overpriced. Furthermore, different industries or sectors have different valuation basis.

4. Illustrative Examples

In this article, we mainly use the relative valuation method to calculate and compare the economic data and economic indicators of NIKE, SKECHERS and LULULEMON (data source: Yahoo Finance).

Table 1. Comparison of P/E and EV/EBITDA data of three companies

NIKE			
	mean	standard deviation	Standard deviation /mean
P/E	25.23	1.58	0.06
EV/EBITDA	18.24	1.16	0.06
SKECHERS			
	mean	standard deviation	Standard deviation /mean
P/E	13.07	1.52	0.12
EV/EBITDA	5.81	0.77	0.13
LULULEMON			
	mean	standard deviation	Standard deviation /mean
P/E	39.49	5.28	0.13
EV/EBITDA	21.40	2.98	0.14

The mean values of P/E and EV/EBITDA of LULULEMON are the largest, which indicates that investors need to invest a large amount of money to obtain the corresponding investment returns. The standard deviation of P/E and EV/EBITDA and the ratio of standard deviation to mean are also the largest among them, which indicates that the P/E and EV/EBITDA values fluctuate greatly and the company value is unstable. The above data may indicate that LULULEMON's price is overvalued relative to that of NIKE and SKECHERS .

The mean values of P/E and EV/EBITDA of NIKE are the second largest among the three companies. Investors can gain profits through appropriate investment. Its P/E variance, EV/EBITDA standard deviation and the ratio of standard deviation to average are smaller than LULULEMON’s, which shows that the P/E value and EV/EBITDA value of NIKE fluctuate less and the company value is relatively stable.

In conclusion, NIKE can be used as a more conservative investment choice for investors preferring moderate return and low risk.

For SKECHERS, the average values of P/E and EV/EBITDA are the smallest among the three

companies, suggesting that investors can get a good return on relatively small investments. The result indicates that SKECHERS's stock price is relatively undervalued. The ratio of standard deviation and standard deviation of P/E and EV/EBITDA to average value are the smallest, which shows the SKECHER's value is the most stable among the three companies.

The following figures show the P/E data of NIKE, SKECHERS and LULULULEMON respectively:

(Note: Because these two multiples agree with each other regarding the valuation, only P/E is shown in the figures.)

The steps of making the three charts are as follows:

Step 1: Calculate PE values for all trading days in a year.

Step 2: Set the maximum P/E value of the company as a and the minimum P/E value as b.

Step 3: Calculate the value of (a-b)/5 and set it to c.

Step 4: Take c as the interval, categorize the values of P/E into five groups which are evenly distributed in c.

Step 5: Calculate the frequency of P/E value in each group in one year.

Step 6: Draw a histogram.

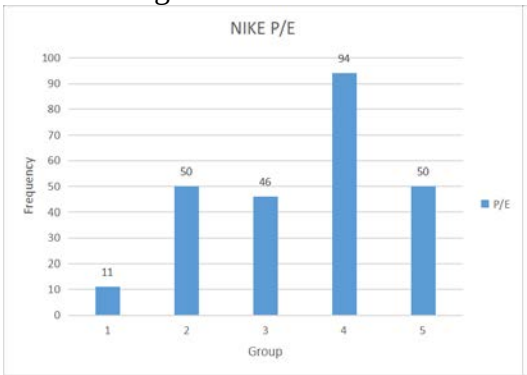

Figure 1. The distribution of PE for NIKE

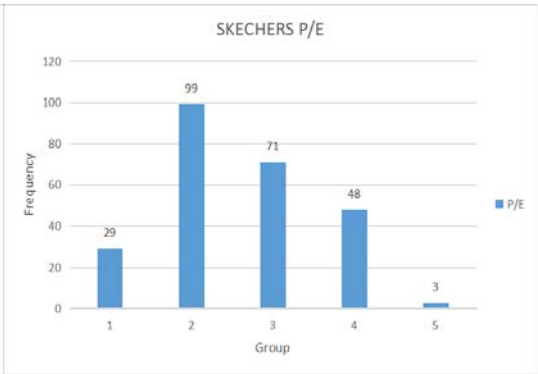

Figure 2. The distribution of PE for SKECHERS

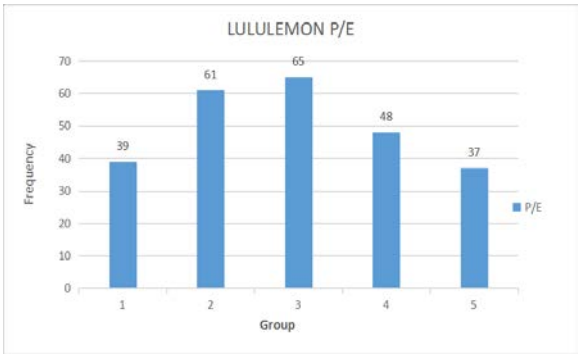

Figure 3. The distribution of PE for LULULEMON

As can be seen, for NIKE, the most data points fall into the fourth group, and the least data points fall into the first group. The overall data skew to the left, meaning that it has a negative deviation trend.

For SKECHERS, a large number of data points fall into the second group, and most of the data are distributed on the left side of the median group. The overall data skew to the right, showing a positive deviation trend.

For LULULEMON, its data distribution is relatively symmetrical, most data points fall into the median group, indicating that the stock price on each trading day approximately follows a normal distribution.

Now we calculate PE and EV/EBITDA by using the Markov-chain based method. We assume the future price has three states (high, medium and low), P is given as below.

$$P=\begin{pmatrix} 0.2 & 0.6 & 0.2 \\ 0.3 & 0.4 & 0.3 \\ 0.1 & 0.6 & 0.3 \end{pmatrix} \tag{1}$$

and p1, p2, p3 are the lowest, mean and highest stock price throughout the previous years, respectively.

According to P, we can get the following equations：

$$\pi_1=0.2\pi_1+0.3\pi_2+0.1\pi_3 \tag{2}$$

$$\pi_2=0.6\pi_1+0.4\pi_2+0.6\pi_3 \tag{3}$$

$$\pi_3=0.2\pi_1+0.3\pi_2+0.3\pi_3 \tag{4}$$

And

$$\pi_1+\pi_2+\pi_3=1 \tag{5}$$

Then we can get the solution of the equation：

$$\pi_1=\frac{2}{9};\quad \pi_2=\frac{1}{2};\quad \pi_3=\frac{5}{18} \tag{6}$$

5. Conclusion

Enterprise valuation refers to a comprehensive evaluation of the fair market value of an enterprise's assets and profitability. The value of an enterprise is not a simple accumulation of all individual assets, but a combination of assets formed under certain organizational management according to the logical relationship between economy and technology in production and operation.

There are various methods to evaluate the value of enterprises.

This paper mainly uses the relative valuation method. By calculating and analyzing the data related to P/E and EV/EBITDA, the enterprise value of three sports brand enterprises is analyzed.

Among them, the relevant data of SKECHERS company fluctuate the least, meaning that the company's value is the most stable among the three companies. Therefore, it is the most suitable for risk-averse investors. LULULEMON company is the most unstable among the three firms, and the cost for investors to obtain profits is relatively high. It is not suitable for investors in this regard. The cost for investors of NIKE to gain corresponding returns is moderate, and the fluctuation of NIKE’s value is small, so it is the most suitable choice for investors who pursue high risk and high return. Then, we use formulas related to Markov chain to estimate the stock prices of three companies in the next year, and recalculate PE and EV/EBITDA according to the predicted stock prices.

There are future research opportunities. The rational evaluation of enterprise value is related to the formation of the rational and balanced value center of the securities market, which is conducive to the correct positioning of stock prices, asset restructuring and value-added and promotion of enterprises. Based on the background of the continuous development of cloud computing, investors and consumers can access a variety of information through the network. Big data-based corporate valuation can enable investors to make reasonable investment decisions and achieve expected returns.

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