Market Anomalies in the Norwegian Stock Market

An exploration about existence of 4 Market Anomalies

He Shan and Gu Sijia

Advisor: Associate Professor Jørgen Haug

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Abstract

This master thesis is aiming to examine the existence of targeting market anomalies and the ability of Fama-French Three factor models explain those anomalies in Norwegian Stock Market during the recent 14 years. Our study examined 4 anomalies: Earning Surprise, Net Stock Issues, Price Momentum and ROE anomaly. Our data collected from Bloomberg and Børsprosjeketved NHH which cover all the known listed stocks on the Oslo Stock Exchange over the past 14 years. Our results reveal that there is only significantly evidence to show Price Momentum in Norwegian Stock Market. For other three anomalies, there is no evidence to prove their existence in Norway though they are prominent in US market.

Preface

This paper is written as the final step of our Master of Science Program at the Norwegian School of Economics and Business Administration.

During our studies, we have experienced an increased interest in market anomalies on Stock Market. Market anomalies are the cross-sectional and time series patterns in security returns that are not predicted by a central paradigm or theory. They are worth exploring and can have huge influence of returns in real investment.

After doing research on market anomalies, we have learnt more about different market anomalies, conditions of Norwegian Stock Market as well as the prevalent of anomalies from the US market to a relative small market like Norwegian Market.

We hope this thesis will provide valuable information of Stock Market in Norway and be a useful reference for readers who are interested in Market Anomalies.

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He Shan & Gu Sijia

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Section 1 Introduction

1.1 Description of topic

The discovery of market anomalies presents challenge to efficient market hypothesis. Market anomalies are defined as the cross-sectional and time series patterns in security returns that are not predicted by standard asset pricing models. Over the years, discussions about market anomalies never stop. Before 1993, discussion around size effect (Banz1981) and value effect (Basu1977, Reinganum 1981&Reid and Lanstein 1985) were very popular in finance literatures. In 1993, Fama and French developed their Fama-French Three Model (FF model) which added size and value effects factors into consideration and eliminate the abnormal returns caused by those two corresponding anomalies. FF model provides a simple and relative precise framework to predict assets returns and it can explains over 90% of the diversified portfolios returns from 1963 to 1990 (Fama and French 1993).

However, as time went by, new market anomalies are discovered which present challenges to FF model. There are some prominent market anomalies that have gained attractive attention in the following years literatures. For example, Earning Surprise (Chan, Jegadeesh and Lakonishok1996), Price Momentum (Jegadeesh and Titman 1993&Carhart 1996), Net Stock Issues(Ritter 2003) and ROE anomaly (Hou, Xue and Zhang 2012). For each of these 4 anomalies, there is plenty of evidence to show the significant abnormal returns exist in the US market. The details of these four anomalies and corresponding research discoveries will be showed later in the literature review section.

In addition to the 4 anomalies we discussed above, there are many other discussions about other market anomalies. For example, Campbell, Hilscher, and Szilagyi's (2008) show that companies with high failure probability have significantly lower returns than others; Titman, Wei, and Xie (2004) show that firms which increase capital investments earn negative subsequent benchmark-adjusted returns; Sloan (1996) shows that firms with high total accruals earn lower average returns than firms with low total accruals and so on...

We noticed that the most discussions of market anomalies are limited within the US market and few papers touched the same area in Norway. So, we realized that it is necessary and meaningful to verify the existence of those market anomalies in Norway. We believe that our study will get an impression of how prevalent the anomalies are, and to see how they change according to the different business environment (US vs. Norway).

In this paper, we will only focus to 4 selected anomalies: Earning Surprise, Price Momentum, Net Stock Issues and ROE anomaly. There are several reasons for us to make this selection:

1) Data Availability: Since Norwegian Stock Market is a relative small and neglected market, and there are many data availability issues. There are many cases of missing accounting entries in database. Our 4 selected anomalies are related those entries with highest attention by public such returns, earnings and net stock issues. So the data availability problems can be relatively small.

2) Difficulties in measurements: It is not easy to create convincing measurements of firm characteristics in term of some anomalies. For example, the quantitative

measure for Price Momentum is only required us to collect historical nominal returns of companies which is easy to do. On the other hands, other unselected anomalies may require measurements which are based on some hypothetical or subjective assumptions, for example, the probability of company failure anomaly mentioned by Campbell, Hilscher, and Szilagyi's (2008). In our paper, we try to avoid hypothetical and subjective measurements and set up our 4 selected anomalies testing which are relative simple and straight-forward.

3) Since the time limitation of our works, we don't have enough time to develop and finish "sound" test for all known anomalies. Concentrating on 4 selected anomalies would be a wise choice.

4) These 4 anomalies gained attractive attention in the recent years. As we showed above, many other papers focus on discussions around them.

There is no doubt that our study will be helpful for both investors and researchers in their investment or study. Firstly, the result of our study will provide investors a guide for their portfolio management to capture 'abnormal returns' caused by corresponding market anomalies.

Secondly, our study aims to get an impression of how those anomalies change in a relative small market. That will be very important in a development of advanced universal assets pricing models.

Thirdly, there are few research papers of market specific market anomalies in Norwegian Market due to the relative small market size. Our paper thoroughly examines the existence of some important market anomalies during the past 10 years to gain valuable insights on the Norwegian Market.

Lastly, we use general approach to form our testing which is very similar with other research did for other larger Market, likes US market. So the results of our paper are comparable to the relevant topic for other countries. Then we can provide information for horizontal comparison.

1.2 Research Questions

The main objective of our research is to verify the existence of the 4 selected market anomalies in Norwegian Stock Market and also to examine explanatory power of FF model for these anomalies in Norway.

To achieve our objective, we separate our works into 3 phases:

1) Define4 measurements in order to sort portfolios for 4 anomalies testing; SUE for Earning Surprise, NSI for Net Stock Issues, PRM for Price Momentum and ROE for ROE anomaly. The definition and calculation for SUE, NSI, PRM and ROE will be delivered later in our methodology section.

2) Investigate whether companies with different value of anomalies measurement have significant different return patterns.

3) Examine the explanatory power of FF model for those return patterns.

By doing these phases, we will be able to answer two research questions:

"Do the 4 selected market anomalies mentioned by other papers really exist in Norwegian Stock Market?"

&

"Can FF model explain those anomalies well in Norwegian Market?"

1.3 The Oslo Stock Exchange (Oslo Børs)

To examine phenomena under Norwegian Stock Market conditions, we need to define a convincing research scope to make our study be feasible and can reflect the real situation of Norwegian Stock Market. We decided to collect data of all the listed companies on the Oslo Stock Exchange (OSE) which includes most Influential companies in Norway. In the following part of the introduction, relevant information of the OSE will be delivered to help readers have a better understanding of our study.

The OSE offers the only regulated markets for securities trading in Norway today. The marketplace OSE is constantly bringing all investors together with issuers in a fully regulated environment. OSE is the largest market place for listing and trading in equities, equity certificates, ETPs (exchange traded funds and notes), derivatives and fixed income products in Norway. The stock exchange is an online market where all trading is settled through computers.

OSE was established by a law on September 18, 1818. Trading on OSE started on April 15, 1819. OSE became a stock exchange since 1881. The first listing of securities contained 16 bond series and 23 stocks. OSE cooperates with London Stock

Exchange on trading systems. The exchange also set up partnership with the Singapore Stock Exchange and Toronto (Canada) for a secondary listing of companies. The stock exchange was privatized in 2001, and is, after the merger in 2007, 100% owned by OSE VPS Holding ASA.

With more than 190 years history, OSE achieved NOK 2 022 billion total Market Capitalization NOK 2 022 billion in 2014. The number of listed companies includes the most Influential companies in Norway. So, the scope of coverage by our study includes all listed companies on OSE which can provide us significant information of Norwegian Stock Market conditions.

1.4 "Standard Pricing Model"

Since market anomalies are the cross-sectional and time series patterns in security returns that are not predicted by standard asset pricing models, a "standard pricing model" is required in our study to verify the existence of anomalies. In the recent finance literatures, FF model is always used as the "standard pricing model" in discussions about anomalies. Fama and French examined 5 market anomalies that cannot be explained by FF model in 2008. Hou, Xue and Zhang choose FF model as a "standard pricing model" and test 7 anomalies in 2012. Daniel and Titman (2006) also use FF model to examine Net Stock Issues in their paper. Besides, Ødegaard (2015) shows that FF model has explanatory power in the Norwegian Market. So, we believe that FF model is a convincing choice of "standard pricing model" and it can also make our research results comparable to similar testing done by others who use the same approach.

1.5 Organization of Study

In Section 2, we firstly review papers which related to Market efficiency and anomalies. Then we will show the information about relevant standard pricing model (FF model) and performance bias in our research. Thereafter, all the information of your testing, findings and results will be discussed in Section 3 & 4.

In Section 3, we present our testing sorted by anomalies. For each anomaly, we start from the definition of anomaly measurement we mentioned in the previous part (SUE, NSI, PRM, and ROE). Then we will discuss the all the relevant information of data we use in our testing. Thirdly, we develop our key hypothesis in order to answer our research question under the specific anomaly. Then, we will explain our portfolio constructions. Thereafter, we will cover the t-test and factor regression which is main components of our testing. At the end of Section 3, the empirical evidence we found and analysis will be presented.

Finally, we make a conclusion with suggestion for further research in Section 4 and some reference tables are listed in Appendix Section.

Section 2 Literature Review

In this Section, we will provide a review of 4 selected anomaly followed by discussions about our "standard model" which is FF model. Besides, we will also have a review about relevant bias may occur in the research.

2.1 Selected Market Anomalies

2.1.1 Earning Surprise Anomaly

The Earning Surprise Anomaly refers to the positive relation between the securities returns and the Earnings Surprise. Foster, Chris and Shevlin (1984) first to document this relationship for US stocks. They defined a factor in order to measure the Earnings Surprise. The measure is called standard unexpected earnings (SUE) where SUE is the change in the most recently quarterly earnings per share from the EPS 4 quarters ago divided by the standard deviation of the change in quarterly EPS over the prior 8 quarters.

$$\mathrm{SUE}_{it} = \frac{e_{iq} - e_{iq-4}}{\sigma_{it}}$$

Jegadeesh and Lakonishok (1996) verify the Earning Surprise Anomaly on the US market. Then they construct testing by using equal-weighted 6-month holding-period returns after formation according to the SUE deciles (NYSE break-points). The high-minus-low SUE decile earns a positive average return which is 0.74% per month and more than 6 standard errors from zero. This result confirms the existence of the positive relation between the securities returns and the Earnings Surprise on US market. Looking back to FF Model, Hou, Xue and Zhang (2012) show that the earnings surprise alpha is 0.88% in FF Model which is even larger than the real number. So, FF Model doesn't have explanatory power for this anomaly.

2.1.2 Net Stock Issues Anomaly

Ritter (2003), Daniel and Titman (2006), Fama and French (2008), and Pontiff and Woodgate (2008) show that net stock issues is negatively related to future stock returns in US market. Sehgal, Subramaniam and Morandiere (2012) did a similar research in India and got the same result for Indian Market. This phenomenon so called ‘new issues puzzle’. It seems that this phenomenon may be a general case regardless of the market conditions. One possible explanation for this puzzle is that the issuer underperformance reflects lower systematic risk exposure for issuing firms relative to the matches. In our paper, we will not try to find the resolution of the puzzle. This paper is aiming to verify the existence of this puzzle in Norway and discuss the explanatory power of FF Model for this phenomenon. Fama and French (2008) agree that net stock issuance relate to large abnormal returns for all size groups that cannot be explained by FF Model. They also show that extremes of net issuance drive the largest abnormal returns. Besides, there are pervasive positive returns after repurchase while no consistently negative returns after sales.

2.1.3 Price Momentum Anomaly

Jegadeesh and Titman (1993) firstly found the Price Momentum Anomaly. Momentum is a tendency for the performance persistent. In other words, stocks with strong past performance in recent periods will continue to outperform stocks with poor past performance in the next period. Hou, Xue and Zhang (2012) did a similar test by using equal-weighting returns excluding NYSE-Amex-NASDAQ stocks with price under $5 to reduce the influence of January effect. They use NYSE-Amex-NASDAQ breakpoints to sort stocks into 10 portfolios and provide evidence that the average winner-minus-loser return is 1.32% which is more than 5.5 standard errors from zero. They also mention that Fama-French Model produce 1.5%

winner-minus-loser alpha which is significant larger than zero. So, Price Momentum cannot be explained by FF Model.

Carhart (1997) wrote an important paper about price momentum. He did an expand FF model by adding a new Price Momentum factor in. The Carhart Model can reduce winner-minus-loser alpha to 0.56%.

2.1.4 ROE Anomaly

Hou, Xue and Zhang (2012) show that firms with high ROE earn higher returns during subsequent periods. Actually, this statement is not surprising because it is a common sense that higher profitability means higher priority for investors to choose. However, it is quite surprised that FF Model ignores this factor and fails to explain it. Fama and French (2014) did a check for their original three-factor model and they found that the correlations between profitability factor and 3 components of their model are all very small. The results show that the correlation between profitability factor and market premium is around -0.1 to -0.3, the correlation between profitability factor and size factor is from -0.3 to -0.35 and the correlation between profitability factor and book-to-market factor is only 0.04 to 0.08. This means the original three-factor fails to explain the profitability factor. Although the idea of profitability factor is such simple and straight forward, it is actually an anomaly which FF model ignored over years.

2.2 Fama-French Three Factor Model

Fama and French (1993) developed their three-factor model (FF model) which is an improvement from CAPM developed by Sharpe in 1964.Fama and French add two factors related to market capitalization and book-to-market ratio into traditional CAPM and generate a new three-factor model arrive at.:

$$\mathrm{r}_{\mathrm{t}}^{\mathrm{n}} - r_t^{\ f} = \beta_M \cdot MKT_t + \beta_{\mathrm{S}} \cdot SMB_t + \beta_H \cdot HML_t + \varepsilon_n$$

Where r_t^n is the expected return of portfolio n at time t, r_t^{f} is the risk-free return rate at time t, ε is the residual. So, the left side of equation is the excess return of portfolio n at time t.

As shown in the formula, MKT, SMB and HML are 3 main factors of the model:

MKT is used to present the excess returns on the markets. It is calculated by taking the difference between the returns on value-weighted market portfolio and the risk-free rate.

SMB represents size factor in returns and is equal to the difference between the returns on stocks of the listed firms with small and big market values.

HML expresses the book-to-market-equity risk factor in returns and equals to the difference between the monthly average of returns on two high BE/ME portfolios (small and big market values) and the monthly average of returns on two low BE-ME portfolios (small and big market values).

Once MKT, SMB and HML are defined, the corresponding coefficients β_{M}, β_{s} and β_{H} are determined by linear regressions, the mathematical expressions of these beta are:

$$\beta_{\mathrm{M}} = \frac{Cov(r_t^n - r_t^f, MKT_t)}{Var(MKT_t)}, \quad \beta_{\mathrm{S}} = \frac{Cov(r_t^n - r_t^f, SMB_t)}{Var(SMB_t)} \, and \, \beta_{\mathrm{H}} = \frac{Cov(r_t^n - r_t^f, HML_t)}{Var(HML_t)}$$

Those betas take role to explain the correlation between portfolio excess returns and the corresponding factors.

Fama and French (1993) show that FF model can explains over 90% of the diversified portfolios returns, compared with the average 70% given by the CAPM.

Hou, Xue and Zhang (2012) run regressions under FF model on US sorted portfolio by different measurement with time period 1972 to 2011. The $R^2$are all above 0.8 which indicates that FF model still has strong explanatory power in US market in recent years.

In a latest paper, Ødegaard (2015) provides empirical results about the general performance of FF model in Norway from 1984 to 2014. He sorts the market portfolios by different measurements. Based on his research, the Adjusted R^2 of sorted portfolios are generally above 0.5 except few specific industries like utility (0.285) and Health (0.377). These results imply that FF model performance is OK in Norwegian Market but not as good as it is in US market.

Fama-French three-factor Model is one of the most commonly used asset pricing model it can explain portfolios returns quite well.

2.3 Performance Bias

In our research, we will face challenges from two kinds of bias: Survivorship Bias and Ex-Post-Selection Bias.

2.3.1 Survivorship Bias

Survivorship bias or survival bias is the logical errors caused by only looking at those who are still survive. In the research about stock market, survivorship biases always happen when we only look at sample which excludes non-survivors. Since non-survivors are always small companies with poor management, survivorship bias may lead to an over-optimistic result.

Survivorship bias could cause huge local error for estimation of returns. Brown, Goetzmann and Ross (1995) demonstrate that surviving markets have higher returns, especially during their earlier stage. Similar research done by Elton, Gruber, and Blake (1996) show that size of the bias of risk-adjusted return caused by survivorship bias across the U.S. mutual fund industry is around 0.9% per annum.

To avoid survivorship bias, we must check the historical company list carefully and make sure all the failed companies are not excluded.

2.3.2 Ex-Post-Selection Bias

Banz and Breen (1986) point out Ex-Post-Selection Bias in their paper.
Ex-Post-Selection Bias arises due to the limitation of data availability. There are several reasons make the required data not available. Firstly, the process to collect

data for new listed companies takes time, so data related to those companies are not available at an early time. There are some cases that the accounting information of those firms for time periods prior to their inclusion in data base is used in a study. So, a bias is introduced. Second, there are some man-made causes. For example, we realized that there are some absolute errors in Bloomberg data base when we are searching data about outstanding shares on Norwegian Market. We believe that those error caused by input mistakes and lack of attention to such a small market.

Since Norwegian Stock Market is a relative small and neglected market in the world. The worry about data availability arises and Ex-Post-Selection Bias is introduced.

Section 3 Analysis of anomalies

Having chosen the 4 anomalies to study the research question, we perform quantitative analysis for the study of the anomalies in this section.

3.1 Study of earning surprise

3.1.1 Methodology

To analyze this anomaly, we design a measurement named as Standard Unexpected earnings (SUE). Intuitively, we suspect that the difference between a company's reported earnings and analysts' expectations may have influences on the future returns on the stock of this company. Having this intuition in the mind, we use the same SUE measurement as Foster, Chris and Shevlin in 1984. We construct the measurement as follows:

$$SUE_{i,q} = \frac{e_{i,q} - e_{i,q-4}}{\sigma_{i,q}}$$

where *e* serves the variable of diluted earnings per share (EPS) and σ is the standard deviation of the diluted EPS over the most recent eight quarters. We employ EPS to take the effect of dilution of company’s shares into account. The subscripts *i* and *q* represent the company, the instantaneous month of study and the most recent quarter in which the EPS of the company is published. *e* represents the EPS published quarterly. As the equation shows, SUE measures a standardized change between the most recently published EPS and the one published four quarters ago. To standardize the change in the historical EPS, we divide it by the standard deviation of the change in quarterly EPS over the most recent eight quarters following (Hou, Xue and Zhang 2012).A large positive SUE imply that the company achieved a large unexpected earnings increasing in the recent period while large negative SUE imply that the company incurred an unexpected decreasing in earnings in the recent period (Foster, Chris and Shevlin 1984).

We exclude the stocks that have available data on EPS for less than eight months for two reasons: 1. the numerical intuition suggests that the stocks with available data-collecting months less than eight months may have an artificially larger standard deviations which may lead to bias of sorting; 2. we follow the previous studies (Foster, Chris and Shevlin 1984, Jegadeesh and Lakonishok1996andHou, Xue& Zhang 2012) which also employ the same technique. However, this approach may generate the ex-post-selection bias, which is a limitation of your testing and beyond our ability.

Having defined the measurement of earning surprise, we need to form a series of portfolio to test for such anomaly. Firstly, we sort all stocks in the market by the descending order of SUE_q. It is worthwhile to mention that the stocks in the quarter *q* are sorted by the descending order of SUE of the most recent quarter, because data on EPS is published quarterly at the end of the last month in each quarter. Secondly, we use percentile ranking to break all the stocks sorted in the quarter *q* with an interval of 10 percentiles and then construct 10 value-weighted portfolios and these portfolios are rebalanced quarterly. It should be noted that the rebalance is performed quarterly because the data on EPS are published quarterly as mentioned before. Once all decile portfolios are constructed, we build a zero-investment portfolio named as H-L by making difference between the lowest decile and highest decile.

There are still some issues left to be clarified. Firstly monthly data on returns are used for further testing though the portfolios are quarterly rebalanced. The reason here is that monthly returns provide a better estimate because it introduce less noise than daily returns in discussion about abnormal returns (Mitchell & Stafford 2000).Secondly we generally use percentile ranking for all anomalies testing instead of absolute breakpoint in sorting to avoid the issue that the unbalanced number of stocks in a given breaking point, for breakpoint method may generate empty decile. To demonstrate this, we provide four frequency distributions on the number of the companies sorted by SUE, NSI, PRM and ROE in Figure 1-4 in the appendix. For example, we can see that the number of the company sorted by NSI is centered around 33% decile.

Finally, all the returns and are nominal rate in this paper. Actually, it doesn't matter because the inflation rate is eliminated when we calculate the excess returns.

To answer our first research question which is the existence of the anomaly of earning surprise and the other three anomalies, we will form a series of standard testing. Firstly, we form such null hypothesis that the average returns on HML ($\overline{r_t^{h-l}}$) is equal to zero in order to check the existence of abnormal returns. We use one sample t test for this hypothesis as follows:

$$t = \frac{\overline{r_t^{h-l}} - \mu_0}{s/\sqrt{n}}$$

where t represents the t stats, $\overline{r_t^{h-l}}$ is the average return of H-L portfolio and μ_0 is zero in our thesis. *s* equals to the corresponding standard deviation and *n* is the number of observation. In this paper, all the results of hypothesis check will be determined by 5% significance level. If the P-value of t-stats is smaller than 5%, that means we have more than 95% confidence that the average return of H-L portfolio is different from zero, then the null hypothesis is rejected which imply that the abnormal returns of earning surprise exist. Otherwise, there is no significant evidence that the Earning Surprise can create abnormal returns on Norwegian Stock Market.

With an existence of an anomaly, we want to study whether a central theory can explain it. In our study, we regress high-minus-low returns on the Fama-French three-factor Model as the central theory as follows

$$r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$$

where the r_t^{h-l} is the returns on H-L portfolio, $\varepsilon_n$is the residual,αrepresents the abnormal return that cannot be explained by the FF model and the three betas are the parameters for the three factors *MKT, SMB* and *HML* as we mentioned in the section of lit. It is worthwhile to state that the risk free rate is not subtracted fromr_t^{h-l} because r_t^{h-l} represents the excess returnon the portfolio with highest ranking over the lowest ranking, consistent with the representation of the left-hand side of the equation as we discussed in Section 2.2. Then key component here is the "alpha" on the right-hand side of the equation. We form the null hypothesis that alpha is equal to zero. The rejection of the null hypothesis indicates that there is a significant abnormal return induced by the anomaly that cannot be explained by FF model.

Since then, the hypotheses proposed focus on the performance of the portfolio with the highest ranking and the lowest ranking, suggesting the middle rankings are ignored. So, we need to regress the returns on the all the decile portfolios using FF model. The results of alphas will provide information about the changes of the explanatory power of FF model over the deciles. Besides, R^2results will enable us to investigate the general performance of FF model to interpret the entire market. We can also make a comparison of our study with the similar studies on US equity markets done by Hou, Xue& Zhang in 2012 to check whether FF model performs differently in both market.

The specification of regression is as follows:

$$r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$$

where r_t^n and r_t^f are the value-weighted returns on the portfolio *n and* the risk free rate at month *t*, respectively. All the other variables in this equation will be the same as factor regression for H-L portfolio.

3.1.2 Data Selection

We collect data of quarterly diluted EPS within the period from 1999 to 2014 using Bloomberg as the data source in order to calculate SUE from 2001 to 2014. We also collect monthly adjusted closed price data from 2001 to 2014 which is consistent with our research scope. In the raw data collection, the data of many companies for a specific quarter *q* are not available for several possible following reasons: the data of diluted EPS of one company was not recorded by Bloomberg at; one company may not be listed at that time. There are of course other possible explanations, but due to the limits of time and the confined access of data source, we are not able to perform further investigation. We are, therefore, forced to exclude these companies. The exclusion, however, may cause the ex-post-selection bias because the company excluded due to these factors may exist in the market.

It should be noted that the number of listed companies in the OSE varies significantly during the period studied according to the historical company lists from OSE website (Oslo Børs).[1] We use a list of companies that have been listed in the market in an attempt to fix an issue of survival bias (Table 13 in Appendix), suggesting that the data base employed includes stocks are both alive and dead. Adopting such list of company for all data on quarterly EPS and prices during the entire period studied, we exclude the company with unavailable data for the quarter q. (All company with available data are listed at Table 14 in Appendix.)

We observe such cases that many companies show a series of unchanged EPS over the past eight quarters. In these cases, the equation of SUE collapses due to the denominator equal to zero. However, the unchanged EPS is equivalent to a zero of SUE.

We use monthly value-weighted returns on the factor portfolios MKT, SMB and HML in FF model for the analysis of earning surprise and other three anomalies from web data source provided by (Ødegaard & Arne). The data on monthly risk free rate is also collected from the same web data source.

3.1.3 Tests and results analysis

From Table 1, firms with high SUE earn slightly higher returns than firms with low SUE on Norwegian Market. We can see that the H-L portfolio earns an average return of 0.27% with a standard deviation 6.8%. Since the sample mean is much smaller than standard deviation and t=0.4044, this result imply that the average

[1]A list of the changes in the number of listed companies is attached in the appendix.

return is insignificantly different from zero. So, we can see that there is no significantly relationship between the unexpected earnings and the stock returns.

Table 1 T-test for Monthly Percent Excess Returns of H-L portfolio Formed on Standardized Unexpected Earnings (SUE) (1/2001-12/2014)

This table shows the T-test for the H-L portfolio under Earning Surprise test. Pr (|T| > |t|) is the p-value. If p-value is smaller than 0.05, then H-null is rejected. Otherwise, we cannot reject H-null.

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]		Pr(|T| > |t|)
R_H-L	168	.0027	.0068	.0878	-.0106	.0161	0.6864
T stats	0.4044						

It is implied that we cannot reject the null, which is the abnormal return of the anomaly is not significant.

Besides, the results above can be used to make a comparison to US market. As Hou, Xue and Zhang showed in their paper[2], a similar H-L portfolio earns an average return of 0.43% with t=3.39 based on historical data of US Stock Market from Jan 1972 to Dec 2011 which imply that there are significantly abnormal returns caused by Earning Surprise in US market. Although there is a difference between time horizons which makes the comparison not fully compatible, we can still see that the standard deviation of the H-L portfolio returns are much larger in Norwegian Stock Market. This implies that small market like Norway has larger total risk compared to large market like US. It seems that there are huge noises on Norwegian Market which makes us difficult to figure out the effect of Earning Surprise.

[2]Hou, K., Xue, C., & Zhang, L. (December, 2012). Digesting Anomalies: An Investment Approach.

Table 2 shows the factor regression for Excess returns of H-L portfolio. It is not surprised to see that none of betas or alpha is significant different from zero, we also notice that the R^2 is only 1%. That means the returns of H-L portfolio is irrelevant to any factor under FF model. Integrated with t-test result, this implies that Earning Surprise Anomaly may not exist in Norway.

Table 2 Factor Regressions for Monthly Percent Excess Returns of H-L portfolio Formed on Standardized Unexpected Earnings (SUE) (1/2001-12/2014)

This table shows the Fama-French three-factor regressions for the H-L portfolio under Earning Surprise. Specifically, $r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$

For results, the numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	(1) R_hml
SMB	-0.174
	(0.220)
HML	-0.0556
	(0.162)
MKT	0.0504
	(0.144)
Alpha	0.00291
	(0.00725)
R^2	0.011
Observations	168

Table 3 gives us feeling about the changes of the explanatory power of FF model over the deciles. Looking at R^2, we realize that most R^2areabove 0.5 (Except lowest decile with R^2 is equal to 0.413).That imply that the FF model has explanatory power in Norway which is consistent with Ødegaard's results[3]. And looking at alpha in table 3, an interesting phenomenon can be observed that several middle level deciles have significant abnormal returns while the highest (large positive SUE) and lowest deciles (large negative SUE) do not have. That means small or no absolute unexpected earnings may create abnormal returns while large unexpected earnings may not in Norway which is opposite to US market.

[3]Ødegaard (2015). Empirics of the Oslo Stock Exchange: Asset pricing results. 1980-2014.

Table 3 Factor Regressions for Monthly Percent Excess Returns of Deciles Formed on Standardized Unexpected Earnings (SUE) (1/2001-12/2014)

SUE is the change in the most recently announced quarterly earnings per share from its value announced four quarters ago divided by the standard deviation of the change in quarterly earnings over the prior eight quarters. We rank all Oslo Børs listed companies with available data into deciles by their most recent past SUE with the percentile ranking, and the portfolios are rebalanced quarterly. The specification of regression is $r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$. This table shows the Fama-French three-factor regressions for the sorted portfolios. The numbers (in parentheses) is the standard errors of corresponding coefficients. R-Square is the average goodness-of-fit across the deciles. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
SMB	0.151	0.160	0.0529	-0.0896	-0.0703	0.269*	0.386**	0.619***	0.0443	0.325*
	(0.145)	(0.115)	(0.132)	(0.120)	(0.142)	(0.145)	(0.170)	(0.172)	(0.139)	(0.171)
HML	-0.0502	-0.0138	0.0769	-0.0565	-0.00826	-0.306***	-0.218*	-0.112	0.210**	0.00533
	(0.107)	(0.0850)	(0.0973)	(0.0885)	(0.105)	(0.107)	(0.125)	(0.127)	(0.102)	(0.126)
MKT	1.130***	0.940***	1.254***	1.009***	1.091***	1.141***	1.491***	1.436***	1.030***	1.079***
	(0.0952)	(0.0755)	(0.0864)	(0.0786)	(0.0930)	(0.0950)	(0.111)	(0.113)	(0.0909)	(0.112)

Alpha	-0.00428	-0.0144***	-0.0130***	-0.00491	-0.0188***	-0.0139***	-0.0212***	-0.0259***	-0.00466	-0.00719
	(0.00480)	(0.00381)	(0.00436)	(0.00397)	(0.00469)	(0.00480)	(0.00562)	(0.00569)	(0.00459)	(0.00565)
R^2	0.547	0.562	0.654	0.626	0.576	0.557	0.593	0.538	0.533	0.413
Observations	168									

Standard errors in parentheses

$^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

3.2 Study of net stock issue

3.2.1 Methodology

As discussed in the previous section that the past events of net stock issue may influence the returns on the stock of the company in the future, we form a measurement to study this anomaly in this subsection. The specification of the measurement is as follows:

$$NSI_{i,y} = \ln(\frac{x_{i,y-1}}{x_{i,y-2}})$$

where $x_{i,y-1}$ and $x_{i,y-2}$ are the annual shares issued of the company *i* in year *y-1* and *y-2*, respectively. In reality, there are always newly listed companies in the stock market every year. The companies that become listed in year *y-1* have the larger number of share issued, compared other kinds of stock issues. Therefore, the influence of such companies should be the most significant accordingly. This intuition is in line with the building of *NSI*, because the data on $x_{i,y-2}$ is zero and makes the NSI value be infinite and the ranking of the corresponding stock should belong to the highest decile. As for the companies that are initially listed in year *y*, there are no impacts of past net stock issue on their stocks 'performance in year *y* and the variations of the companies' stocks are noise to the anomaly analysis. By the definition of the measurement, such companies are excluded, consistent with the underlying logic of the anomaly.

To construct portfolio, we sort stocks by the descending order of NSI in year *y* and then form ten value-weighted portfolios by using percentile ranking with an interval of 10 percentiles. The monthly nominal returns are calculated accordingly and the ranking is rebalanced annually. The diversity in the frequencies of returns and the rebalance arises due to the same logic discussed in 3.1.1. For the convenience of the hypothesis tests, we also build an *H-L* portfolio by taking differences of nominal monthly returns on the highest decile and the lowest decile.

As for the test for the anomaly existence, we make a null hypothesis that the average returns on HML ($\overline{r_t^{h-l}}$) is equal to zero as previously discussed. The alternative hypothesis is the opposite. The specification of hypothesis test and the interpretation of the test results are the same as stated in 3.1.1.

As proposed in 3.1.1, we form another hypothesis testing for the ability of FF model to explain the abnormal returns induced by NSI. The null hypothesis is, as stated, that the alpha are equal to zero.

$$r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$$

Finally, we also do the factors regressions for all decile portfolios as we discussed under Earning Surprise Test.

$$r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$$

3.2.2 Data selection

We collect annual data on the shares issued and monthly data on adjusted closed prices of all the companies on the company list mentioned in 3.1.2. The data on prices is collected from 31.01.2001 to 30.12.2014 and the one on the shares issued are from 31.12.1999 to 30.12.2014. We observe some specific inconsistencies in our raw data from Bloomberg, such as a stock with no available prices in a year when the share issued is available in Bloomberg. For example, a stock with a ticker of “Next” shows a series of prices starting from 30.03.2007, but the data on the annual share issued is not available until 30.12.2014. Together with the fact that the time of the stock being listed on the exchange is contradictory to the time when the share outstanding appears for the first time in Bloomberg, such inconsistency makes us skeptical for the reliability of Bloomberg. To fix this issue, we use Børsprosjeketved NHH as the data source of the annual shares issued.

The data on the factor loadings of FF model is from the same source referred in 3.1.2.

3.2.3 Tests and result analysis

From Table 4, firms with high NSI earn lower returns than firms with low NSI in Norwegian Market. We can see that the H-L portfolio earns an average return of -1.68% with a standard deviation 16.18%. Since the sample mean is much smaller than standard deviation and t=0.5321, this result imply that the average return is insignificantly different from zero. We notice that the standard deviation is extremely large in Norwegian Market and there is no evidence to show significantly abnormal return due to the large standard deviation.

Table 4 T-test for Monthly Price Excess Returns of H-L portfolio Formed on Net Stock Issues (NSI) (1/2001-12/2014)

This table shows the T-test for the H-L portfolio under Net Stock Issues test. Pr (|T| > |t|) is the p-value. If p-value is smaller than 0.05, then H-null is rejected. Otherwise, we cannot reject H-null.

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]	Pr(|T| > |t|)
R_H-L	168	-.0078	.0125	.1618	-.0325	.0168	0.5321
T stats	-0.6261						

It is implied that we cannot reject the null, which is the average returns of the H-L is not significant different from zero.

Compared to US market, Hou, Xue and Zhang show that a similar H-L portfolio earns an average return of 0.68% with t=-4.11 based on historical data of US Stock Market from Jan 1972 to Dec 2011[2] which imply that there are significantly abnormal returns caused by Net Stock Issues in US market. We realize that though the average return of H-L in US market is lower compared to Norwegian Market, a very low standard deviation can still make it significant. This imply that small market like Norway has larger total risk compared to large market like US which is consistent with our previous test with SUE. And again, the huge noises in Norwegian Market which makes us difficult to figure out the effect of Net Stock Issues.

Table 5 shows the factor regression for Excess returns of H-L portfolio. We find that only the beta of HML factor is significantly different from zero and $R^2$is 7%. That means the 7% variance of H-L portfolio average returns can be explained by HML factor. Integrated with t-test result, this implies that Net Stock Issues Anomaly may not exist in Norway though it exist in US market.

Table 5 Factor Regressions for Monthly Percent Excess Returns of H-L portfolio Formed on Net Stock Issues (NSI) (1/2001-12/2014)

This table shows the Fama-French three-factor regressions for the H-L portfolio under Net Stock Issues. Specifically, $r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$

For results, the numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	(1)
	R_hml
SMB	-0.00136
	(0.392)
HML	0.927***
	(0.289)
MKT	0.393
	(0.257)
Alpha	-0.0141
	(0.0130)
R^2	0.070
Observations	168

Table 6 shows that half of decile portfolios have negative alphas from -1.06% to -2.99%. However, there is no significantly evidence to show that these abnormal returns are caused by NSI, for abnormal returns appear randomly across deciles (appear in some high deciles as well as some other low deciles). Looking at R^2, we realize that most R^2arereduced to around 0.3which means that the explanatory power of FF model decreases for these sorted portfolios. What's more, the standard errors are much larger than those in previous SUE testing and other sorted portfolios caused by Ødegaard (2015). That implies that stocks with similar NSI in Norway may share some idiosyncratic risks which contribute to increasing of total risks of those sorted portfolios. However, this phenomenon doesn't show in US market (Hou, Xue and Zhang 2012).

Table 6 Factor Regressions for Monthly Percent Excess Returns of Deciles Formed on Net Stock Issues (NSI) (1/2001-12/2014)

NSI is the change in the log changes of annual shares issued from year y-2 to y-1. We rank all Oslo Børs listed companies with available data into deciles by their most recent past NSI with the percentile ranking, and the portfolios are rebalanced annually. The specification of regression is $r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$. This table shows the Fama-French three-factor regressions for the sorted portfolios. The numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit across the deciles. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
SMB	0.424	-0.0314	0.624**	0.485	0.311	0.0502	0.446*	0.426***	0.302	0.425**
	(0.338)	(0.349)	(0.272)	(0.322)	(0.219)	(0.261)	(0.240)	(0.125)	(0.209)	(0.198)
HML	0.578**	-0.00142	-0.328	0.233	-0.118	0.0212	-0.0882	0.0856	0.00207	-0.348**
	(0.249)	(0.257)	(0.200)	(0.238)	(0.162)	(0.193)	(0.177)	(0.0925)	(0.154)	(0.146)
MKT	1.708***	1.432***	1.573***	1.358***	1.294***	1.133***	1.173***	1.196***	1.278***	1.315***
	(0.221)	(0.228)	(0.178)	(0.211)	(0.144)	(0.171)	(0.157)	(0.0821)	(0.136)	(0.129)
Alpha	-0.0218*	-0.0299**	-0.0251***	-0.0200*	-0.0125*	-0.0174**	-0.0217***	-0.0106**	-0.0256***	-0.00767
	(0.0112)	(0.0115)	(0.00897)	(0.0106)	(0.00725)	(0.00863)	(0.00793)	(0.00414)	(0.00689)	(0.00653)
R^2	0.319	0.273	0.376	0.230	0.396	0.284	0.291	0.606	0.409	0.460
Observations	168									

Standard errors in parentheses $^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

3.3 Study of price momentum

3.3.1 Methodology

We develop a measurement named as PRM for the study of price momentum as follows:

$$PRM_{i,m} = \ln\left(\frac{p_{i,m-2}}{p_{i,m-7}}\right),$$

where $p_{i,m}$ is the monthly return on the stock of company *i* and the subscript *m* represents the month *m*. Importantly, since the number of the companies listed in the market varies a lot, it may happen that either $p_{i,m-2}$ or $p_{i,m-2}$ is zero, suggesting two cases, respectively: 1. company *i* is delisted in month *m-2*; 2. company *i* is not listed in month *m-7*. For the first case, company *i* is excluded from the analysis for the price momentum in month *m*, simply because such company has been delisted in month *m-2* and it has no price to be influenced in the future. For the second case, we record PRM as the log returns from the company's opening price at the listing date to the adjusted closed price at the end of m-2.

With the defined measurement in hands, we build portfolios as follows: 1. At month *m*, we sort stocks by the descending order of PRM; 2. then we break the stocks into ten value-weighted portfolios by using percentile rank with an interval of 10 percentile; 3. we calculate the monthly returns on the portfolios from month *m* to month *m+5*; 4. then we take the simple average of these six-month returns as the returns on the portfolio in month *m*. It is necessary to state that, in step 3, we calculate the returns in month *m+k* (k=0 … 5) by using the market value weights of each stock in the month *m+k*, suggesting that we rebalance the weights of the stock monthly from *m* to *m+5*. In addition, we also build the *H-L* portfolio for the hypothesis test.

We develop the usual null hypothesis that the average return on *H-L* is equal to zero. We use one sample T test as the hypothesis test. As for the ability of FF model to explain the abnormal returns related to the anomaly, the null hypothesis is the same as stated in 3.1.1. And to test for such hypothesis, we use the following regression model, which is also proposed in 3.1.1:

$$r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_t$$

At last, we regress returns on each portfolio on FF model using the following regression equation:

$$r_t^i - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_t$$

The underlying logic has been stated in 3.1.1.

3.3.2 Data selection

To calculate this characteristic, we collect data on monthly prices of the companies in the company list from 30.06.2000 to 27.02.2015 using Bloomberg as data source. Importantly, we are supposed to calculate monthly returns from December 2014 to May 2015 in the calculation of PRM in December 2014, and from November 2014 to April in the calculation of PRM in November 2014. However, due to the availability of data, we can only calculate the returns till February 2015. Intuitively, price momentum characteristic has influence that may weaken as time continues. Therefore, the limited data availability may cause the average returns in November and December 2014 larger than the ones by the definition (expected to use average return of 6 month). Unfortunately, we cannot avoid or mitigate this ex-post-selection bias since we do not have an access to the later data.

Table 7 T-test for Monthly Percent Excess Returns of H-L portfolio Formed on Price Momentum (PRM) (1/2001-12/2014)

This table shows the T-test for the H-L portfolio under Price Momentum test. Pr (|T| > |t|) is the p-value. If p-value is smaller than 0.05, then H-null is rejected. Otherwise, we cannot reject H-null.

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]		Pr(|T| > |t|)
R_H-L	168	.0202	.0035	.0451	.0132	.0270	0.000
T stats	5.7879						

It is implied that we can reject the null, which is the average excess returns is significantly different from zero.

3.3.3 Tests and result analysis

From Table 7, firms with high PRM earn higher returns than firms with low PRM which indication a performance persistency in Norwegian Market. We can see that the H-L portfolio earns an average return of 2.02% with a standard deviation 0.35%. Since the sample mean is much smaller than standard deviation and t=5.7879, we should reject H-null. This result implies that the average return is significantly different from zero. That means abnormal returns caused by Price Momentum exist in Norway.

Compared to US market, Hou, Xue and Zhang show that a similar H-L portfolio earns an average return of 0.87% with t=3.15 based on historical data of US Stock Market from Jan 1972 to Dec 2011.That means the Price Momentum effect in Norwegian Stock Market is stronger than Price Momentum in US market, for a larger abnormal returns and t-stats.

Table 8 shows the factor regression for Excess returns of H-L portfolio. We find that there is a significantly positive alpha. Besides, none of the betas is insignificantly different from zero and R^2 is only 1.7%. That means that there exists a pattern of abnormal returns which cannot be explained by FF model in Norwegian Market.

Table 8 Factor Regressions for Monthly Percent Excess Returns of H-L portfolio Formed on Price Momentum (PRM) (1/2001-12/2014)

This table shows the Fama-French three-factor regressions for the H-L portfolio under Price Momentum. Specifically, $r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$

For results, the numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	(1) R_hml
SMB	0.151
	(0.113)
HML	-0.0474
	(0.0830)
MKT	0.102
	(0.0736)
Alpha	0.0183***
	(0.00372)
R2	0.017
Observations	168

Table 9 shows that only lowest decile portfolio has a significantly negative alpha. That means that there is evidence that companies with extremely poor performance will still performs poorly in short-term future while there is no evidence that companies with good performance will stay in good position in the future. This fact is different from US market, for the persistency appears at both good and bad side in US market.

Table 9 Factor Regressions for Monthly Percent Excess Returns of Deciles Formed on Price Momentum (PRM) (1/2001-12/2014)
PRM is the change in the log return of stock from month m-7 to m-2. We rank all Oslo Børs listed companies with available data into deciles by their most recent past PRM with the percentile ranking, and the portfolios are rebalanced monthly. The specification of regression is $r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$. This table shows the Fama-French three-factor regressions for the sorted portfolios. The numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit across the deciles. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	r1	r2	r3	r4	r5	r6	r7	r8	er9	er10
SMB	0.165	0.173*	-0.00108	0.0456	0.0203	-0.0596	0.0324	0.00312	0.0687	0.0138
	(0.115)	(0.0974)	(0.0940)	(0.0850)	(0.0799)	(0.0840)	(0.0933)	(0.107)	(0.129)	(0.141)
HML	-0.0893	-0.0550	-0.107	-0.0604	-0.0225	0.0140	-0.0584	0.00818	0.0256	-0.0419
	(0.0848)	(0.0718)	(0.0693)	(0.0627)	(0.0589)	(0.0619)	(0.0688)	(0.0788)	(0.0948)	(0.104)
MKT	0.426***	0.333***	0.224***	0.254***	0.182***	0.272***	0.313***	0.284***	0.321***	0.324***
	(0.0753)	(0.0638)	(0.0615)	(0.0556)	(0.0523)	(0.0549)	(0.0610)	(0.0700)	(0.0841)	(0.0926)
Alpha	0.000460	0.00110	0.000615	-0.000263	0.000574	-0.00356	-0.00758**	-0.00440	-0.00554	-0.0178***
	(0.00380)	(0.00322)	(0.00310)	(0.00281)	(0.00264)	(0.00277)	(0.00308)	(0.00353)	(0.00425)	(0.00467)
R^2	0.199	0.162	0.132	0.156	0.097	0.213	0.194	0.132	0.103	0.103
Observations	168									

3.4 Study of the influence of profitability

3.4.1 Methodology

We develop returns on equity of a company *i* in year *y-1* ($ROE_{i,y-1}$) as an indicator to measure the influence of profitability of a company on its stock performance in year *y*, such as monthly returns. The definition of ROE is commonly known.

As for the construction of portfolio, we firstly sort the stocks by the descending order of $ROE_{i,y-1}$for the portfolio in year *y* and break them into ten value-weighted portfolios by using percentile rank. Secondly, we calculate the 12 monthly returns on these portfolios in year *y*. The rebalance of the portfolio is conducted annually at the end of the year.

As previously, we conduct one sample T test for the presence of the anomaly related to ROE with the null hypothesis that the average returns on *H-L* is equal to zero. The alternative hypothesis is the opposite.

Afterwards, we perform the following regression to test whether FF model can explain the potential anomaly related to the profitability:

$$r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_t$$

The attention is paid on the significance of alpha. If it is significant, then FF model fails to interpret the potential anomaly.

We finally perform regression of returns on each portfolio on FF model using the following regression equation:

$$r_t^i - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_t$$

The underlying logic has been stated in 3.1.1.

3.4.2 Data selection

We collect annual data on ROE from 29.12.2000 to 30.12.2014 and monthly data from 29.12.2000 to 30.12.2014 on the prices of the companies on the list mentioned before.

3.4.3 Tests and result analysis

From Table 10, firms with high ROE earn higher returns than firms with low ROE in Norwegian Market. We can see that the H-L portfolio earns an average return of 2.9% with a standard deviation 25.70%. Since the sample mean is much smaller than standard deviation and t=1.46, this result imply that the average return is insignificantly different from zero. Although the average return of H-L looks very huge, the standard deviation is even at relative larger level and create a very large 95% confidence interval which is from -10.1% to 6.82%. The total risks of sorted portfolios by ROE in Norway are too large to get any information about the existence of abnormal returns. However, the Fama and French show significantly abnormal returns created by different double-dimensional sorting. The average abnormal returns of US sorted H-L portfolios are from 0.05% to 0.30%.

Table 10 T-test for Monthly Percent Excess Returns of H-L portfolio Formed on ROE (1/2001-12/2014)

This table shows the T-test for the H-L portfolio under ROE test. Pr (|T| > |t|) is the p-value. If p-value is smaller than 0.05, then H-null is rejected. Otherwise, we cannot reject H-null.

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]	Pr(|T| > |t|)
R_H-L	168	.0290	.0198	.2570	-.0101	.0682	0.1447
T stats	1.4652						

Table 11 shows the factor regression for Excess returns of H-L portfolio. We find that only the beta of HML factor is significantly different from zero and R^2 is 3.9%. That means the 3.9% variance of H-L portfolio average returns can be explained by HML factor. Integrated with t-test result, this implies that there is no evidence to show ROE anomaly exist in Norway.

Table 11 Factor Regressions for Monthly Percent Excess Returns of H-L portfolio Formed on ROE (1/2001-12/2014)

This table shows the Fama-French three-factor regressions for the H-L portfolio under ROE. Specifically, $r_t^{h-l} = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$

For results, the numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	(1) R_hml
SMB	-0.631
	(0.634)

HML	1.069^{**}
	(0.467)
MTK	-0.381
	(0.415)
Alpha	0.0352^{*}
	(0.0209)
R^2	0.039
Observations	168

Table 12 shows that 7 of decile portfolios have negative alphas from -1.06% to -2.99%. And we notice that the 6 lowest portfolios all have significantly negative abnormal returns. That implies that companies with poor profitability typically have poor financial performance in Norway. A surprising fact here is that there is also a significantly negative alpha for the highest decile which means the companies with best profitability also incur poor financial performance which is opposite to the case in US market.

Table 12 Factor Regressions for Monthly Percent Excess Returns of Deciles Formed on ROE anomaly (ROE) (1/2001-12/2014)
We rank all Oslo Børs listed companies with available data into deciles by their most recent past ROE with the percentile ranking, and the portfolios are rebalanced annually. The specification of regression is $r_t^n - r_t^f = \alpha + \beta_m \cdot MKT_t + \beta_s \cdot SMB_t + \beta_h \cdot HML_t + \varepsilon_n$. This table show the Fama-French three-factor regressions for the sorted portfolios. The numbers (in parentheses) is the standard errors of corresponding coefficients. R- Square is the average goodness-of-fit across the deciles. The results of Gibbons, Ross, and Shanken (1989) test on the null hypothesis are showed on the superscript of the coefficients with the number of "*". Alpha with not less than two stars imply that null hypothesis is rejected and the alpha is significantly different from zero. Otherwise, we cannot reject H-null.

	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
SMB	0.324	0.0389	-0.0304	-0.291**	0.0309	0.383*	0.154	0.503**	0.801**	0.955**
	(0.370)	(0.120)	(0.123)	(0.143)	(0.134)	(0.219)	(0.158)	(0.194)	(0.404)	(0.480)
HML	0.422	-0.141	0.0140	0.280***	0.120	0.135	-0.0748	0.282**	-0.284	-0.647*
	(0.272)	(0.0884)	(0.0908)	(0.105)	(0.0987)	(0.162)	(0.116)	(0.143)	(0.298)	(0.354)
MKT	1.465***	1.118***	0.969***	1.016***	1.065***	1.492***	1.217***	1.603***	1.834***	1.845***
	(0.242)	(0.0784)	(0.0806)	(0.0936)	(0.0876)	(0.144)	(0.103)	(0.127)	(0.264)	(0.314)
Alpha	-0.0278**	-0.00509	-0.00530	0.000189	-0.0137***	-0.0335***	-0.0169***	-0.0183***	-0.0706***	-0.0630***
	(0.0122)	(0.00396)	(0.00407)	(0.00473)	(0.00442)	(0.00724)	(0.00522)	(0.00640)	(0.0133)	(0.0159)
R^2	0.224	0.657	0.581	0.575	0.571	0.454	0.545	0.541	0.261	0.213
Observations	168									

Section 4 Summary

In this paper, we study four anomalies observed in the most equity markets: earning surprise, net stock issue, price momentum and ROE.

To test for their presences in the Norwegian Stock Market, we form the null hypothesis that the average of the abnormal returns caused by these anomalies is equal to zero. Then we regress the abnormal returns on the FF model and study the significance of the alpha to check the explaining power of the FF model. Finally, we focus on the abnormal returns across the sorted portfolios in terms of SUE, NSI, PRM and ROE.

We find that only price momentum is statistically significant. As for the other three, we cannot find solid evidences to support their existences in the Norwegian equity market.

In addition, we find that the total risk in the Norwegian stock market is higher than in the US stock market. Such finding is consistent with the intuition that the market with small market capitalization has higher risk. The reason can be that such kind of market is relatively unstable and are more likely to be influenced by the external impacts. More interestingly, we observe that the companies that enjoy the highest profitability, however, show negative abnormal returns, opposite to what happens in the US markets. It is suggested to take further studies on this topic.

In general, the significances of market anomalies in a relatively small market, such as the Norwegian stock market, are different from in a big market, such as the US market. According to test results of SUE, NSI and ROE, we prove that a specific market anomaly that is significant in the US market is not necessary to be significant in the Norwegian equity market. However, the test result of PRM demonstrates that the related anomaly is more significant in Norway than in the US and generates higher abnormal returns in Norway than in the US.

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Appendix

Table 13 The number of companies listed on OSE (2001-2015)

	New companies			*Delisted*			*Change of name*	*Total number of listed instruments*
	Total	***By demerger***	***Other***	***Total***	***By merger***	***Other***		
2015	1	0	1	2	0	2	1	184
2014	12	2	10	13	0	13	9	185
2013	8	0	8	16	0	16	7	186
2012	7	1	6	11	0	11	8	194
2011	5	1	4	13	1	12	10	198
2010	10	0	10	13	0	13	12	206
2009	0	0	0	16	0	16	7	209
2008	6	0	6	23	0	23	10	225
2007	30	1	29	18	0	18	21	242
2006	32	0	32	22	0	22	8	230
2005	46	4	42	15	2	13	5	220
2004	22	3	19	12	0	12	7	189
2003	5	1	4	30	3	27	0	179
2002	6	0	6	15	0	15	4	204
2001	17	4	13	19	1	18	13	213

Table 14 The list of companies used in the paper

BEARFOE	BULLDNBN	SACA	BULLORKX	CECON
BEARPGS	NHY	REDM	BULLOBXX	HBC
BEARAKSO	BEARKOBB	TOM	AKA	SDRL
BEARSUBC	RING	BULLSCH	POL	BULLTGS
BEAROBOS	MEDI	SBO	BULLELHA	IMSK
WEIFA	MING	MOJU	STL	DOF
BULLRCLH	YAR	TVTI	EIOF	OBOSX
BULLRCL	NTSG	MSEIS	EKO	BULLOLJE
BEAROLJE	BULLOPER	NTS	PDR	BULLBREN
BEARBREN	BULLTELX	BEAROBX3	ITX	BEAROPER
BEARSDRL	SADG	ATEA	TGS	FAR
BULLMHG	VARDIA	SSHIP	NORTH	MCG
EVRY	NATTO	ROM	HAVI	ARCHER
AKVA	MORG	SRBANK	RISH	BIRD
OTS	SKUE	ORK	QFR	BEARGJFX
BAKKA	GJF	STB	BEARDNBN	PRS
BEARSTLX	HELG	BULLGULL	SAGA	SIOFF
BULLNHY3	OPERA	KIT	WRL	SUBC
COV	GSF	BULLGUHA	REPANT	BULLBWLP
BULLGJFX	DNB	KOG	NSG	BEARYARX
GIG	BULLTEL	BULLEL	NAPA	TTS
HLNG	BRG	BIONOR	ABT	ODL
NPRO	TIDE	OBXEXACT	WILS	BEARNHY3
FLNG	SPOG	ODF	BULLOBX4	BULLSTLX
BULLALUH	BEARNAS	OBXEDNB	JIN	EQO
BULLYARX	AURG	BEARRECS	BEARTELX	WBULK
MHG	SVEG	NOM	GRO	IDEX
BEARSTL	NONG	VEI	APP	BULLGOGL
BEARSTLH	BEAROBXX	WWI	EAM	PGS
SOAG	BEAROBX4	SONG	DETNOR	EMGS
JAEREN	TEL	BULLSTB	AKPS	ASETEK
BULLNHY	OCY	KOA	DNO	SBX
BULLNHYH	SSI	BULLORKL	KVAER	DOLP
BEARTGS	OBXBEAR	REACH	SOFF	BULLDNO
SALM	SKI	OBXBULL	BWLPG	BEARMHG
BEARGUHA	TIL	AVANCE	THIN	BULLSDRL
AURLPG	PSI	ITE	AKER	BEARRCL
LSG	BULLKOBB	GOD	SNI	FOE
BEARGULL	GULL	BXPL	ZONC	BULLOBOS

SOR	NEL	RECSOL	PHO	BULLREC
BEARRECH	NAVA	BEARALU	BEARYARA	BULLRECH
BULLYARA	REM	FUNCOM	BEARYAR	BULLSUBC
BULLYAR	SER	BOUVET	AWDR	BULLAKSO
SSC	SOLV	WWASA	HEX	NOFIN
AFK	VVL	BEL	SPU	SEVDR
SBVG	HNA	ASC	REC	BULLPGS
LINK	SCH	NAS	PEN	PLCS
BMA	BLO	SEVAN	BEARNHYH	IOX
NRS	BEAREL	STORM	BULLRECS	NOR
HSPG	ALNG	BRENT	SCI	BULLFOE
ISSG	BEARORKL	AMSC	NEXT	
BEARDNO	GYL	BULLOBX3	BULLNAS	
RGT	AFG	BIOTEC	BON	
NOD	DAT	BOR	BEARNHY	
TOTG	EL	BEARTEL	NMG	
HFISK	BEARSTB	BEARSCH	PCIB	
PROTCT	BWO	DESSC	EMAS	
BEARELHA	MELG	BERGEN	BULLSTLH	
BEARGOGL	OLT	NOF	BULLSTL	
AUSS	BEARORKX	AGA	SDSD	

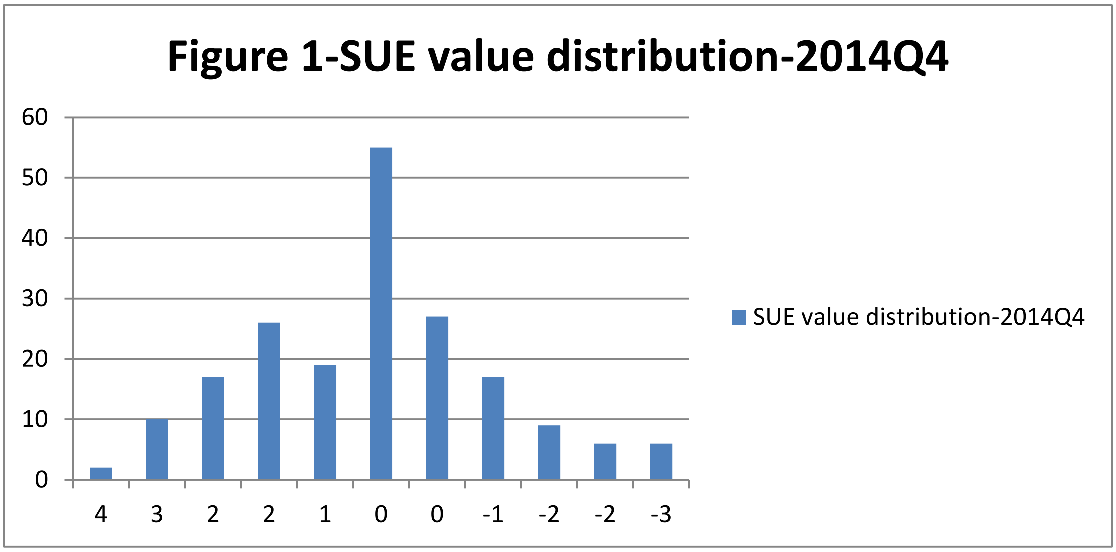
Figure 1-SUE value distribution-2014Q4
60
50
40
30
20
10
0
4
3
2
2
1
0
0
-1
-2
-2
-3
SUE value distribution-2014Q4

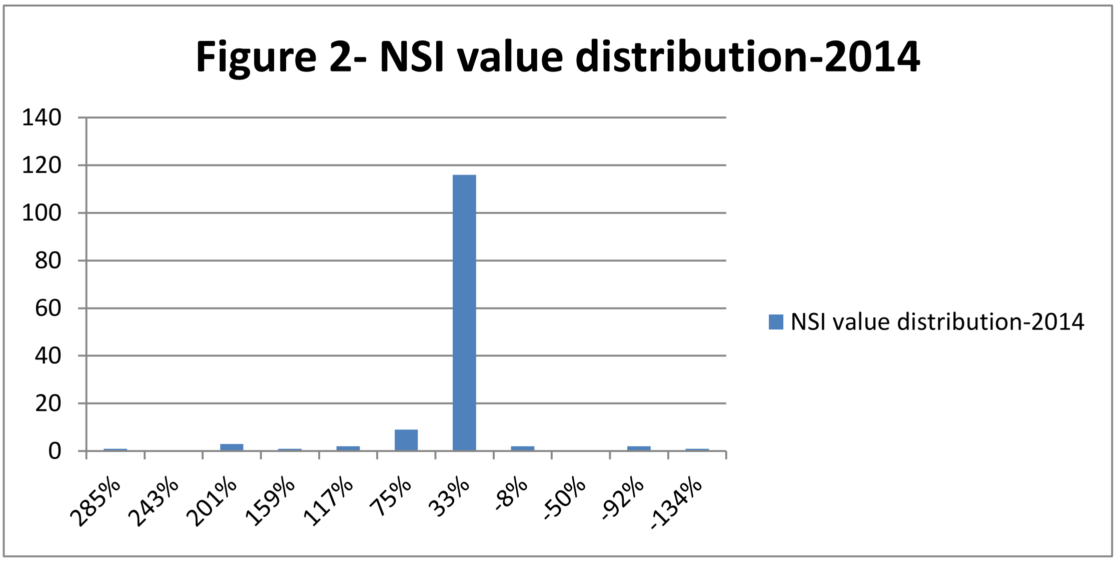
Figure 2- NSI value distribution-2014
140
120
100
80
60
40
20
0
285%
243%
201%
159%
117%
75%
33%
-8%
-50%
-92%
-134%
NSI value distribution-2014

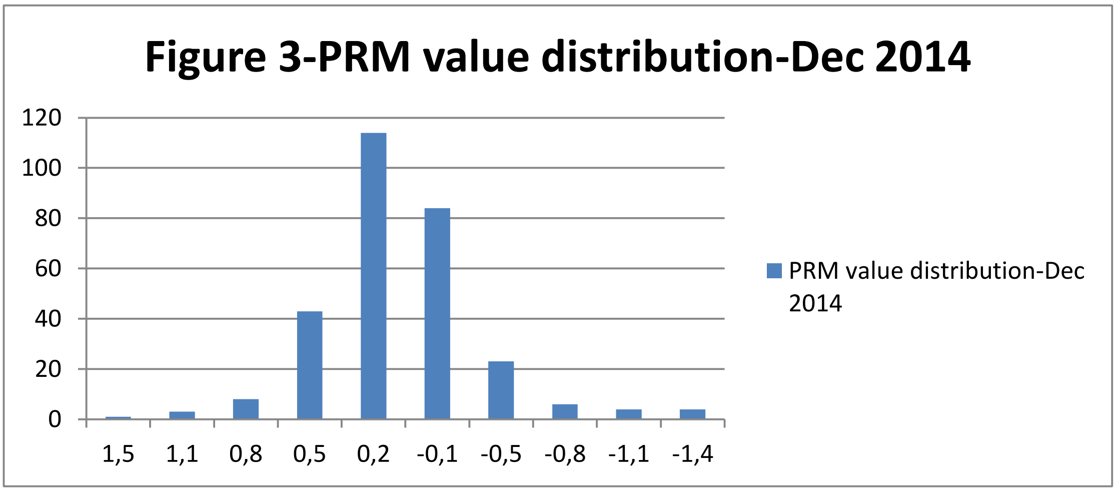
Figure 3-PRM value distribution-Dec 2014
120
100
80
60
40
20
0
1,5
1,1
0,8
0,5
0,2
-0,1
-0,5
-0,8
-1,1
-1,4
PRM value distribution-Dec 2014

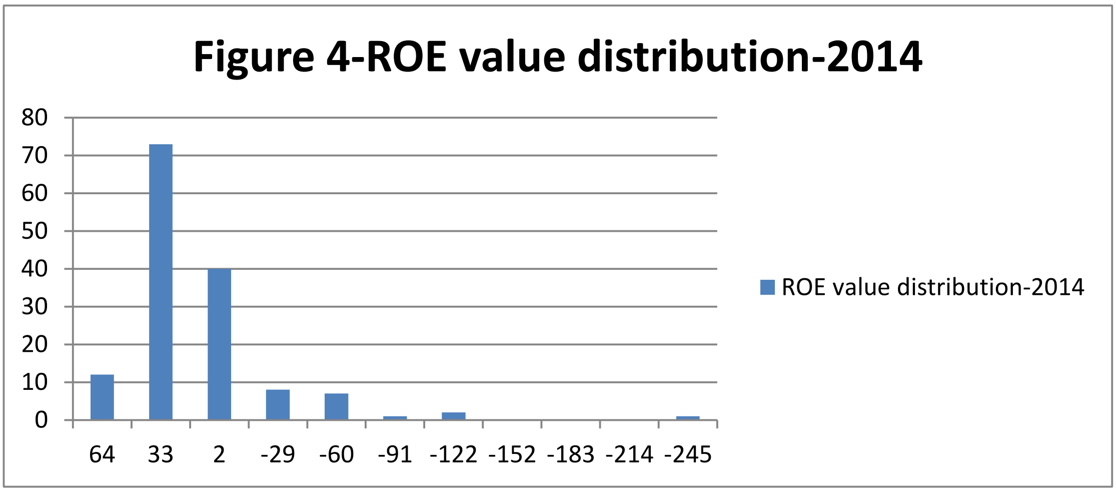
Figure 4-ROE value distribution-2014
80
70
60
50
40
30
20
10
0
64
33
2
-29
-60
-91
-122
-152
-183
-214
-245
ROE value distribution-2014