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Efficient Market Hypothesis in KOSPI Stock Market:

Developing an Investment Strategy

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, , [Date]

Approved by

Professor (Seal or signature)

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ABSTRACT

According to the efficient market hypothesis (EMH) stock prices already reflect all available information. This means that investors should not expect excess return from obtaining new information. Momentum strategy is an investment strategy, which tries to generate excess returns by buying past winner stocks and selling past loser stocks. In this paper, KOSPI stock market is analyzed for market efficiency during the 2000-2015 through developing and testing price momentum and alpha momentum strategies.

The results indicated that simple price momentum strategy is not able to generate any excess return, which is consistent with previous academic studies conducted for the Korean stock market. However, implementing the novel alpha momentum strategy, which ranks stocks according to their CAPM alpha in contrast to their past returns, reveals us economically and statistically significant returns over all observed holding periods. This research will implement traditional Capital Asset Pricing Model (CAPM) in estimating the alphas and running regressions. Therefore, along with standard assumptions of the model, this paper accepts that there are no market frictions, no transaction costs as well as no limits on short-selling.

Keywords: Investments, efficient market hypothesis, momentum effect, price momentum, alpha momentum

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Chapter 1. Introduction

1.1. Research Background

The efficient market hypothesis was born as a consequence of studies by several distinguished scientists on stock price predictability in the early 50-s of last century. Kendall (1953) found that stock prices are unpredictable as they follow a random walk. Efficient market hypothesis also tells us that stock prices reflect all available information and that is the reason why investors should not expect excess return from obtaining new information. Fama (1970) categorized market efficiency into 3 forms: 1) weak form, where stock prices include stock trading data; 2) semi-strong, which includes qualitative data, such as all public information and accounting statements of the firm; and 3) strong form, where along with quantitative and qualitative data stock prices also reflect private, including insider information.

In this case, several questions arise concerning the need for research for new information and active portfolio management. Jensen (1978) explained that stock prices reflect information up to the point, where marginal benefits of acting on new information do not exceed the marginal costs of collecting it. Grossman and Stiglitz (1980) pointed out that there would be no financial incentive for an investor to obtain new information if stock prices already reflect all available information.

Nevertheless, there were many studies and empirical evidence on stock market efficiency by countries. Distinguished scientists, such as Fama (1965) and Lo and MacKinlay (1988) concluded that stock markets in developed countries are generally weak-form efficient. Choudhry (1994) also found that stock markets of seven OECD countries were efficient. As to Korea, there are several differing opinions, but one of the latest analysis on Korean stock market efficiency by Hasanov (2009) discovered it was not weak form efficient. There are several statistical tests, such as runs test, variance ratio tests which identify and measure the level of market efficiency. However, in this paper we will try to utilize the momentum strategy to see if we can predict stock prices pattern.

Jegadeesh and Titman (1993) developed momentum strategy, which showed that past winner by stock returns outperform past losers, thus allowing the investor to earn a momentum profit. The methodology to this strategy is to rank stocks according to their past returns and group them into 10 equally-weighted portfolios. Then, the investor buys “winner” portfolio, takes a short-sells “loser” portfolio, and holds this position for 6 to 12 months.

Momentum strategy has been widely documented by many researchers across different countries. And the results of these studies are quite different from one another. Kim (2000), Ahn and Lee (2002,2004) and Kang et al. (2011) reported that there was no momentum in Korean stock market in 1990s. However, Kang et al (2011) discovered a significant momentum in the 2000s among large companies.

Later, Grundy and Martin (2001) argued that the performance of price momentum depends on underlying factors driving stock returns and introduced a momentum strategy that ranks stocks on a stock-specific return component during the portfolio formation period. Following their methodology, Huehn and Scholz (2014) developed a different momentum strategy, which ranks stocks according to their past Fama-French three-factor

alphas during the formation period, then buys "winner" stocks with highest alpha and sell "loser" stocks with lowest alpha. In their study of U.S. and European stock markets they found the dominance of alpha momentum in the U.S., and that it is less volatile than price momentum.

In this study we examine if there is a momentum effect in KOSPI market of Korean Stock Exchange during 2000-2015 by developing both price momentum and alpha momentum strategies. For the alpha-momentum strategy, we use traditional CAPM model to estimate stock alphas and adopt the model's standard assumptions that investors are price-takers with identical holding period and that there are no market frictions, including transaction costs.

We also develop two variations of these strategies: first, we will take into account possible short-term reversal by skipping 1-month between the portfolio formation and investing periods, whereas in the second variation we will not include this interval between the portfolio formation and investing periods. Furthermore, we will divide the stocks into 10, 7, 5 and 3 portfolios and invest for 6-month, 3-month and 1-month.

Overall, we will have 48 investment strategies: 24 different price momentum strategies and 24 different alpha-based momentum strategies. The results of the calculations for price momentum are found to be consistent with others' work; only 8 out of 24 strategies demonstrated momentum effect, which, unfortunately were not statistically significant. On the contrary, 20 out of 24 alpha-based momentum strategies revealed economically and statistically significant high returns.

This paper contributes to the existing research on efficient market hypothesis by testing whether we can predict stock price patterns through momentum strategy. At the same time, this paper is among the first to the author's knowledge to examine alpha momentum strategy in KOSPI market.

1.2. Purpose of the thesis

The aim of this thesis is to develop an investment strategy that will try to examine efficient market hypothesis in KOSPI market during the period 2000 and 2015. More specifically, it aims at developing price momentum as originally developed by Jegadeesh and Titman (1993) and alpha-based momentum strategy, which was introduced by Huehn and Scholz (2014) to see whether we can predict future price returns of stocks.

1.3. Structure of the thesis

This paper will proceed as follows. Chapter 2 reviews the previous literature on efficient market hypothesis, previous research on market efficiency of Korean stock market and the momentum effect. Chapter 3 describes the data and data characteristics as well as short description of KOSPI. Chapter 4 illustrates the method used for constructing momentum portfolio and investment strategies. The results of the analysis of price and alpha-based momentum strategies are interpreted and discussed separately in Chapter 5. Finally, Chapter 6 summarizes and concludes the study.

Chapter 2. Literature Review

2.1. Efficient market hypothesis

Early in 1950-s, Maurice Kendall (1953) analyzed 22 price-series at weekly intervals for stock price predictability and found that stock prices are equally likely to go up and equally likely to go down at any particular day. Later, in 1960s Osborne (1959) and Cootner (1964) further formulated and confirmed this random walk theory. Since then, there have been much interest and many debates, research and empirical evidences by scientists concerning predictability of stock prices. These studies gave rise to the development of efficient market hypothesis.

Efficient market hypothesis tells us that stock prices are not forecastable and that investors should not be able to generate excess return from conducting technical or fundamental analysis. Fama (1965) clarified that an efficient market is a place where rational investors compete actively, where each investor is trying to forecast future prices of stocks and where important current information about stock is almost freely available to all participants. Later, in his influential work Fama (1970) added that in efficient markets stock prices entirely reflect all available information regarding stocks and adjust rapidly to new information.

First, Robert (1967) distinguished efficient market into weak and strong form. Then Fama (1970) conducted further analysis and categorized market efficiency into three forms:

1. Weak form - only quantitative data such as past price, trading volume and such market trading data are reflected in the price of a stock;
2. Semi-strong form includes quantitative as well as qualitative data, such as all public information, including published accounting statements of the firm
3. In a market with strong form efficiency prices reflect all public and private, including insider information.

Among them, weak form is the cheapest and easiest one for the investors. Investors need only financial and computer skills to easily obtain and analyze stock prices to look for and try to predict the price pattern. Semi-strong form of market efficiency would require the investors to have a good knowledge of accounting, economics and be familiar with the industries of the companies they want to invest. As to strong form efficiency, stock prices reflect market trading data, other public information and private, including insider information.

In terms of market efficiency by countries, an extensive body of early research findings by Fama (1965) and Lo and MacKinlay (1988) revealed that stock markets in developed countries are generally weak-form efficient. Consistent to their findings, Choudhry (1994) found the stock markets of the seven OECD countries

also to be efficient. Nisar and Hanif (2012) conducted runs test and variance ratio test of seven Asia-Pacific major stock exchanges and found that three out of them do not follow random walk. Their analysis showed that NIKKE N225 (Japan), KOSPI Composite (Korea), Hang Seng Index HIS (Hong Kong) and All Ordinaries ASX (Australia) stock exchanges are weak form of efficient markets.

Ayadi and Pyun (1994) conducted traditional variance ratio test of Lo and MacKinlay for daily Korean prices and suggested that when heteroscedastic stochastic disturbance term is used random walk hypothesis holds true. Narayan and Smyth (2004) also examined the random walk hypothesis for South Korean stock market and concluded that the stock prices are consistent with the efficient market hypothesis. Hasanov (2009) re-examined efficiency of the South Korea's stock market, extending previous work of Narayan and Smyth (2004) by conducting a nonlinear unit root test procedure developed by Kapetanios et al. (2003). For his calculations, Hasanov (2009) used monthly KOSPI200 index for the period of September 1987 to December 2005. Contrary to Narayan and Smyth's (2004) conclusions, the results of his test suggested that the South Korea's stock market is not weak form efficient.

Nevertheless, there have also been several strong arguments against the efficient market hypothesis. The most prominent one was presented by Grossman and Stiglitz (1980), who argued that if stock prices "entirely reflect all available information" investors have no financial incentive to obtain new information, saying that, then, it is not possible to achieve perfectly efficient market. Earlier Jensen (1978) also tried to explain that prices reflect information up to the point where the marginal benefits of acting on the information do not exceed the marginal costs of collecting it. On the other hand, regardless of all those debates and arguments several anomalies such as price-earnings, small-firm or January effect, market-to-book, momentum effects have been observed. Basu (1977) demonstrated that portfolios of low price-earnings (P/E) ratio stocks have provided higher returns than high P/E portfolios. This effect remained true even when returns were adjusted for portfolio beta. Banz (1981) noticed that investing in low-capitalization stocks enables an investor to earn excess returns, which became to be called small-firm-in-January effect. Fama and French (1992) showed that ratio of the book value of the firm's equity to the market value of equity is a powerful predictor of returns across securities.

2.2. Momentum Effect

Jegadeesh and Titman (1993) discovered that good or bad recent performance of particular stocks continue over time. They discovered that taking long position on stocks with past highest returns and taking a short position in stocks with past lowest returns generates a momentum profit. They grouped stocks into 10 decile portfolios that equally weight the stocks contained in the respective decile and showed that the strategy of buying "winner" group of stocks and selling "loser" group of stocks is significantly profitable for 6 to 12 months holding period.

Jegadeesh and Titman (1993) explain that when new information is not instantly incorporated into the current stock prices, the speculative behavior of irrational investors can lead to momentum effect. Chan, Jegadeesh and Lakonishok (1996) support this argument by saying that markets underreaction to information on earnings results in momentum effect. They also suggest that markets respond to new information only gradually. Furthermore, Barberis et al. (1998) and Hong and Stein (1999) presented a behavioral framework and also showed that investors tend to underreact to firm-specific news, which allows for momentum effect.

The momentum effect has been documented by many other researches in many stock markets. Recently, Fama and French (2012) and Asness et al. (2013) demonstrated momentum effect in countries worldwide. Muga and Santamaria (2007) found evidence of stronger stock momentum in emerging markets of Latin America than in developed markets. Contrary to them, after studying 40 markets around the world, Griffin, Ji and Martin (2005) reported the profitability of the momentum strategy to be smaller in emerging markets. Hameed and Kusnadi (2002) conducted a research for the presence of momentum in prices of past winners and losers for the period 1979-1994 in Hong Kong, Malaysia, Singapore, South Korea, Taiwan and Thailand. They found little evidence to support the prevalence of price momentum in Asian markets, except for insignificant profits under unrestricted momentum trading strategies in long positions on past winners and short positions on past losers across six Asian stock markets. Nevertheless, they could only observe momentum profits for high-turnover portfolios for high-turnover portfolios in Malaysia and South Korea.

Kang, Kwon and Park (2011) examined momentum in Korean stock market from 1990 to 2010 and reported the absence of momentum profit in 1990s. Kim (2000), Lee and Ahn (2002), Ahn and Lee (2004) could not find momentum profits for the sample period through the 1990s neither. However, Kang et al (2011) reported significant momentum profits in large companies in the 2000's. Chui et al. (2012) report a -0.0039 percent momentum profit in Korea for the period of 1985-2003. In their previous research, Chui et al. (2000) found a momentum profit of -0.107 percent for the period of 1978-2000. Yet, in both cases, these profit were not statistically significant, with t-statistics of only -0.81 and -0.23, respectively.

Pyo and Shin (2013) also studied the profitability of momentum trading in the Korean stock market. More specifically, they focused on examining the relationship between momentum returns and idiosyncratic volatility. They found momentum returns, which are higher among high idiosyncratic volatility, especially the winners. They also confirmed the effect of idiosyncratic volatility on momentum returns by illustrating that a time-series relationship between momentum returns and aggregate idiosyncratic volatility is positive

In terms of the nature of risks and sources of momentum profits, Grundy and Martin (2001) argued that price momentum performance depends strongly on the performance of the underlying factors driving stock returns. They implemented a momentum strategy, which rank stocks according to their stock-specific

components. Using NYSE and AMEX listed stocks for the period of 1926-1995 and ranking them according to their stock-specific components, or in other words, dummy alphas, which was estimated through a modified Fama-French (1993) model, and holding the "winner minus loser" portfolio for one month they showed that momentum profits remained stable even after adjusting for dynamic risk exposure.

Similar to Grundy and Martin (2001), Huehn and Scholz (2014) also developed a momentum strategy, which ranked stocks according to their past Fama-French three-factor model alphas, estimated by considering daily stock returns during the formation period. Their empirical analysis reveals that i) past alpha have power in predicting the cross-section of individual stock returns, ii) alpha momentum exhibits less dynamic factor exposures within the holding period than price momentum and is, therefore, less volatile and iii) alpha momentum dominates price momentum in the U.S. but not in Europe. They argue that performance differences between alpha and price momentum could be explained by time-dependent differences between the stock composition of the zero-investment portfolios (winner-loser portfolio) of their alpha momentum and price momentum strategy. Finally, they conclude that under-reaction to firm specific news drives alpha momentum more strongly than price momentum and that momentum trading resulting in price overshooting drives price momentum more strongly than alpha momentum.

Chapter 3. Data

3.1. Data

This study covers all KOSPI stocks data from December 1999 to January 2015. Korea Stock Exchange (KRX) was established in 2005 as a merger of the Korea Stock Exchange, KOSDAQ and the Korea Futures Exchange. KOSPI represents all common stocks listed on the Stock Market Division of Korea Exchange. As of January 2000, KOSPI had 727 listed companies with a total market capitalization of 332 trillion KRW. Currently, there are 773 companies listed in KOSPI market reaching a total market capitalization of 1,192 trillion KRW. The rest of the stocks are represented by KOSDAQ, which serves for mainly small and intermediate businesses. The figure below shows the changes in number of listed companies during the period 2000-2014.

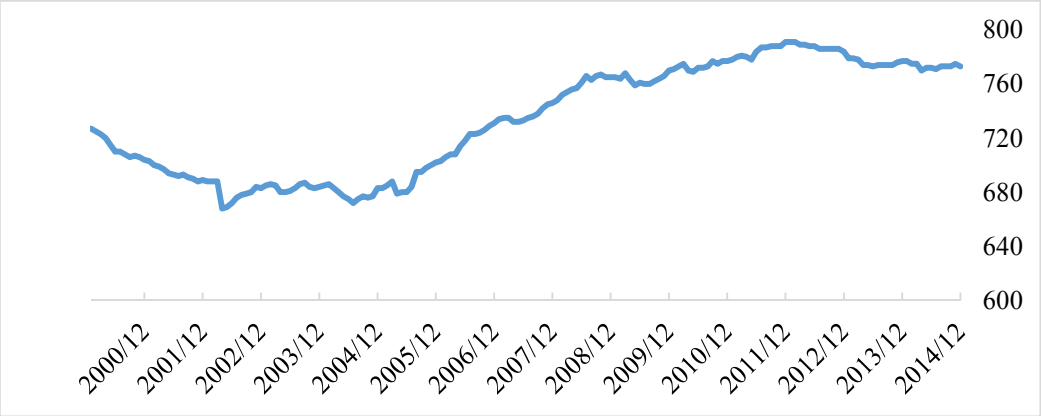


Figure 1. Number of listed companies in KOSPI for the period of 2000-2014

3.2. Data characteristics

For the construction of alpha-based momentum strategy monthly stock data starting from December, 1999 to January 2015 was obtained from Thomson Datastream. Before starting the download of the data, ETF, warrants, trusts, closed-end funds, preferred stock as well as stocks traded in foreign currency were unchecked. Unfortunately, along Thomson Datastream extracts dead stock constituents too. It repeats the last available stock price after the security is delisted, merged or bankrupted. For example, Asia Papertec was delisted on January 23rd, 2013, and the downloaded data would show the last day price of 8,550 for the remaining months until January 1st, 2015. Thomson Datastream even extracted data for the stocks that were delisted before year 2000. Therefore, total number of stocks equaled 1,296. Then all these unnecessary data were removed through filtering, sorting and searching. Lastly, monthly stock prices equal to and less than 500 KRW were deleted. This should help free us from the so-called “penny stocks” bias.

As a benchmark to the momentum strategy, monthly KOSPI 200 index data for the respective period has also been extracted from Thomson Datastream. KOSPI 200 index was introduced in 1990 with a base value of 100 and it consists of 200 big companies listed on the Stock Market Division of the KRX. Below figure shows the KOSPI 200 index monthly movement in the sample period.

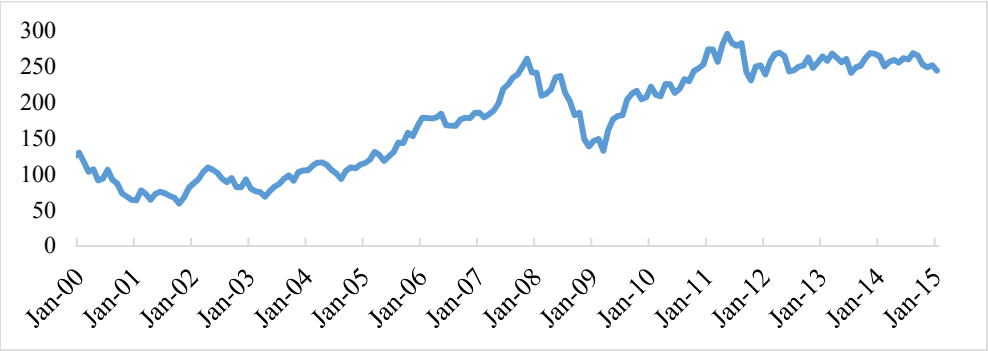


Figure 2. KOSPI 200 Index movement for the period 2000-2014

For the purposes of calculating excess returns, 91-day commercial paper yield was selected as a risk-free rate. Moreover, stock price data was used to calculate their excess return using the simple holding period return formula:

$$\frac{P_1 - P_0}{P_0} - rf$$

where P_1 is the beginning stock price, P_0 is the ending stock price and rf is the risk-free rate. The formula also helped to further clear the sample from those Thomson Datastream dead stock errors that might have been skipped during filtering process. The formula would generate division by zero errors in Excel, which were then tracked and deleted. The risk-free rate was also deducted to compute the momentum strategy excess return.

Chapter 4. Methodology

4.1. Portfolio construction and investment strategies

Basic methodology for constructing momentum strategy is consistent with the original approach developed by Jegadeesh and Titman (1993) – ranking and grouping stocks according to their past return and taking long position on previous winners and short position on loser stocks. For common price momentum strategy portfolios are constructed based on individual securities past returns during a J-ranking period, in this case 24-month and holding them for K months. They grouped stocks into 10 decile portfolios that equally weight the stocks contained in the respective decile and showed that momentum strategy is significantly profitable for 6 to 12 months holding period.

Meanwhile, it is important to note that we consider two variations of these price momentum and alpha momentum strategies. First, we take into account possible short-term reversal and bid-ask bounce effects, and include a one-month interval between the portfolio formation and investing periods. In the second variation, we go ahead investing right after the portfolio formation.

Furthermore, in order to see comparable results we group stocks into 10, 7, 5 and 3 portfolios according to their past returns and then held for 6-month, 3-month and 1-month. This gives us 12 strategies with a one-month interval and other 12 strategies without one-month interval between the portfolio formation and investing periods. Thus, there are total 24 different price momentum strategies developed in this paper.

Second and most importantly, alpha momentum strategy is developed for the same sample data. As it was noted in the previous chapter, Grundy and Martin (2001) first introduced a momentum strategy based on stock-specific component of stocks during the formation period. They found that this strategy to be significantly more profitable than the strategy that takes long position in winners and short position on loser stocks, which are not also winners/losers on a stock-specific basis, on a total return basis. Following them, Huehn and Scholz (2014) developed a momentum strategy by ranking stocks on their past 3-factor alphas during the formation period. Thus, in our research we also rank the stocks according to their past abnormal returns during the formation period. However, unlike Huehn and Scholz (2014) stock alphas are estimated by considering monthly stock excess returns during the formation period, i.e. past 24 months, based on CAPM regression model. Yet, Fama and French (1993) recommend a multi-factor model, which better explains the factors determining the stock prices. Unfortunately, factor data necessary for this model could not be obtained for Korea.

When adopting the Capital Asset Pricing Model (CAPM) we accept the standard assumptions that all investors are rational mean-variance optimizers, who are also price-takers with one identical holding period without paying tax on their returns from investing in publicly traded financial assets after analyzing the

securities in the same way. Another important point to note is that with CAPM we also accept that there are no market frictions, no transaction costs and no restrictions on short-selling, and that investors can borrow or lend at risk-free rate.

Then, similar to the original concept the stocks are grouped from highest past 24-month CAPM alpha to lowest CAPM alpha into 10, 7, 5 and 3 portfolios. Our alpha momentum strategy buys stocks with highest alpha and sells stocks with lowest alpha, thus generating a momentum profit in-between. Likewise, the winner-loser portfolios are held for 6-month, 3-month and 1-month. This will allow us to see which combination of groups and investing period is the most profitable. Again, these combinations are also computed in two variations: 1) considering short-term reversal effect by skipping a one-month between the ranking and holding period, and 2) investing in the stocks without allowing any interval. This will give us another 24 strategies with different combinations. Lastly, to compare these strategies we will look at the average returns, CAPM alphas and t-statistic values.

Chapter 5. Discussions

5.1. Performance of Price Momentum Strategies

Interestingly, momentum profit was observed only in 8 of 24 strategies as there was no decreasing or increasing pattern of returns between winner and loser portfolios. Nonetheless, among these eight only 2 strategies (without a lag) – strategy of dividing the stocks into 5 groups and 3 groups based on their past 24-month returns and investing for 1 month – generated a reliable t-statistic value. The following table shows the average return, CAPM alpha and t-value of the respective strategies.

		24/6		24/3		24/1	
		1 month lag	No lag	1 month lag	No lag	1 month lag	No lag
5 Group	μ	0.01288	*0.01204*	*0.01151*	*0.01089*	*0.00908*	0.00893
	CAPM α	0.00989	*0.00876*	*0.00887*	*0.00822*	*0.00794*	0.00782
	t-value	1.14583	*0.87632*	*1.66864*	*1.39068*	*2.70546*	2.51209
3 Group	μ	0.00590	*0.00869*	*0.00915*	0.01176	0.00585	0.00738
	CAPM α	0.00675	*0.00905*	*0.00654*	0.00905	0.00466	0.00618
	t-value	0.87789	*1.06530*	*1.31991*	1.64513	1.66951	2.05636

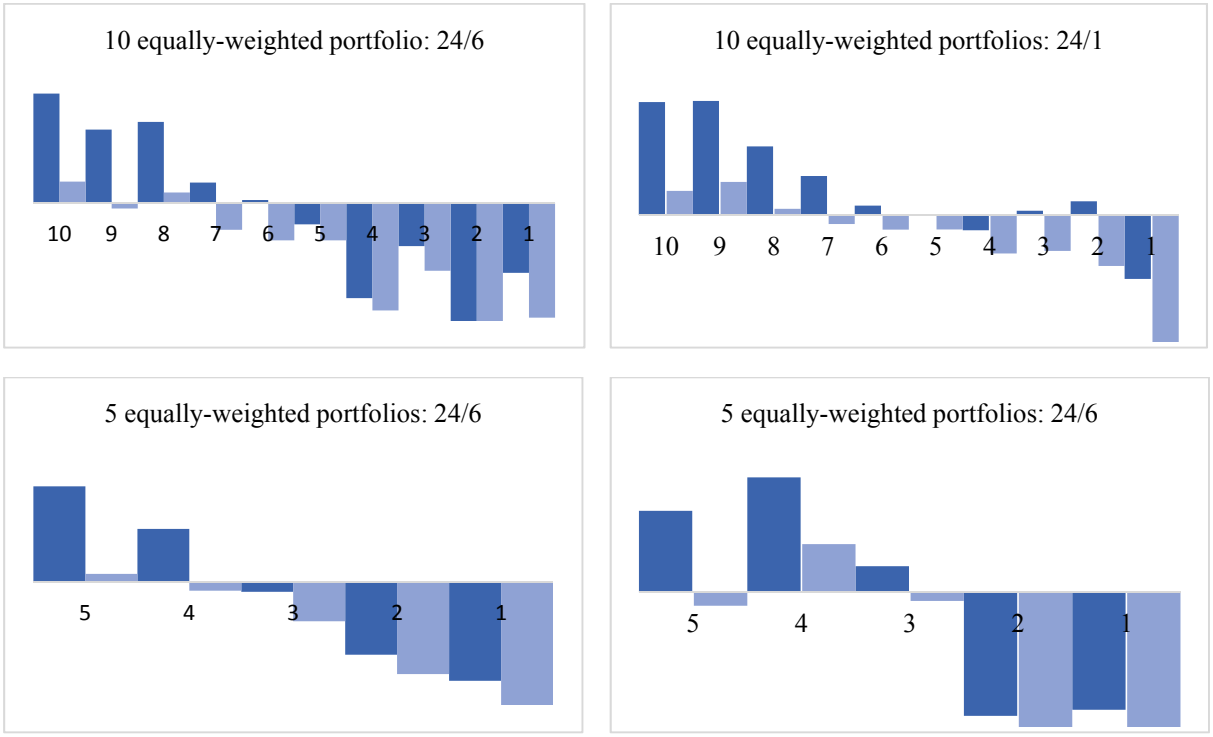
Table 1. Performance of price momentum strategies. Monthly average excess return, CAPM alpha and t-value for price momentum strategies. "24/6" stands for "J/K strategy", and means J-ranking period/K-investing period; thus, 24 month ranking and 6-month, 3-month and 1-month investing period. "1-month" lag stands for skipping one-month after the portfolio formation period. "No lag" means that short-term reversal effect was not taken into account, and therefore, there was no interval between the portfolio formation and investing period. "5 Group" and "3 Group" represents equally weighted winner portfolio minus equally weighted loser portfolio for the strategies where stocks were grouped into 5 and 3 portfolios according to their past returns. CAPM alpha reports the abnormal returns of these winner-loser portfolio. t-value is calculated as a ratio of the regression parameter to its standard error. If it is greater than 2, it means that the probability of the true value equals zero is unlikely. Numbers in red and italics represent strategies where momentum profit was not observed.

Investment strategy of dividing the stocks into 10 groups and 7 groups did not reveal any momentum profit. Thus, we can say that past 24-month return has no impact on future returns of individual stocks. In fact, the longer the holding period the lower the return, though statistically insignificant. This was supported by Lee and Swaminathan (2000) and Jegadeesh and Titman (2001), that momentum strategies tend to reverse in the long-run. Investment strategy with 5 groups skipping a one-month after the formation period generated a momentum a profit of 0.13% per month, although with a low t-statistic value; whereas the same strategy without an interval does not show a decreasing pattern of average excess returns across the winner to loser portfolios. Lastly, the investment strategies with 3 groups demonstrate a momentum profit for both variations, i.e. with and without 1-month lag between the portfolio formation and investing periods. Unfortunately, in both cases the t-statistic is not large enough to claim the profits.

The below figure shows the patterns of average excess returns and CAPM alpha for some of the strategies, which did not reveal a momentum profit. Panel A of the figure shows investment strategies of dividing stocks into 10 equally-weighted portfolios and 5 equally-weighted portfolios with skipping a 1-month after the portfolio formation period. Panel B shows the same investment strategies but without a 1-month interval before the investment period.

Panel A. Investment strategies with 1-month lag

Panel B. Investment strategies without a 1-month lag



Legend: - Average excess returns, - CAPM alpha

Figure 3. Patterns of average excess returns and CAPM alpha for price momentum strategies

In their research, Kang, Kwon and Park (2011) who examined whether Korean stock market had a momentum during the periods 1990-2010 found momentum effect only in the 2000's especially in large size firms with a return of 0.827% for a holding period of 5-months. Consistent with other studies (Kim, 2000; Lee and Ahn, 2002; Ahn and Lee, 2004), their research did not reveal momentum effect in the 1990-s neither. Kang, Kwon and Park (2011) think that changes in Korean stock market during the 2000s and flow of foreign investors might have been the reason behind the observed momentum strategy.

In their momentum profits by countries, Chui et al. (2010) report only -0.0039 percent momentum for the period of 1988-2003, which is not statistically significant neither, with a t-statistic of -0.81. They ranked stocks in ascending order based on their 6-month cumulative returns, and then they divided them into three – one third of the stocks were grouped as winner and another one-third were grouped as loser portfolio. Then, these equally-weighted portfolios were held for 6 months. Kang et al. (2011) also adopted a similar set-up for their momentum

strategy. They examined Korea exchange for momentum effect by buying past six-month winner stocks and selling past six-month loser stocks by their monthly returns and report the results of holding these positions for one-month, three-month and six-month. Their equally-weighted winners portfolio also consists of one-third of stocks with higher returns and the loser portfolio consists of one-third of loser stocks with lowest returns. Nonetheless, as Conrad and Kaul (1998) argue depending on how the momentum is set up and holding periods the strategies may perform differently. Thus, we can say the differences in the result must lie in differences in number of groups, different formation period as well as different holding periods.

5.2. Performance of Alpha Momentum Strategies

Unlike the price momentum, 20 out of 24 strategies based on buying stocks with high alpha and selling stocks with low alphas generate a momentum profit. Significance of all of these returns are supported with high t-statistic values. However, in this section we show the two variations of the strategies in separate tables. Below table presents the performance of alpha momentum strategies with a one-month interval between the portfolio formation and investing period.

		24/6	24/3	24/1
10 Group	μ	*0.06314*	0.06296	0.05845
	CAPM α	*0.05964*	0.05960	0.05665
	t-value	*5.83633*	8.93872	14.85855
7 Group		*0.05627*	0.05739	0.05293
		0.05277	0.05403	0.05105
		5.40656	8.80245	14.66808
5 Group		0.04987	0.05234	0.04763
		0.04645	0.04915	0.04591
		5.17906	8.57543	14.35832
3 Group		0.03388	0.03874	0.03521
		0.03048	0.03545	0.03336
		3.77310	6.93081	11.73802

Table 2. Performance of Alpha momentum strategies with a one-month interval. Monthly average excess return, CAPM alpha and t-value for alpha momentum strategies with a one-month interval. "24/6" stands for "J/K strategy", which is J-ranking period/K-investing period strategy; thus,"24/6", "24/3" and "24/1" mean 24 month ranking and 6-month, 3-month and 1-month investing periods. "10 Group", "7 Group", "5 Group" and "3 Group" represents equally weighted winner portfolio minus equally weighted loser portfolio for the strategies where stocks were grouped into 10, 7, 5 and 3 portfolios according to their past returns. CAPM alpha reports the abnormal returns of these winner-loser portfolio. t-value is calculated as a ratio of the regression parameter to its standard error. If it is greater than 2, it means that the probability of the true value equals zero is unlikely. Numbers in red and italics represent strategies where momentum profit was not observed

In comparison to the price momentum strategy, the average excess returns of alpha-based momentum are considerably higher; for example, the highest average return with a reliable t-statistic among price momentum strategies is 0.91%, whereas the return for the same combination under alpha-momentum strategy, but with a 1-month interval, is 4.76%. On the other hand, the investment strategy, which divides stocks into 10 groups based on their past 24 month alpha and invests for 3 months generates the highest average return of 6.29%. We also notice that holding the strategies for 3-months generates the highest return.

Figure below shows patterns of average returns for investment strategies of dividing the stocks into 10 groups and 5 groups based on their past 24-month CAPM alpha for the investment periods of 6-month and 1-month.

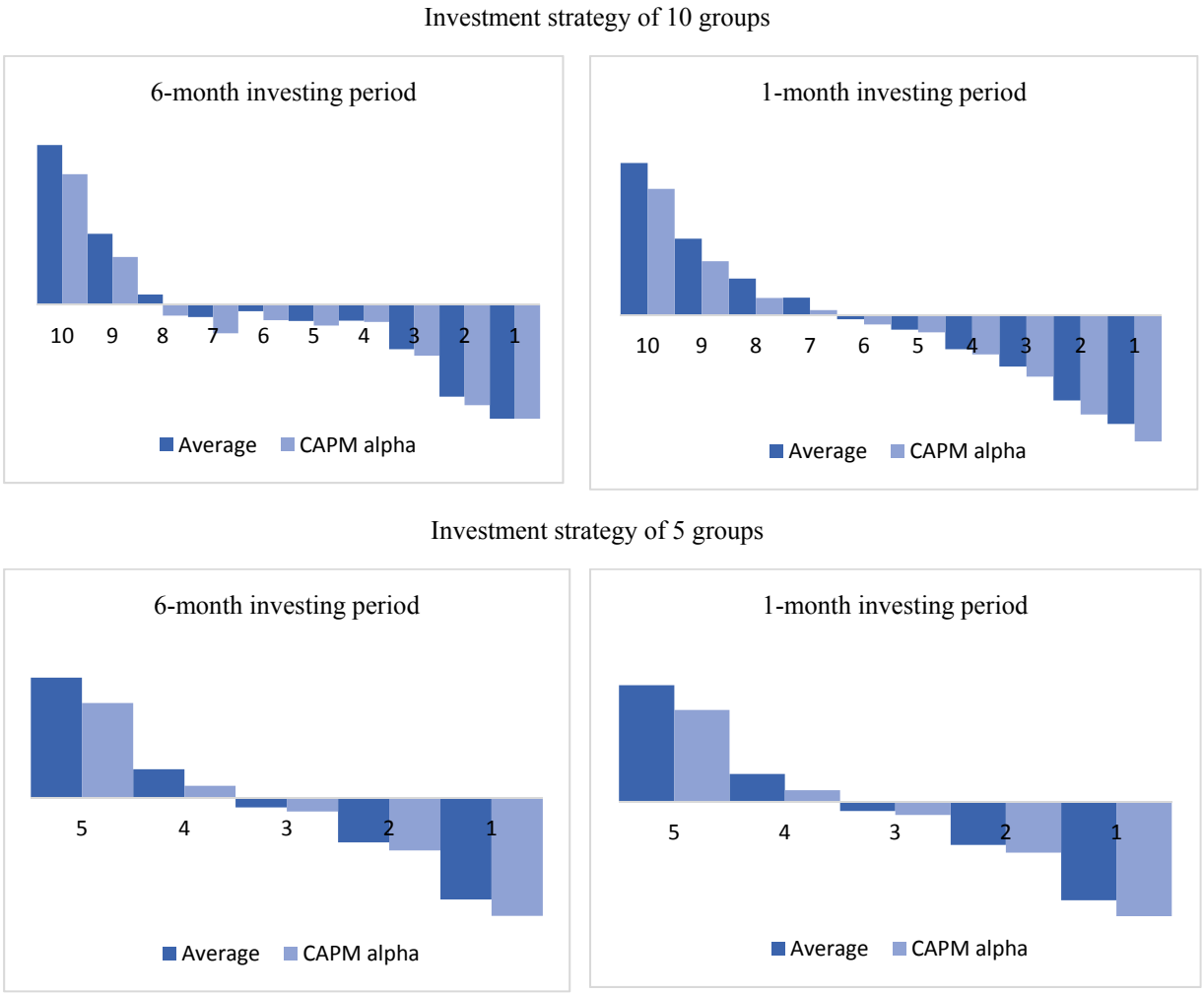


Figure 4. Patterns of average excess returns and CAPM alpha for alpha-based momentum strategies with 1-month lag after the portfolio formation

The second variation of the 24/3 alpha momentum strategy without a 1-month interval between the portfolio formation period and the holding period also gives a similar result. This time, we do not observe

momentum strategy for strategies with 10 group for the 6 month investing period. In terms of profitability, we can also see the highest average return of 6.807% in 10 group strategy with a 3-month investing period.

		24/6	24/3	24/1
10 Group	μ	*0.06610*	0.06807	0.06067
	CAPM α	*0.06273*	0.06475	0.05869
	t-value	*5.89647*	9.42673	15.45694
7 Group		0.05820	0.06029	0.05481
		0.05488	0.05699	0.05275
		5.54118	9.14505	15.20597
5 Group		0.05200	0.05413	0.04913
		0.04861	0.05084	0.04716
		5.43038	8.92360	14.62444
3 Group		0.03666	0.04104	0.03710
		0.03319	0.03762	0.03502
		4.14137	7.38107	12.37073

Table 3. Performance of Alpha momentum strategies without a one-month interval. Monthly average excess return, CAPM alpha and t-value for alpha momentum strategies without a one-month interval. "24/6" stands for "J/K strategy", which is J-ranking period/K-investing period strategy; thus, "24/6", "24/3" and "24/1" mean 24 month ranking and 6-month, 3-month and 1-month investing periods. "10 Group", "7 Group", "5 Group" and "3 Group" represents equally weighted winner portfolio minus equally weighted loser portfolio for the strategies where stocks were grouped into 10, 7, 5 and 3 portfolios according to their past returns. CAPM alpha reports the abnormal returns of these winner-loser portfolio. t-value is calculated as a ratio of the regression parameter to its standard error. If it is greater than 2, it means that the probability of the true value equals zero is unlikely. Numbers in red and italics represent strategies where momentum profit was not observed

In all these cases, where momentum effect was discovered we observe perfectly decreasing pattern of average excess returns. The figure in the next page shows the patterns of average returns for investment strategies of 10 groups and 5 groups with investment periods of 6-month and 1-month. Note that the return patterns of the strategy with 10 groups, which invests in 6-months does not follow a perfectly decreasing pattern.

Huehn and Scholz (2014) also noticed the power of past alpha in predicting future return and that the alpha momentum strategy outperformed common price momentum in the U.S. for the period from 1982-2011 with higher average returns and higher risk-adjusted returns; however, they did not observe the same for Europe. To see the differences, they looked at the stock composition of winner and loser deciles of price and alpha momentum strategies over time and discovered that loser stocks were more often located in deviating alpha momentum deciles, especially when the absolute difference between the average factor-related return contributions was large. In summary, they agree that when the market excess return is positive over the formation period, price momentum strategies opt for buying high-beta stocks and selling low-beta stocks.

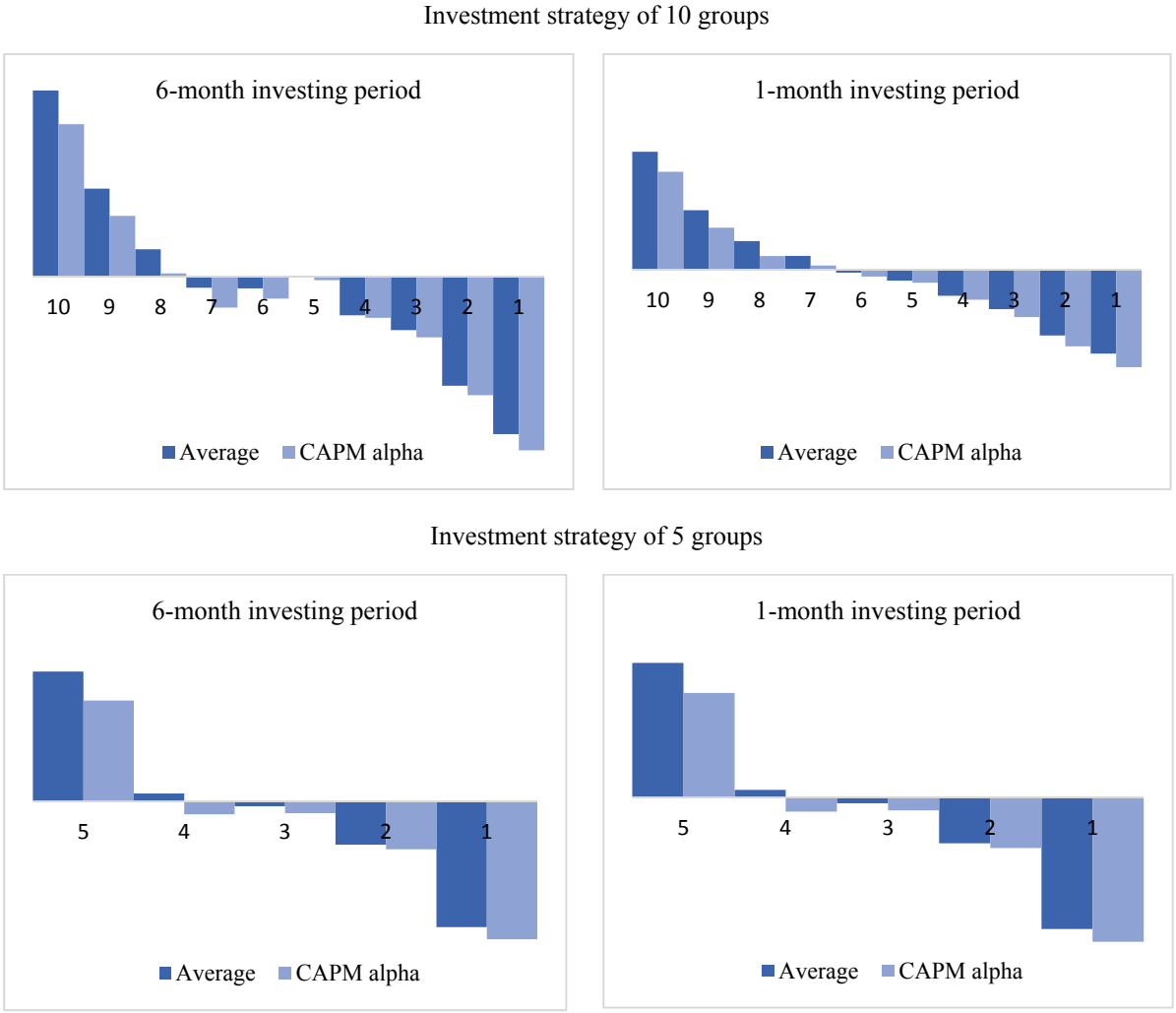


Figure 5. Patterns of average excess returns and CAPM alpha for alpha-based momentum strategies without 1-month lag after the portfolio formation

Lastly, to compare the profitability of the two variations, the following table in the next page shows the superiority of a variation of the strategy without skipping a 1-month after formation period. In their initial paper, Jegadeesh and Titman (1993) also performed two variations of the strategy and found that a zero-cost strategy with a 1-week lag between formation period and the holding period yields higher return (1.49%) than the one without any time lag (1.31%). However, in our case, it turned out to be opposite: skipping a month after the portfolio formation is less profitable by 0.01-0.03% depending on the combination of the strategy.

It is difficult to point at a concrete reason why there is a difference between these two variations of the strategies. In literature, there are several debates as to why it is important to skip a month after the portfolio formation.

	24/6	24/3	24/1
10 Group	-0.00296	0.06610	-0.06296
7 Group	-0.00193	0.05820	-0.05739
5 Group	-0.00214	0.05200	-0.05234
3 Group	-0.00278	0.03666	-0.03874

Table 4. Comparison of the alpha momentum strategies. Difference between average excess returns of alpha momentum strategies (equally-weighted winner portfolio minus equally-weighted loser portfolio) with and without a 1-month interval after the ranking period and 6-month, 3-month and 1-month investing periods.

Nevertheless, the general trend is to allow an interval between the portfolio formation and investing period. Moreover, Grundy and Martin (2001) also reported a statistically significant momentum profits for their strategy without a 1-month interval between the formation period and the investment month, whereas the strategy with a one-month interval did not earn momentum profits. To explain this phenomena, it may be required to conduct additional statistical tests to see what makes an impact on bid-ask bounce.

Chapter 6. Conclusions

Efficient market tells us that stock prices reflect all available information and that investors should not expect excess returns from obtaining new information. Fama (1970) divided market efficiency into weak, semi-strong and strong forms, where each form includes specific information into stock prices. If we accept the efficient market, obtaining new information and conducting any analysis becomes irrelevant. There will be no financial incentive for the investors, and they would rather invest in index funds or ETFs. As discussed earlier, there have been several contradicting studies as to the level of market efficiency in Korea. Though we did not accept that Korean stock market is efficient, we adopted for conducting a technical analysis, which is suitable for weak form of market efficiency.

Momentum strategy is a trading strategy, through which investors can predict future price movement of securities to exploit market efficiency by buying past "winner" stocks and selling past "loser" stocks by their returns. In this research we developed traditional price momentum and new alpha-based momentum strategy for the KOSPI listed stocks for the period 2000-2015. Yet, this is just a trading strategy and not an advanced statistical test, which other scholars implemented to test efficient market hypothesis in South Korea. The fact that our price momentum strategy did not reveal plausible profits, except the two cases where we could generate 0.074% and 0.089%, which may not cover the transaction costs – tempts us to wonder whether the Korean market is indeed efficient.

However, our alpha momentum strategy generated a totally different result. Our best trading strategy showed an impressive return of 6.807%, supported by a high level of t-statistic. Thus, it shows that we were able to predict stock price patterns based on analyzing their past returns. In our analysis, stocks were grouped into 10, 7, 5 and 3 portfolios by their past alphas and held for 6-month, 3-month and 1-month. First, considering the short-term reversal effect we allowed 1-month lag between the portfolio formation and investing period. In the second case, we did not include any time lag between the portfolio formation and investing period. The results of the calculations show that 20 out of the 24 alpha-based momentum strategies generates economically and statistically significant profits, whereas only 2 out of 24 price momentum strategies revealed statistically significant, but economically inferior returns. Comparing these two variations, we see that the second variation of the alpha momentum strategy leaves us with 0.01-0.03% additional excess return. Yet we are not able to explain the factors behind this difference in this paper.

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