

Evaluating quantitative stock selection strategies in Tehran Stock Exchange

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Abstract

There are different strategies for selecting stocks, and different investors use different strategies according to their risk tolerance or their expected rate of return. In this study, the profitability of a broad range of stock selection strategies in Tehran Stock Exchange over the period 1370-1383, has been examined, and it has been investigated whether the successful strategies in other countries are also successful in Iran or not. Although a lot of comprehensive studies have been done in the developed and in a considerable number of emerging markets, and successful strategies have been well documented in those countries, such studies have never been done in Tehran Stock Exchange. The sample is all the companies in Tehran Stock Exchange in the aforementioned period. Also, in order to evaluate different strategies, various portfolios have been formed for each year according to each strategy. Then, computing the return of winner portfolios, those strategies generating the maximum return in excess of market return, are presented. The evaluation of the performance of the strategies has been done regarding various diagnostics criteria like risk and return. The results show that value strategy is the most successful strategy in Iran and generates significant excess return, in contrast to growth, size, price momentum and fundamental strategies. In other words, the most successful strategy in Iran is the multivariate strategy which selects the stocks with high E/P, B/P, C/P, S/P and D/E. Moreover, as apposed to the developed markets and a considerable number of emerging markets, size and momentum strategies are not profitable ones in Tehran Stock Exchange and can not distinguish between profitable and unprofitable stocks.

Keywords: Value strategy; Growth strategy; Momentum strategy; Size strategy; Stock selection; Tehran Stock Exchange

1. Introduction

Due to the following facts, stock selection is a complex process: first, so many factors affect a company's health that it is nearly impossible to construct a formula to predict the company's success.

Second, the required information is intangible and cannot be measured. The quantifiable aspects of a company, such as profits, net loss, etc. are easy enough to find. But, the qualitative factors, such as the company's staff, its competitive advantages, its reputation and so on, can not be explicitly measured. This combination of tangible and intangible aspects makes selecting stocks a highly subjective and even sometimes intuitive process.

Third, because of the human (often irrational) element inherent in the forces that move the stock market, stocks do not always behave as anticipated. Emotions may change the market quickly and unpredictably and when confidence turns into fear, the stock market can be even a dangerous place.

Forth, different investors have various personal outlook, time frame, and risk tolerance; thus, different investment strategies may be required. The above-mentioned facts state that in addition to the complexity in the stock selection process, an efficient strategy for an investor in a market does not necessarily yield the same results for other investors in other markets.

Moreover, all of the above-mentioned statements,

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highlights the need of knowing different stock selection strategies and paying attention to the fact that how efficient each of these strategies is in a specific market.

This has motivated the authors to perform current research to compare the performance of the most popular stock selection strategies in Iran, and to determine the strategies that outperform in Tehran Stock Exchange.

2. Literature survey

The success of quantitative stock selection strategies in developed markets is well documented. In these markets, portfolios formed on the basis of earning to price (E/P), book to market (B/M), price momentum or earning revisions have been found to earn significant excess returns.

For emerging markets, however, only few studies which investigate individual stock selection exist. Moreover, most of these studies have rendered conflicting results. For instance, whereas Claessens et al. [7] find evidence for a premium for large firms and growth stocks, Fama and French [9], Patel [13], Rouwenhorst [14] and Barry et al. [3] report a premium for small firms and value stocks. Whereas the above-mentioned studies consider only a limited number of strategies, Achour et al. [1] examine a much broader range of trading strategies, but their sample includes stocks from only three emerging markets (Malaysia, Mexico and South Africa). They found that so many strategies earn significant excess returns, including strategies based on analysts' earnings revisions.

In 2003, Hart et al. [10] examined 2851 firms from 32 emerging markets over the period 1985-1999. They found that value, momentum and earnings revisions strategies are the most successful strategies and generate excess returns, in contrast to strategies based on size, liquidity and mean revisions.

The results of the aforementioned studies show that the successful strategies in developed markets are also successful in emerging markets.

In another study, Hart et al. [11] investigate the reason of the success of the value, momentum and earning revision in emerging markets, to see if the excess return can be interpreted as compensation for risk or it is because of investor's behavioral biases. They found that the excess return is due to investor's behavioral biases.

Such studies have never been done in Iran and the performance of stock selection strategies has not been evaluated in Iran, so the lack of such studies is severe in Iran and this motivates this study.

3. Sample and data

The sample is all the companies in Tehran Stock Exchange over the period 1370-1383. Stock prices and relevant firm characteristics are taken from the Rahavarde Novin database. It is noteworthy to mention that the observations with returns in the upper and lower 3σ tails of the return distribution were omitted when forming top and bottom portfolios.

4. Methodology

In this study several stock selection strategies have been evaluated based on indicators of value, momentum, size, growth, growth at reasonable price and fundamental factors.

As measures of value, earning to price ratio (E/P), book to market ratio (B/M), cash flow to price ratio (C/P), sales to price ratio (S/P), dividend to earning ratio (D/E) and dividend to price ratio (D/P) have been applied. For growth strategy, EPS growth rate, revenue growth rate and rate of reinvestment have been applied. Size is taken to be the market capitalization of the stock. For growth at reasonable price, PEG ratio has been applied. For fundamental factors, ROE, ROE growth rate, ROA, ROA growth rate, profit growth rate, debt to equity ratio and debt to asset ratio have been applied. Moreover, it should be mentioned that all the above indicators are defined in Appendix I.

At the end of each year, the stocks of each particular strategy are ranked in descending order. Then, equally weighted top and bottom portfolios are formed from the 20% stocks ranked highest and lowest, respectively. After formation, the portfolio is not rebalanced, except for stocks that leave Tehran Stock Exchange.

Usually the performance of stock selection strategies is measured as the return on a "zero-investment" strategy, which involves a long position in the winners portfolio and an offsetting short position in the losers portfolio, as in the work of Fama and French [9] and Rouwenhorst [14], among many others. However, the question is that whether these returns can actually be realized in practice, as short selling constraints may prevent implementation of such a zero investment strategy [2]. Short selling restrictions are particularly relevant for emerging markets [4,5,8] and also Tehran Stock Exchange.

In this study another method which is very similar to what Hart et al. [10] do, is used. In other words, the average return of the winner portfolios is com-

pared with Tehran Stock Exchange Index. Since loser portfolios provide important information regarding which stocks are to be avoided, loser portfolios are also formed.

Moreover, some diagnostic criteria are presented to assist the evaluation of each strategy. These criteria are presented and defined as follows:

1. Average annualized return.
2. Average annual return in excess of market return.
3. Average annual return in excess of risk free rate.
4. t stat: test of whether average excess return is significantly different from zero
5. Annualized geometric average.
6. Cumulative return: value of 1 Rial if invested at the first observation date and compounded over intervening periods.
7. Standard Deviation of returns.
8. Sharp ratio: the ratio of average annual return in excess of risk free rate to standard deviation of returns.
9. Systematic risk (beta): Slope of regression line estimated by regressing average portfolio returns on the relevant market portfolio return over all observation periods.
10. Alpha: Annualized intercept of the regression line estimation per systematic risk (beta) above.
11. Treynor ratio: the ratio of average annual return in excess of risk free rate to systematic risk(beta)

Since ranking the stocks according to a single factor may yield wrong results, in this study the performance of multivariate strategies, which rank the stocks according to multiple factors, are also evaluated.

In most of the researches, for example in the research of Lakonishok et al. [12] and also Chan et al. [6], the following method is used in order to evaluate the performance of multivariate strategies: first the stocks are ranked in descending order regarding the first factor; in other words, in the beginning the stocks are ranked according to the first factor, and the first 20% of the stocks is determined. Then the identified stocks in the previous stage are ranked, once

more, according to the second factor and the first 20% of them is determined. Consequently, if there exists n factor, the ranking will be done n times.

In this study a method which is very similar to the method of Hart et al. [10], is used. In this method first the stocks are ranked in descending order according to each single factor. For each factor, grade 1 is assigned to the stock with the greatest value in the ranking, grade 2 is assigned to the second stock, and so on. So stocks obtain different grades according to different factors.

At the end, the grade of each stock according to the multivariate strategy is computed as the average of its grades regarding various factors. Considering this final grade, which is computed for each stock, the stocks are ranked in ascending order, and then winner portfolios are built from the first 20% stocks with the least final grade. Also, loser portfolios are built from the last 20% stocks.

5. Profitability of stock selection strategies

In this section, performance of univariate strategies, which rank stocks according to a single return factor, and seven multivariate strategies, which combine different factors to produce the stock ranking, are evaluated. The multivariate strategies which are evaluated in this study are as follows:

Multi-strategy 1 (E/P, B/P), multi-strategy 2 (E/P, B/P, C/P, S/P), multi-strategy 3 (E/P, B/P, C/P, S/P, D/E), multi-strategy 4 (E/P, B/P, C/P, S/P, momentum), multi-strategy 5 (ROE, ROA), multi-strategy 6 (debt / equity, debt / asset), multi-strategy 7 (ROE, ROA, debt / equity, debt / asset).

As mentioned before the strategies are evaluated according to 11 criteria. Table 1 summarizes the average annual return, average annual return in excess of market return and t stat to test whether average excess return is significantly different from zero.

In the first column of Table 1 the strategies are shown. In column 2 and 3 average return of top and bottom portfolios are presented. In forth column the difference between average return of top and bottom portfolios (TMB) is presented. In column 5 t stat, which tests whether average excess return of top portfolio relative to bottom portfolio is significantly different from zero, is presented. Column 6 shows market average return. In column 7 the difference between top portfolio average return and market average return (TMI), is presented. Finally in column 8 we have t stat which tests whether average excess return of top portfolio relative to market index is significantly different from zero or not.

Table 1. Average annual return, average annual return in excess of market and t stat.

Strategy	Top portfolio average return	Bottom portfolio average return	TMB	t (TMB)	Market average return	TMI	t (TMI)
E/P	0.7646	0.1719	0.5927	7.6290	0.2986	0.4660	4.0291
C/P	0.7263	0.1544	0.5719	7.3525	0.2986	0.4277	3.7389
B/P	0.5400	0.2937	0.2462	3.7708	0.2986	0.2413	2.1319
S/P	0.6043	0.3384	0.2660	2.4810	0.2986	0.3057	2.4728
D/E	0.5308	0.2966	0.2343	3.8156	0.2986	0.2322	2.2547
ROE	0.5887	0.2165	0.3722	3.5329	0.2986	0.2901	2.4445
ROA	0.5838	0.2672	0.3165	3.6642	0.2986	0.2851	2.6332
D/P	0.7615	0.2280	0.5335	6.9687	0.2986	0.4629	4.1025
Debt/equity	0.4343	0.3746	0.0597	0.6692	0.2986	0.1357	1.4091
Debt/asset	0.3864	0.3944	0.0080	0.0961	0.2986	0.0878	0.8906
Eps growth rate	0.4856	0.2871	0.1986	2.5136	0.2986	0.1870	2.0427
Revenue growth rate	0.5400	0.3064	0.2336	2.7228	0.2986	0.2414	2.4416
Profit growth rate	0.5084	0.2351	0.2733	4.4538	0.2986	0.2098	2.0105
Rate of reinvestment	0.4541	0.3894	0.0647	1.3276	0.2986	0.1554	1.3989
Price growth rate	0.3669	0.5127	0.1458	1.5808	0.2986	0.0682	0.7630
ROE growth rate	0.5077	0.2392	0.2685	4.1868	0.2986	0.2091	1.8132
ROA growth rate	0.4940	0.2754	0.2186	4.0477	0.2986	0.1953	1.8480
PEG	0.3304	0.2937	0.0366	0.5966	0.2986	0.0318	0.2720
Market cap	0.3641	0.4850	0.1209	1.3649	0.2986	0.0655	0.7033
MS1	0.7508	0.2312	0.5196	6.0621	0.2986	0.4522	3.9177
MS2	0.7711	0.1832	0.5879	5.5629	0.2986	0.4725	4.1435
MS3	0.7885	0.1440	0.6445	6.8413	0.2986	0.4899	4.2186
MS4	0.7167	0.1919	0.5248	5.1063	0.2986	0.4181	3.5454
MS5	0.5733	0.2485	0.3248	4.2961	0.2986	0.2746	2.6512
MS6	0.4091	0.3919	0.0172	0.2085	0.2986	0.1105	1.1362
MS7	0.5077	0.2768	0.2309	2.9055	0.2986	0.2091	1.9057

Of the different value strategies considered, the earnings-to price strategy generates the highest average excess return. This holds irrespective of whether excess returns are measured relative to the market index (TMI, Top-Minus-Index) or relative to the loser portfolios (TMB, Top-Minus-Bottom). The return on the E/P winner portfolios exceeds the return on the market index by 46.6% per year on average, whereas high E/P stocks have outperformed low E/P stocks by 53.35% per year. These excess returns are strongly statistically significant, with t statistics of 4.02 and 7.62, respectively.

Among univariate strategies, debt to equity, debt to asset, rate of reinvestment, momentum, PEG and market cap strategies did not generate significant excess return relative to market index, at 90% confidence level. Since the difference between average yearly return of top and bottom portfolios in these strategies is not significant, it could be said that these strategies are inefficient in Iran.

Among multivariate strategies, multi-strategy 3 generates the highest average excess return. This holds irrespective of whether excess returns are measured relative to the market index or relative to the loser portfolios. In this strategy the return on the winner portfolios exceeds the return on the market index by 48.99% per year on average, whereas high B/P,S/P,C/P,D/E,E/P stocks have outperformed low B/P,S/P,C/P,D/E,E/P stocks by 64.45% per year. These excess returns are strongly statistically significant, with t statistics of 4.21 and 6.84, respectively.

Among multivariate strategies, multi-strategy 6 (debt/equity & debt/asset) did not generate significant excess return relative to market index, at 90% confidence level. On the other hand, the difference between average yearly return of top and bottom portfolios in this strategy is not significant, so this strategy is also inefficient in Iran.

Table 3 summarizes geometric return, cumulative return and the average annual return in excess of risk free rate. In this study risk free rate is considered as Melli Bank one year interest rate since 1370 till 1380 and Parsian Bank one year interest rate since 1381 till 1383. This is because after the establishment of Parsian Bank, this bank offers higher interest rate to its investors. In Table 2 these risk free interest rates are presented.

In the first column of Table 3 the strategies are shown. In column 2 and 3 average annual return in excess of risk free interest rate are presented for top and bottom portfolios. In column 4 and 5 cumulative return of top and bottom portfolios are presented. Fi-

nally in column 6 and 7 geometric return of top and bottom portfolios are presented.

Table 4 summarizes standard deviation of return and sharp ratio. In the first column the strategies are shown. In column 2 and 3 standard deviation of return of top and bottom portfolios are presented. In column 4 and 5 Sharp ratio for top and bottom portfolios are calculated.

Table 5 summarizes alpha, beta and Treynor ratio. In the first column the strategies are shown. In column 2 and 3 beta of top and bottom portfolios are presented. In column 4 and 5 Treynor ratio for top and bottom portfolios are calculated. Finally in column 6 and 7 alpha of top and bottom portfolios are presented.

6. Final evaluation of strategies

In this section, the most successful strategies are presented considering all the criteria mentioned above. Since debt to equity, debt to asset, rate of reinvestment, momentum, PEG, market cap and multi-strategy 6 are inefficient strategies in Iran, these strategies are not considered in the final evaluation. Consequently, in order to find the best strategies among the 19 remained strategies, the following method has been applied. First, different strategies are ranked according to average annualized return, average annual return in excess of market, average annual return in excess of risk free rate, annualized geometric average, cumulative return, sharp ratio, treynor ratio and alpha.

According to each of the abovementioned criteria, the best strategy is chosen and got the first rank in that specific strategy. Similarly the next strategy gets the second rank and the worst strategy gets the last rank. Then in order to determine the final rank of each strategy, the average rank of the strategy in the 8 criteria mentioned above, is computed. It is clear that the strategy with the least final rank is the best one. The results are summarized in Table 6.

It is clear that multi-strategy 3 is the best strategy, and multi-strategy 2 is the second. Furthermore, among univariate strategies, buying the stock with the highest E/P is the best one.

Table 2. Risk free interest rate.

Year	1370	1371	1372	1373	1374	1375	1376
Interest rate	0.09	0.1	0.12	0.11	0.14	0.14	0.14
Year	1377	1378	1379	1380	1381	1382	1383
Interest rate	0.14	0.14	0.14	0.14	0.17	0.17	0.18

Table 3. Average annual excess return regarding risk free rate, cumulative return and geometric return.

Strategy	TMRf	BMRf	CRT	CRB	GRT	GRB
E/P	0.63	0.04	2152.42	6.98	0.73	0.15
C/P	0.59	0.02	1702.08	6.14	0.70	0.14
B/P	0.40	0.16	378.75	24.64	0.53	0.26
S/P	0.47	0.20	593.19	39.30	0.58	0.30
D/E	0.39	0.16	322.26	34.65	0.51	0.29
ROE	0.45	0.08	463.20	13.09	0.55	0.20
ROA	0.45	0.13	488.83	23.38	0.56	0.25
D/P	0.62	0.09	2115.00	16.97	0.73	0.22
Debt/equity	0.30	0.24	114.24	72.76	0.40	0.36
Debt/asset	0.25	0.26	70.96	89.58	0.36	0.38
Eps growth rate	0.35	0.15	191.52	29.18	0.46	0.27
Revenue growth rate	0.40	0.17	313.13	35.80	0.51	0.29
Profit growth rate	0.37	0.10	248.12	16.15	0.48	0.22
Rate of reinvestment	0.32	0.25	151.53	86.22	0.43	0.37
Price growth rate	0.23	0.38	58.72	242.10	0.34	0.48
ROE growth rate	0.37	0.10	238.07	17.97	0.48	0.23
ROA growth rate	0.36	0.14	212.80	25.34	0.47	0.26
PEG	0.19	0.16	41.27	28.00	0.30	0.27
Market cap	0.23	0.35	47.80	229.65	0.32	0.47
MS1	0.61	0.09	1966.48	13.14	0.72	0.20
MS2	0.63	0.05	2262.78	7.42	0.74	0.15
MS3	0.65	0.01	2672.44	5.05	0.76	0.12
MS4	0.58	0.06	1479.99	8.62	0.68	0.17
MS5	0.44	0.11	446.64	19.57	0.55	0.24
MS6	0.27	0.26	91.10	86.47	0.38	0.38
MS7	0.37	0.14	245.69	26.69	0.48	0.26

Table 4. Standard deviation of return and sharp ratio.

Strategy	TStd	BStd	T Sharp R	B Sharp R
E/P	0.360536	0.225611	1.732391	0.141545
C/P	0.297358	0.192139	1.971677	0.075127
B/P	0.195718	0.296422	2.043619	0.518627
S/P	0.305649	0.319479	1.519146	0.620897
D/E	0.260365	0.15624	1.501058	1.002059
ROE	0.38351	0.196396	1.170035	0.389435
ROA	0.321231	0.199896	1.381412	0.636463
D/P	0.346279	0.102936	1.794763	0.855222
Debt/equity	0.317268	0.222446	0.927621	1.0548
Debt/asset	0.308962	0.216344	0.797559	1.175961
Eps growth rate	0.336057	0.196528	1.028488	0.74831
Revenue growth rate	0.337441	0.203298	1.185482	0.818472
Profit growth rate	0.287346	0.193149	1.282163	0.492247
Rate of reinvestment	0.260332	0.198216	1.206378	1.258037
Price growth rate	0.286104	0.325033	0.792999	1.146727
ROE growth rate	0.311593	0.166181	1.180157	0.596966
ROA growth rate	0.296871	0.207753	1.192372	0.651879
PEG	0.263137	0.250117	0.72355	0.614707
Market cap	0.324883	0.184359	0.689823	1.871524
MS1	0.34046	0.264306	1.79405	0.344915
MS2	0.360789	0.258877	1.749252	0.166879
MS3	0.34177	0.220967	1.897606	0.018144
MS4	0.34101	0.240571	1.691153	0.215815
MS5	0.312224	0.176322	1.387646	0.615099
MS6	0.299965	0.222891	0.897132	1.130071
MS7	0.287691	0.188451	1.27807	0.72609

Table 5. Alpha, beta and treynor ratio.

Strategy	T beta	B beta	T Treynor	B Treynor	T alpha	B alpha
E/P	0.37	0.22	1.68	0.15	0.65	0.11
C/P	0.29	0.13	2.02	0.11	0.64	0.11
B/P	0.19	0.40	2.14	0.38	0.48	0.17
S/P	0.23	0.25	2.00	0.80	0.53	0.26
D/E	0.32	0.21	1.22	0.76	0.44	0.23
ROE	0.39	0.16	1.15	0.47	0.47	0.17
ROA	0.36	0.19	1.22	0.65	0.47	0.21
D/P	0.37	0.10	1.68	0.84	0.65	0.20
Debt/equity	0.44	0.20	0.68	1.15	0.30	0.31
Debt/asset	0.41	0.22	0.60	1.17	0.26	0.33
Eps growth rate	0.49	0.28	0.71	0.52	0.34	0.20
Revenue growth rate	0.45	0.05	0.89	3.27	0.41	0.29
Profit growth rate	0.34	0.22	1.07	0.43	0.41	0.17
Rate of reinvestment	0.27	0.20	1.18	1.26	0.37	0.33
Price growth rate	0.43	0.29	0.52	1.30	0.24	0.43
ROE growth rate	0.30	0.10	1.22	0.96	0.42	0.21
ROA growth rate	0.35	0.19	1.02	0.71	0.39	0.22
PEG	0.23	0.23	0.83	0.67	0.26	0.23
Market cap	0.46	0.13	0.48	2.72	0.23	0.45
MS1	0.34	0.32	1.78	0.29	0.65	0.14
MS2	0.38	0.28	1.64	0.16	0.66	0.10
MS3	0.34	0.20	1.91	0.02	0.69	0.08
MS4	0.33	0.20	1.77	0.26	0.62	0.13
MS5	0.38	0.16	1.13	0.66	0.46	0.20
MS6	0.41	0.22	0.66	1.14	0.29	0.33
MS7	0.31	0.08	1.19	1.71	0.42	0.25

Table 6. Final rank of the strategies.

Strategy	Final rank	Strategy	Final rank
MS3	1.625	ROA	10.25
MS2	3.375	ROE	11.5
E/P	4.125	MS5	11.75
D/P	4.375	D/E	12.625
C/P	5	Revenue growth rate	14.5
MS1	5	Profit growth rate	15.25
MS4	7	MS7	15.625
S/P	7.5	ROE growth rate	15.625
B/P	9.25	ROA growth rate	17.75
		Eps growth rate	19.5

7. Conclusion and further research

In this study, the performance of 26 stock selection strategies was evaluated in Tehran Stock Exchange for a period of fourteen years. Among different strategies evaluated, debt to equity ratio, debt to asset ratio, rate of reinvestment, momentum, PEG, size and the multivariate strategy which ranks the stocks according to debt to equity and debt to asset ratios, are not efficient strategies in Iran.

The most successful strategy was the multivariate strategy which selects the stocks with high E/P, B/P, C/P, S/P and D/E. The second successful strategy was the multivariate strategy which selects the stocks with high E/P, B/P, C/P and S/P. Since E/P, B/P, C/P, S/P and D/E are value factors, so value strategy is recognized as the most successful strategy in Iran. This is similar to the result of Hart et al. [10], Barry et al. [3], Rouwenhorst [14], Fama and French [9] and Patel [13] who report a premium for value stocks.

On the other hand, the results for momentum strategy are quite different from the results in developed and emerging markets. In Iran selecting the stocks with low price growth rate in the last one year, are more profitable than the stocks with high price growth rate in the last one year.

For size strategy, at 80% confidence level, the difference between stocks with large market capitalization and small market capitalization is obtained as different from zero. The average return of the small cap stocks is 12.09% higher than the average return of large cap stocks. This result is similar to the results of Fama and French [9], Patel [13] and Rouwenhorst [14] who reported a premium for small cap stocks. On the other hand, this result is in contrast with the results of Hart et al. [10]. But, this is not important as size strategy does not generate significant excess return relative to market index.

The following are some comments for further researches and studies.

1. As this study was about selecting a subset of efficient stocks out of a set of market's stocks, it is proposed to other researchers to study how funds must be invested on those efficient stocks.
2. A research to study whether the excess returns of value strategies may be interpreted as compensation for risk or it is due to behavioral biases.
3. Since it is possible that short selling restrictions finishes in the future, it is recommended that the stock selection strategies be evalu-

ated by zero-investment strategy and also transaction cost be considered in the analysis.

4. Since for a big investor it is important that the stocks in the strategy portfolio have sufficient size and liquidity, it is recommended that the role of size and liquidity be examined on stock selection strategies.
5. Since institutional restrictions, such as delays in the decision making process, may prevent a timely implementation of the stock selection strategies, it is suggested that strategies be evaluated with a one month implementation delay, that is, winners and losers portfolios are formed one month after the stock's ranking.

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15. ROA growth rate: $(\text{Current year ROA} - \text{last year ROA}) / \text{last year ROA}$.
16. Profit growth rate: $(\text{Current year profit} - \text{last year profit}) / \text{last year profit}$.
17. Debt / equity: Total debt / shareholder's equity.
18. Debt / asset: Total debt / total asset.
19. Price growth rate: $(\text{Current year price} - \text{last year price}) / \text{last year price}$.

Appendix I:

1. Market capitalization: Stock price \times number of shares.
2. E/P: Earning per share / stock price.
3. C/P: Cash earning per share / stock price, whereas cash earning per share is equal to:
last year EPS + depreciation / number of shares.
4. B/P: Book value / stock price.
5. S/P: Sale / stock price.
6. D/E: Dividend per share / earning per share.
7. D/P: Dividend per share / stock price.
8. EPS growth rate: $(\text{Current year EPS} - \text{last year EPS}) / \text{last year EPS}$.
9. Revenue growth rate: $(\text{Current year total revenue} - \text{last year total revenue}) / \text{last year total revenue}$.
10. Rate of reinvestment: $(\text{EPS} - \text{DPS}) / \text{shareholder's equity}$.
11. PEG: $(\text{P} / \text{E}) / (\text{EPS annual growth})$.
12. ROE: Net income / shareholder's equity.
13. ROE growth rate: $(\text{Current year ROE} - \text{last year ROE}) / \text{last year ROE}$.
14. ROA: Net income / total asset.