

APPLICATION OF MARKET VALUATION MODELS IN PORTFOLIO MANAGEMENT

Pastor D., Kisela P., Kováč V., Sabol T., Vajda V.*

Abstract: The paper deals with application of market valuation models in portfolio management. Its aim is to find out if it is possible to gain excess returns with simple investment strategies based on indicators constructed from some well-known ratios that are used to detect undervaluation or overvaluation of stock market. The theoretical background is followed by an overview of other studies in this field. In the next chapter Tregler's market valuation indicators and the created investment strategies are discussed. Portfolio management approaches for different indicators were tested on historical S&P 500 monthly close prices. Any of chosen approaches was not able to achieve a higher return than basic buy and hold strategy. One strategy achieved return comparable to benchmark, but with lower risk, so it may be suitable for some portfolio managers.

Key words: valuation indicators, market valuation, portfolio management, investment strategies, efficiency market hypothesis, undervaluation, overvaluation

Introduction

The efficiency market hypothesis is very often discussed topic in a field of investment theory. There is no possibility for returns, which are beyond standard, in the financial market according to it.

The efficient market definition was firstly mentioned by Eugene Francis Fama. He described it as a market, where prices always fully reflect available information. According to him there are several different types of efficient markets that are based on three elementary concepts – weak form, semi-strong form and strong form. Each of them stands on a conception of availability of any information. The first one expresses historical price information, the second one comprises all publicly available information and the last one encompasses all information regardless the origin of these information – whether they come from public or private sources (Verheyden et al., 2015).

Literature Overview

There is still no widespread numerical model for price detection based on the market participants' behaviour in terms of future prediction. In some cases markets are able to allocate resources efficiently and hence to influence the price of an asset by taking into account all provided information that can relate to the assets. This

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creates basement for the efficient market hypothesis (Samuelson, 1965). There are many forms of this premise, but every one of them says each market is efficient, if prices immediately reflect all relevant information about the assets (Fama, 1970). The market participants review their opportunities properly to continue in a way the actual price move (Lo, 2004).

On the other hand there are several reproaches about the efficient market hypothesis. For instance when the perfectly efficient asset prices recall only random price oscillations (Lo and MacKinlay, 1988) or when bubble appears in the market as a consequence of other investors' expectations (Abreu and Brunnermeier, 2003). From another point of view efficient market should not allow unusual profitability of very simple strategies based on technical analysis (Schulmeister, 2009). Many studies bring statement the particular market does not involve the same level of efficiency throughout the whole observed period. Its ability to carry and to provide environment for the efficient moving of the assets' prices can fluctuate according to other factors. These elements influencing market attributes are usually not known in the time they affect the prices. One of the ways how to describe such factors is to apply dynamics in the efficient market model (Immonen, 2015).

Dynamics as an idea to improve pragmatism of market model is on the one hand quite old proposal, but on the other hand it is not as trivial as it looks like to be. To accommodate a conception of a changing degree of market efficiency over time, there is suggested a new version of the efficient market hypothesis derived from evolutionary principles. Basement lies in biological perspective and requests an evolutionary alternative to market efficiency. Such a concept is called adaptive market hypothesis (Lo, 2004). It does not mean that the previous version of the efficient market hypothesis is forgotten, but these two methods of market inefficiency are able to collaborate in a supporting way. Another form of dynamics is shown by Farmer and Joshi. In most cases market changes perform as orders in the real world. Assuming market orders as trade requests that are done immediately after their proposal at the best available price expresses an alternative way of market dynamics (Farmer and Joshi, 2002). Agent-based modelling is also a way to represent dynamics in evolution of the efficient market hypothesis. Agents represent individual types of traders with their own patterns of behaviour (Alvarez-Ramirez et al., 2003). Dynamic view on market performance is not always acceptable as usual manner of trading activity. For instance, Malkiel (2003) expresses an apprehension that terms such random walk and efficiency are not saving themselves and do not recast standard theory to real behaviour of markets. However, if markets are efficient, there will not be potential to gain extraordinary profit in comparison with a benchmark. According to Neuhierl and Schlusche (2009) though, many empirical findings show us potential to predict future stock market returns using certain indicators. In the literature can be found many useful indicators, such as the dividend yield (Shiller, 1984), the earnings to price ratio (Campbell and Shiller, 1998) or dividend payout ratio (Lamont, 1998).

Indicators

Tregler (2005) in his work constructed the stock market valuation indicators based on some well-known ratios. These indicators compare the current value of the ratio to the reference base – mostly a historical mean of the ratio or a long-term trend. In this paper three different ratios are used. The indicator for each of them is calculated the same way. The current value of the ratio is divided by its 20-year moving average, deducted 1 and then multiplied by 100. Value of the indicator then says for how many percent the current value of the ratio is higher or lower than its average value. In the case of correct valuation – the current value equal to the long-term moving average – the indicator value is equal to 0. Values over 0 indicate overvaluation and values below 0 indicate undervaluation of the stock market.

P/E Ratio

P/E ratio is usually calculated as the ratio of the current share price and the sum of net earnings per share for the most recent four financial quarters. In quarterly earnings, we took into account the fact that information about company's earnings is not available to all investors immediately. We calculated with one month delay, which means that earnings for the first quarter were first used when calculating P/E ratio at the end of April, and so on.

According to the analysis of investment bank Morgan Stanley focusing on the relationship between the values of P/E ratio and the stock market returns in the next five years, which conclusions are mentioned by Tregler (2005), in the period 1926 to 2002 the low P/E ratios were followed by a period of high annualized return and high P/E ratios were followed by a five-year period with low annualized return. This conclusion indicates that P/E ratio may be a good indicator of undervaluation or overvaluation of the stock market.

Based on P/E ratio Tregler (2005) constructed the indicator of valuation accuracy calculated by the following formula:

$$\frac{P}{E} \text{ 10 valuation indicator} = \left(\frac{\frac{P}{E} \text{ 10}}{MA \text{ 20 } \left(\frac{P}{E} \text{ 10} \right)} - 1 \right) \times 100 \quad (1)$$

where: MA 20 (P/E) is a 20-year moving average of P/E ratio.

High values of the indicator means overvalued stocks so we can expect a decline of their prices. With decreasing prices the value of P/E ratio approaches its long-term values represented in the formula by a long-term moving average.

P/E 10 Ratio

Graham and Dodd (1934) recommend for portfolio management calculating P/E ratio with average earnings for at least the last 5 years, optimally 7 to 10 years.

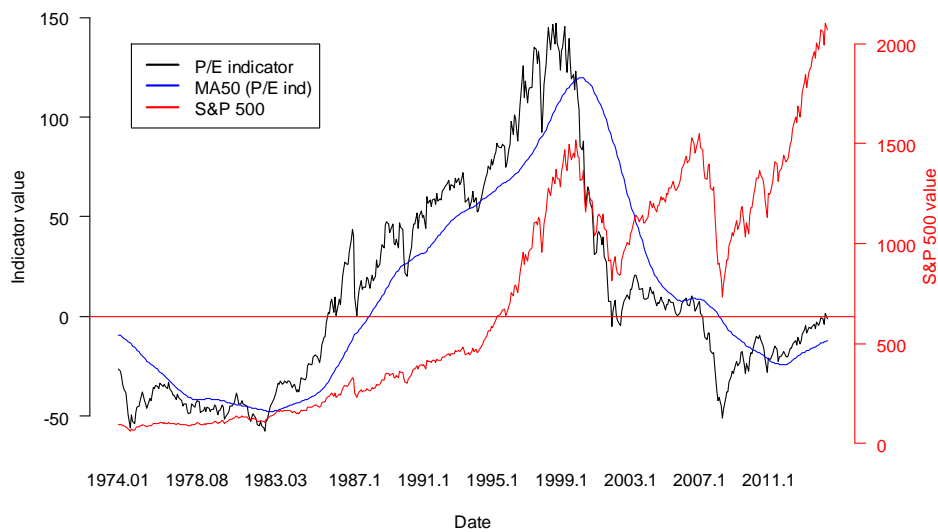


Figure 1. P/E indicator, MA 50 of P/E indicator and close prices of S&P 500

In accordance with this recommendation, Campbell and Shiller (1988) constructed a ratio called CAPE – cyclically adjusted price-to-earnings ratio – with an average stock or index price for the last month in nominator and 10-year average real earnings in denominator. Real earnings were calculated from nominal earnings using the consumer price index. Instead of average price in nominator we used an actual price of index and calculated the ratio that is usually known as P/E 10 ratio. The same approach was applied by Tregler (2005). The valuation indicator based on P/E 10 has the following form:

$$\frac{P}{E} 10 \text{ valuation indicator} = \left(\frac{\frac{P}{E} 10}{MA 20 \left(\frac{P}{E} 10 \right)} - 1 \right) \times 100 \quad (2)$$

where: MA 20 (P/E 10) is a 20-year moving average of P/E 10 ratio.

Dividend Yield

As stated by Kaczmarek (2014) dividends are one of the factors in the creation of value on the capital market. Dividend yield is the sum of dividends paid last year per share divided by the stock price.

$$\text{dividend yield} = \frac{D}{P} \quad (3)$$

where: D is the sum of dividends paid during last year per share;
 P is a current price of the stock or stock index.

The valuation of the stock or the stock market can be done by comparing the current value of the dividend yield to its long-term level. Then the formula for calculating the valuation indicator looks as follows:

$$\text{DY valuation indicator} = \left(\frac{\left(\frac{D}{P}\right)_t}{MA\ 20\left(\frac{D}{P}\right)} - 1 \right) \times 100 \quad (4)$$

where: D/P is a dividend yield in time t;
MA 20 (D/P) is a 20-year moving average of D/P ratio.

Data

For the calculation of indicators were used: S&P 500 monthly close prices from January 1950 to March 2015, S&P 500 quarterly earnings per share, monthly data of dividends per share paid over the last year for S&P 500, monthly data on consumer price index, monthly data on risk-free rate. As a risk-free rate we chose 3-month Treasury bills. Quarterly earnings were used for three consecutive months to obtain a monthly data.

We took into account the fact that regular portfolio managers and investors do not have an access to some information immediately. We assumed that portfolio managers get the information about earnings and inflation with one month delay. Mentioned data were downloaded from Yahoo finance (2015), Shiller database (2015), and Federal Reserve Bank of St. Louis (2015).

Portfolio Management Approaches

To analyse a prediction ability of the above indicators and their possible application in portfolio management we created some investment strategies with clearly defined rules for opening and closing the positions, which are presented below.

Our basic strategies – strategies 1 and 2 – are based on the primary principle of valuation indicators described by Tregler (2005). Valuation indicator gives us an information about under or overvaluation of the stock market. Fairly valued stock market has an indicator value of 0. If the indicator is below the zero line, the market is perceived as undervalued and an increase of the prices is expected.

Tregler (2005), however, in his book does not say when to buy or sell shares. We have tried to formulate simple rules based on principles presented by Tregler (2005), our knowledge, and our trading experiences.

The First Strategy

The first strategy was built on already mentioned idea of market valuation from the value of the indicator compared to zero line. Entry and exit rules then look as follows:

- open a long position if the indicator value is less than 0 – the market is undervalued,
- close a long position if the indicator value is greater than 0 – the market is overvalued.

The Second Strategy

The second strategy was similar to the first one, but we added the possibility of short selling. When the market was overvalued, we tested whether it is appropriate to open a short position and exploit this overvaluation. The rules are as follows:

- open a long position if the indicator value is less than 0, it means the market is undervalued, and close this position, if the indicator value is greater than 0, it means the market is overvalued,
- open a short position if the indicator value is greater than 0, it means the market is overvalued, and close this position if the indicator value is less than 0, it means the market is undervalued.

For the alternative strategies – strategies 3, 4 and 5, we tested different variations of the conditions and applied an alternative approach to look at the indicators mentioned.

The Third Strategy

In this strategy we used a moving average of indicator values and we watched the indicator values, applied moving average, and zero line. The idea behind building this strategy was to solve the problems we perceived in the basic strategies presented above. Specifically, we are referring to the situation when the indicator falls below 0 line and indicates the undervaluation of the market. According to the Mean reversion theory, the market will go after some time from extended values to its mean. In this case the mean value of indicator is 0. However, it is important to wait for these extended values, and therefore it is necessary to wait for the situation when the indicator reaches the local minimum (ideally) and then open a long position. For this reason we used the indicator values smoothed by moving average and waited for the situation when the value of the valuation indicator is above the moving average value, which was used to identify the substantial market changes. We also wanted to hold the position as long as possible, so we waited for the situation when the moving average exceeds the value of the valuation indicator. For the moving average calculation a period of 50 months were used. This choice was based on popularity of MA 50 in trading strategies and our test of some other moving averages. Short moving averages caused too frequent opening and closing the positions connected with high transaction costs. With long moving averages the opening or closing the position was rare and reaction of indicator to market changes was slow.

The rules for the third strategy look as follows:

- open a long position if the indicator value is greater than the value of MA 50, but less than 0,

- close a long position if the indicator value is less than the value of MA 50.

The Fourth Strategy

At last we have two strategies that do not use the zero line. We tested only the use of a moving average. Conditions for opening and closing the positions are:

- open a long position if the indicator value is greater than the value of MA 50,
- close a long position if the indicator value is less than the value of MA 50.

The Fifth Strategy

In the fifth strategy we added an option of short selling to the previous strategy. The rules are similar:

- open a long position if the indicator value is greater than the value of MA 50 and close this positions if the indicator value is less than the value of MA 50,
- open a short position if the indicator value is less than the value of MA 50 and close this position if the indicator value is less than the value of MA 50.

Results

We tested our five strategies for three above mentioned valuation indicators. We consider the transaction costs of 0.2 % of the trade value when opening and closing the position. Our estimate was based on the fees that are charged to the clients of brokerage company Interactive Brokers (in many cases the fees are lower, but some brokers charge even higher fees). In the strategies 2 and 5 we have an opened position during the entire period, either long or short. In the strategies 1, 3 and 4 the periods without opened position occurred. During these intervals, we considered the risk-free investment of the money in our portfolio with returns derived from the 3-month Treasury bills returns. The results are presented in Table 1.

Table 1 shows us that any of chosen strategies was not able to beat the market. In almost all parameters were strategies worse than the market itself. If we look at groups of strategies themselves, the strategy 1, based purely on the ideas of Tregler, was in positive territory, but could not gain even half of the return of the market. The second important aspect of investing is the risk. We applied the same measures of risk as Šoltés and Pinka (2015): standard deviation, Sharpe ratio, Maximum drawdown, and we calculated also negative standard deviation and Sortino ratio. For the first strategy the risk measured with maximal drawdown was even worse than for S&P 500 with about 80% drawdown in comparison with 53% drawdown of the market.

The strategies 2 and 5 with possibility of short selling were the worst. Many of these strategies had final return below the initial balance. Based on these results we can say that using short selling is counterproductive in our strategies.

The third strategy has the lowest standard deviation of the returns. Total net profit is positive, but lower than for S&P 500. It is a result of being in position less than one third of time and investing mostly in risk-free assets.

From created strategies the similar results with the market had only P/E 10 indicator in connection with the fourth strategy. The final return is slightly lower than market's, but with significantly lower drawdown – only 30.2%.

Table 1. Performance of different strategies based on valuation indicators

Strategy	Indicator	in position	P / L	V _P	V _P - TC	Max DD	Total NP	SD	Neg SD	Sharpe R	Sortino R
SAP	SAP	494	3.064	21.413	21.413	0.526	20.413	0.045	0.034	455.35	597.34
1	P/E	265	1.781	6.114	5.933	0.806	4.933	0.031	0.030	159.44	165.38
1	P/E 10	236	1.765	5.938	5.843	0.895	4.843	0.033	0.033	148.93	148.25
1	DY	292	2.057	8.016	7.826	0.690	6.826	0.033	0.035	204.91	195.91
2	P/E	494	-0.111	0.922	0.895	0.798	-0.105	0.045	0.027	-2.32	-3.84
2	P/E 10	494	-0.245	0.796	0.783	0.505	-0.217	0.045	0.027	-4.79	-7.99
2	DY	494	0.489	1.673	1.630	0.916	0.630	0.045	0.032	13.92	19.69
3	P/E	112	0.851	2.393	2.341	0.403	1.341	0.025	0.045	53.89	29.79
3	P/E 10	153	1.811	6.201	6.115	0.500	5.115	0.024	0.037	213.38	139.51
3	DY	119	0.594	1.833	1.811	0.463	0.811	0.023	0.039	35.21	20.80
4	P/E	212	1.473	4.623	4.362	0.545	3.362	0.032	0.040	103.62	84.32
4	P/E 10	269	2.926	19.304	18.658	0.302	17.658	0.030	0.033	581.89	542.00
4	DY	235	1.586	5.219	4.886	0.526	3.886	0.033	0.035	118.98	111.78
5	P/E	494	-0.816	0.469	0.442	0.384	-0.558	0.045	0.031	-12.34	-18.23
5	P/E 10	494	2.212	9.465	9.130	0.302	8.130	0.045	0.031	180.55	266.54
5	DY	494	-0.629	0.570	0.533	0.526	-0.467	0.045	0.028	-10.31	-16.43

Note: Table shows the performance of different strategies based on three valuation indicators: P/E, P/E 10, and DY indicator. Profit of S&P 500 (log return) during followed period was 3.064.

P / L – profit or loss measured as log return, V_P – portfolio value at the end of period (starting value = 1), V_P – portfolio value at the end of period minus transaction costs, Max DD – Maximum drawdown, Total NP – Total net profit, SD – Standard deviation, Neg SD – Negative standard deviation, Sharpe R – Sharpe ratio, Sortino R – Sortino ratio.

In the risk management is very important parameter – Sharpe ratio and this ratio is even higher. It means that experienced ratio between the received return and the experienced risk was lower. This strategy is suitable for less aggressive portfolio management and for investors with a higher aversion of risk.

If we take a look on the results of the indicators themselves, P/E 10 indicator has clearly the best results almost in each strategy group. However, as was mentioned earlier, almost none of these strategies were able to follow the results of the market itself.

The reason of the best results of this indicator can be explained by its construction. In the calculation are smoothed values of earnings taking into account and the market noise is removed. Moreover, the best strategy – the fourth strategy – constructed from P/E 10 indicator – itself, is based on removing market noise by

using moving average of its values and the trading signals are created only if there is clear change in trend.

Below can be seen the comparison of the S&P 500 and the equity curve of the best strategy – Figure 2. From the chart a period during two big market crashes is visible, when the strategy was completely off. On the other hand, during this period using the best strategy in our portfolio management was off even when the market was running up.

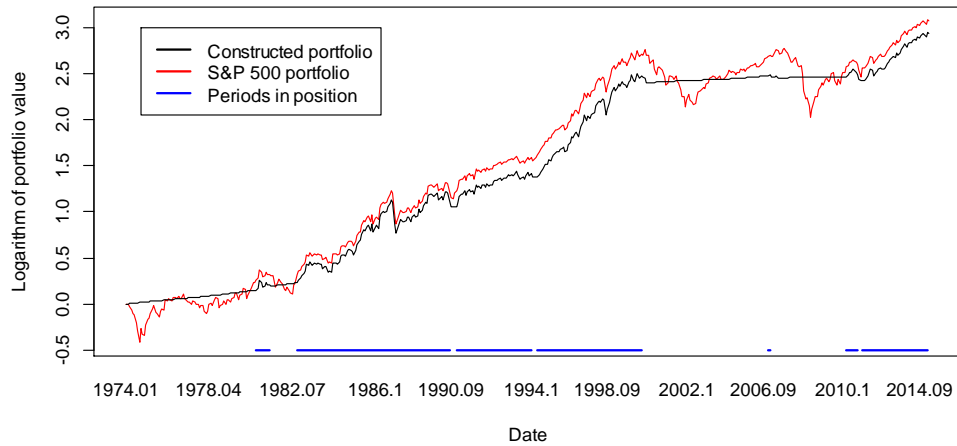


Figure 2. Cumulative returns of portfolio based on fourth strategy with P/E 10 indicator compared to S&P 500

Figure 3 represents the P/E 10 indicator and the moving average, according the trading rules, which were applied for our best portfolio. Complete rules are described above in the paper.

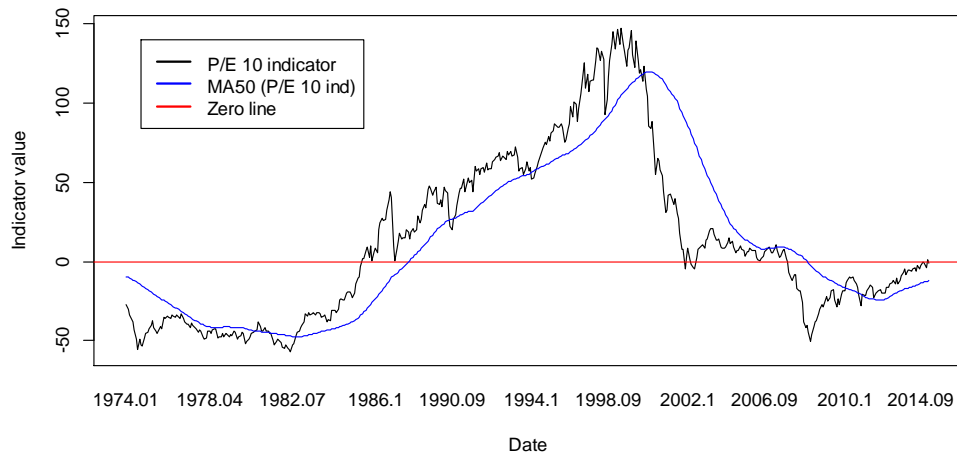


Figure 3. P/E 10 indicator and MA 50 of P/E 10 indicator

The similar calculations were made for valuation indicators with 30-year moving average in denominator. It means that we changed the reference base and prolonged the historical average considered. The results were similar to these described above – the created strategies were not able to beat the market and the best results were achieved by the strategy 4 based on P/E 10 indicator, so they are not part of this paper.

Conclusion

Tregler's basic market valuation indicators should indicate when the market is overvalued and when it is undervalued. It should help portfolio managers and investors to time the market, when to buy and when to sell.

However, there is almost no evidence that using these indicators in such a simple way has significant benefits for higher returns of such portfolio. Therefore we looked at these indicators and tested them on real market condition. We tried to find out if it is possible to beat the market itself using listed portfolio management approaches.

Our focus was on the indicators themselves as well as on their variations using moving average of their values and the rules made with this moving average. We found out, that with using such strategies with the mentioned rules we could not gain higher return. Only benefits could be for risk management, when risk measured in standard deviation was lower using these strategies.

On the one hand we were able to find strategy with sufficient results, but on the other hand from so many strategies it is more because of luck and to repeat the results in the future is more than the unsure. In addition, it seems to be worthless to use such a complicated strategy for portfolio management in comparison with simple buy and hold strategy for S&P 500 to achieve only comparable results.

In this paper only the simple investment strategies were analysed. Construction of more sophisticated strategies with higher returns may be possible and it could be a subject of future research.

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ZASTOSOWANIE MODELI WYCENY RYNKOWEJ Z ZARZĄDZANIU PORTFELEM

Streszczenie: Niniejszy artykuł dotyczy stosowania technik wyceny rynkowej w zarządzaniu portfelem. Jego celem jest dowiedzieć się, czy możliwe jest uzyskanie nadwyżki zysków dzięki prostym strategiom inwestycyjnym opartym na wskaźnikach skonstruowanych z kilku znanych współczynników, które używane są do wykrywania zaniżonej lub zawyżonej wyceny rynku akcji. Po tle teoretycznym zaprezentowano przegląd innych badań w tej dziedzinie. W kolejnym rozdziale omawiane są wskaźniki wyceny rynkowej Treglera oraz stworzone strategie inwestycyjne. Podejścia zarządzania portfelem dla różnych wskaźników testowane były na historycznych miesięcznych kursach zamknięcia S&P 500. Żadne z wybranych podejść nie było w stanie osiągnąć wyższego zwrotu niż podstawowa strategia „kup i trzymaj”. Jedna ze strategii osiągnęła zwrot porównywalny do poziomu odniesienia, ale z mniejszym ryzykiem, a więc może być ona odpowiednia dla niektórych zarządzających portfelami.

Słowa kluczowe: wskaźniki wyceny, wycena rynkowa, zarządzanie portfelem, strategie inwestycyjne, hipoteza wydajności rynku, zaniżona wycena, zawyżona wycena

市場估值模型投資組合管理中的應用

摘要: 本文涉及的投資組合管理應用市場的估值模型。其目的是找出是否有可能獲得基於從一些用來檢測低估或股市高估知名的比例構成指標簡單的投資策略的超額收益。理論背景之後是其他研究的在本領域的概述。在下一章Tregler的市場估值指標與創建投資策略進行了討論。投資組合管理方法，不同的指標進行了歷史標準普爾500指數月度收盤價測試。任何選擇的辦法是不是能夠實現更高的回報比基本的買入持有策略。實現一個策略返回媲美基準，但風險較低，因此它可能適合一些投資組合經理。

關鍵詞: 估值指標，市場估值，投資組合管理，投資策略，效率市場假說，價值低估，高估