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Valuation using multiples:

Does a Portfolio based on Multiple Selection Strategy Yield a Higher Return-to-Risk Ratio than the Benchmark Index?

The thesis applies relative valuation for creating yearly rebalanced portfolios from 1999 to 2009 by the use of the multiples: EV/Sales, EV/EBITDA, EV/EBIT, P/E, P/B and P/tangible-B. The portfolios performance are measured using the adjusted for skew Sharpe ratio (ASR).

Master Thesis within the main profile of Financial Economics
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Abstract

This paper examines the performance of portfolios based on a multiple selection strategy in the Marine- and Energy index. Both enterprise and equity multiples are used for portfolio selection. In addition, criteria's regarding market value and the use of a multiple band is also applied in the analysis. The return and risk differences between portfolios and the benchmark are tested using the non-parametric Wilcoxon signed rank test, and the portfolio performance are ranked using the Sharpe ratio and the adjusted for skew Sharpe ratio, which includes investors preference for positive skew in the return distribution.

This thesis finds that portfolios based on companies with low multiple values yields a higher return-to-risk ratio than the benchmark index. Based on the result from the analysis, the overall best performing portfolio strategy is based on investing in companies with a P/B multiple below the harmonic mean multiple and a market value above 100 MNOK.

Abbreviations

APV = Adjusted Present Value

CAPM = Capital Asset Pricing Model

COE = Cost of Equity

EBIT = Earnings before interest and taxes

EBITDA = Earnings before interest, taxes, depreciation and amortization

EES index = Oil & Gas Equipment & Services

EV = Enterprise value

FCF = Free Cash Flow

NOPLAT = Net operating profit less adjusted taxes

P = Market value of equity

ROE = Return on equity

ROIC = Return on invested capital

Tangible book value = Book value excluding intangible assets

WACC = Weighted average cost of capital

Calculations of market values and multiples		
Equity value$_{31.12.t}$	=	Market value equity $_{31.03.t}$ = Shares outstanding$_{31.03.t}$ * Share price$_{31.03.t}$
Enterprise value$_{31.12.t}$	=	Market value equity $_{31.03.t}$ + Net debt$_{31.12.t-1}$ + Minority interests$_{31.12.t-1}$
Net debt$_{31.12.t}$	=	Total debt$_{31.12.t}$ - Total Cash & Equivalent$_{31.12.t}$
EV/SALES$_{31.12.t}$	=	EV$_{31.03.t}$ /Total Sales$_{31.12.t-1}$
EV/EBITDA$_{31.12.t}$	=	EV$_{31.03.t}$ /EBITDA$_{31.12.t-1}$
EV/EBITDA$_{31.12.t}$	=	EV$_{31.03.t}$ /EBIT$_{31.12.t-1}$
P/E$_{31.12.t}$	=	Market value equity$_{31.03.t}$ /Earnings$_{31.12.t-1}$
P/B$_{31.12.t}$	=	Market value equity$_{31.03.t}$ /Book value equity$_{31.12.t-1}$
P/Bxint$_{31.12.t}$	=	EV$_{31.03.t}$ /Book (value equity$_{31.12.t-1}$ – Total intangibles$_{31.12.t-1}$)

Table 1: To get a better understanding of the methodology, the table explains the calculations of the valuation multiples. In the calculation the market values (EV or equity) at the time of investment, is divided by the relevant income or balance sheet statistic.

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1. Introduction

This thesis examines the performance of portfolios based on a multiple selection strategy in the Norwegian stock market. The multiples examined are the enterprise multiples enterprise-to-sales, enterprise-to-EBITDA and enterprise-to-EBIT, and the equity multiples price-to-earnings, price-to-book value and price-to- book value when excluding intangible assets.

Multiples are a popular tool and used extensively in practice to reason the forecasted earnings, estimate the terminal value, define the current state of the business cycle, value companies and perform relative valuation. Bhojraj et al. (2003), claims that the most common technique in equity valuation is accounting-based multiples. They are used by investment bankers and analysts when considering if stocks have a high or low price. They are also a practical technique in valuation associated with initial public offerings (IPOs), leveraged buyout transactions, seasoned equity offerings (SPOs), and merger and acquisition activities (M&A). (Bhojraj, Lee and NG 2003)

Using multiples could seem like a simplified way to value companies. Even though multiples avoid explicit forecasting of earnings and present value calculation, they rely on the same value drivers as more comprehensive valuation methods (DCF, APV etc.). Since this paper does not study forward multiples, a main difference between using multiples and for example the DCF method, is that multiples have a backward looking perspective. More comprehensive valuation methods usually estimate the equity value based on future earnings. Using historical multiples is therefore to some extent contradictive of investment theory stating that stock prices reflect expected future earnings. More comprehensive valuation methods such, requires extensive knowledge in the area and sufficient time to perform the analysis, multiples are therefore often used as a substitute. (Liu, Nissin and Thomas 2002)

Reasoning for using multiples compared to methods like discounted cash flow could be supported from the high uncertainty attached to the estimated equity value. Forward looking valuation methods requires a superior skill to predict future earnings: in essence predict the future for a company. Not much reasoning is required to understand that this is a challenge for all analysts despite superior knowledge and experience. Finn Kinserdal a lecturer from NHH told in class that "Valuation is not science, it is art". To follow up, Figure 1 shows forecast of the worlds GDP published by the Internationally Monetary Fund (IMF) on October 2008 versus their forecast in April 2009. The miss in their forecast in October 2008 is quite striking.

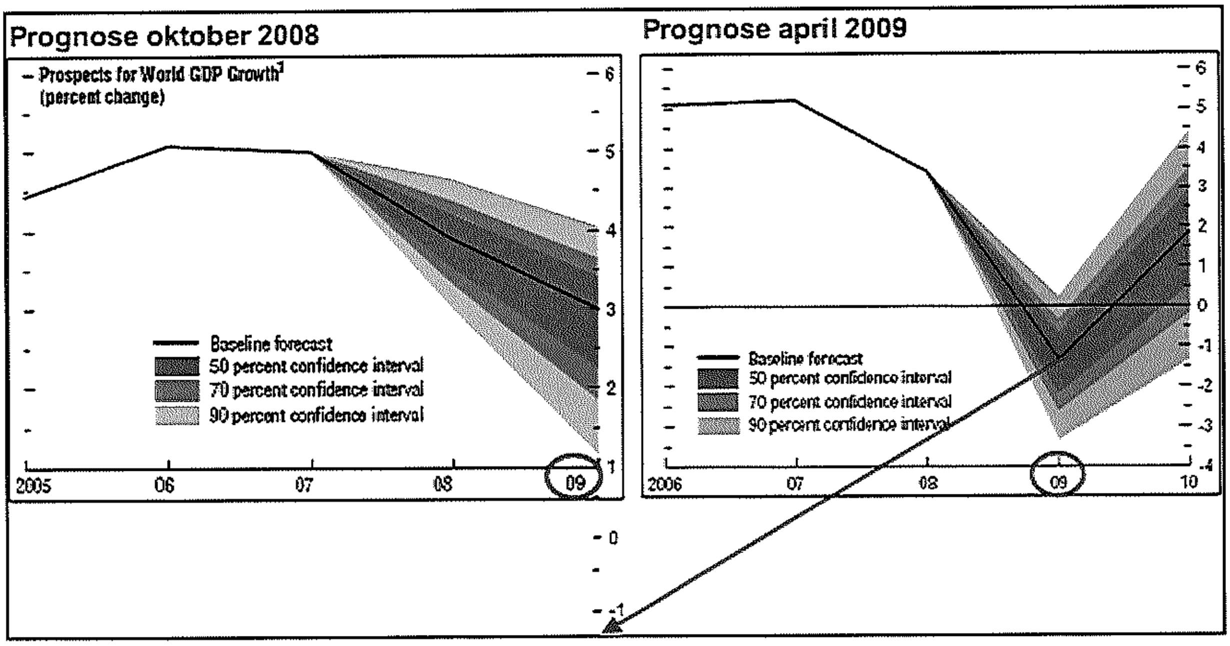


Figure 1: Source: Holbergfondene, by Slyngsladsli.

Analysts are aware of the uncertainty and it is common to analyze a wide range of possible outcomes. The question in this paper is whether one could yield abnormal return by using available historical information, and not rely on predicting the future. A statement suitable for explaining the motivation underlying the study of multiples efficiency in portfolio selection is:

"There are two kinds of economists; Those who don't know what will happen and those who don't know that they don't know." (J. K. Galbraith)

This paper by testing if multiples based on available information could yield abnormal return, mutually tests the market efficiency. If the market has high efficiency, all available information would be reflected in the stock price. The theory of mean reversion of performance and stock return supports the principal behind investing in companies with previously lower performance than average. The idea is that performance tends to revert to average over time. However, returning to market efficiency, if mean reversion exist it can be identified through analyzing trends in stock prices. Since this is available information it should have been accounted for in the stock prices. Another support for using relative valuation is consistency. Studies show that the performance of indexes outperforms analysts that perform active portfolio management.

Koller, Goedhart & Wessels (2005) states that forward looking multiples should be used since historical multiples measures past performance. The author has no objection against this statement, but has the view that performing statistical tests and measurements on the performance of forward multiples would more or less test how well the expectations regarding future earnings are, and give less information about the multiples efficiency for portfolio selection.

1.1. Research Question and hypothesizes

The research question is stated as the following:

Does a Portfolio based on Multiple Selection Strategy Yield a Higher Return-to-Risk ratio than the Benchmark Index?

This paper seeks to answer the question by analyzing the return of portfolios selected on the basis of multiple values. To obtain a grounded conclusion or recommendation regarding the use of multiple for investment purpose, the following sub-question must also be answered.

1) Which method is best to determine the industry multiple, for which to use for determining if a company has a high- or low multiple relative to its comparable companies?
2) Which of the portfolio selection strategies; investing in companies with high or low multiple values, or no use of multiples, yields the highest return?
3) Is the excess return explained by higher risk?
4) Are the differences in return and risk significant?

In general, a good investment advice is to "buy when it is cheap and sell when it is expensive". It is one of the simplest advice one can give, and also one of the most undisputable. There is however a statement that is suitable as a follow up. "When things sounds too good to be true, it often is." Most of the readers would agree that buying when it is cheap is reasonable, but the problem is not actually following that advice, but rather determining when it is cheap. Multiples are a tool, and many would say a secondary tool, to answer which companies are currently traded at a low stock price. For the purpose of clarification, relative valuation cannot determine if a company is cheap. This is only a relative measure and fundamental valuation methods must be used to determine is a stock is priced below its fair value ("cheap" stock). Multiples can however define when stocks are traded at a low price. Financial theory such as the CAPM model, states that there is a close connection between risk and return. Hence, one can only achieve higher return by accepting higher risk. This leads to the following null hypothesizes which will be analyzed in this thesis.

Hypotheses:

H_0: The portfolio returns are not significantly different.

H_1: The returns of the L portfolios are significantly higher and significantly lower for the H portfolio, compared to the benchmark portfolio.

H_0: Excess portfolio return leads to increased risk.

H_1: Excess returns do not significantly increase the portfolio risk.

These hypothesize can be written in more formal terms:

$H_o: r_{l,t} = r_{bm,t}$ $\quad$ $H_1: r_{l,t} > r_{bm,t}$

$H_o: r_{h,t} = r_{bm,t}$ $\quad$ $H_1: r_{h,t} < r_{bm,t}$

$H_o: If\ r_{l,t} > r_{bm,t}\ then\ \sigma_{l,t} > \sigma_{bm,t}$ $\quad$ $H_o: If\ r_{l,t} > r_{bm,t}\ then\ \sigma_{l,t} \leq \sigma_{bm,t}$

$H_o: If\ r_{h,t} < r_{bm,t}\ then\ \sigma_{h,t} < \sigma_{bm,t}$ $\quad$ $H_o: If\ r_{h,t} < r_{bm,t}\ then\ \sigma_{h,t} \geq \sigma_{bm,t}$

, were subscript l represent the portfolio consisting of companies with low multiple values, h with high values, and t represent the years from 2000 to 2009.

1.2 Purpose

This paper tests the efficiency and quality of using relative valuation for selecting companies. By doing a thorough analysis and cover the theoretical framework, this paper will give information about the performance of the portfolios, present a practical figure for measuring the risk vs. return relationship of the portfolios, perform a non-parametric statistical test for comparing differences in risk and return, and finally measure the portfolios performance using return-to-risk ratio methods.

The analysis will reveal to some extent the reliability of the information obtained from multiples, but more in focus is the portfolio performance when using multiples for selecting companies. The analysis and results in this paper can contribute to the individual choice of how much weight one should put on the results from relative valuation using multiples versus fundamental analysis. In the end of the paper, the author will make concluding remarks and recommendation backed by theory and empirical results.

1.3. Limitations

There are four main limitations in this paper. The first is studied companies, which are limited to companies listed in the Energy, Oil & Gas Equipment & Services index and the Marine index. The process of replicating the indexes reflects in the best way the available stocks for investors during the period in study.

The second limitation is measurements of return and standard deviation, which uses yearly data from the period March 31, 2000 to March 31, 2009. This results in nine measurements of yearly returns and is few measurements for performing significance tests. In addition, calculation the companies or portfolios beta value will require more measurements and is therefore not performed in this paper.

The third limitation is the quality of the multiples. Valuation literature states that the multiples should be estimated based on normalized numbers, which excludes non-operating income, costs, gains and losses (Koller, Goedhart and Wessels 2005). The process of normalizing the numbers is highly dependent on the investors and will therefore reduce the possibility to generalize the results. The income and balance sheet numbers used in this thesis is therefore not normalized.

2. Literature review

The success of quantitative portfolio strategies has strong support from various research papers. Early research have found evidence of overreaction in the stock market, were companies with poor prior return ("losers") gives excess return than companies with prior good performance ("winners") (De Bondt and Thaler 1984).

Jegadesh and Titman (1993) found that companies with high return over the previous three months to one year, continues to perform better than those with previous low return. These findings were not due to an increase in systematic risk. (Jegadeesh and Titman 1993)

Rouwenhorst (1997) found similar results that an international diversified portfolio of past winners outperformed, by about 1 percent per month, the portfolio with past losers. The outperformance lasted for about one year and could not be explained by higher risk. (Rouwenhorst 1996)

Fama and French (1992, 1996) and Lakonisshok, Shleifer, and Vishny (1994) found a strong value premium in average return for so called value stocks. Ratios or multiples used in their study were B/M, E/P, and C/P, were companies with high ratios[1] is defined as value stocks. In a later study by Fama and French (1998), their findings supported excess return of value stocks versus growth stock (low ratios) around the world. They also claim that an international CAPM cannot explain the value premium for which you also have to include a factor for relative distress. (Fama and French 1998)

[1] Rama and French (1992, 1996) formulates the ratios differently by using for example E/P instead of P/E. Therefore high ratios for the E/P multiple equals a low ratio when using the P/E multiple.

Arshanapalli et al. (1998) found superior performance for portfolios with a long position in value stocks (high book-to-market) and short position in growth stocks (low book-to-market). They also found that value stock had a higher risk-adjusted performance than growth stocks. (Arshanapalli, Coggin and Doukas 1998)

Kim and Ritter (1999) studied valuation of IPOs using multiples. They conclude that multiples, when historical numbers are used, have only modest predictive ability. When forward earning were used in the P/E multiple, the accuracy improved substantially. The multiples studied are the P/E, PB, P/Sales, EV/Sales, and EV/Operating cash flow.
(Kim and Jay 1999)

Van der Hart et al. (2003) studied the profitability of a broad range of stock selection strategies in 32 emerging markets. They found significant excess return for value, momentum and earnings strategies. They analyzed both univariate and multivariate strategies, and conclude that the performance of univariate strategies can be increased by using multivariate strategies. They studied only two valuation multiples, but found that stocks with high E/P and B/M (low P/E and P/B) outperforms those with low E/P and B/M (high P/E and P/B). In addition, their study found no evidence of short or long term mean reversion. (van der Hart, Slagter and van Dijk 2002)

Balzer (2000) introduces a graph for comparing portfolio performance using relative return and risk measurements. The graph shows the dynamic performance over time relative to a benchmark. The power of this method stems from the ability to capture and display a portfolios performance over time, and remove the market effect to highlight the portfolio or managers efficiency in increasing return and reducing risk. (Balzer 2000)

Baker and Ruback (1999) studies the efficiency of different methods for estimating the industry multiple. Their studies find that harmonic mean is both a practical and well performing method.

Median has reasonable performance, but falls short of harmonic mean. (Baker and Ruback 1999)

Alford (1992) studies the selection criteria's for comparable firms. The study shows that selecting comparable firms by industry is relative effective when the industries is defined by three SIC digits. He implies that industry could be effective in controlling for differences in risk and earnings growth. The results show no supports for controlling for leverage. (Alford 1992)

There exists wide research on the efficiency of multiples and relative valuation. Most studies have however limitation by not considering important principles in relative valuation. The main contribution of this thesis is:

1) Exclusion of survivorship bias,
2) using comparable firms for selecting the portfolios,
3) analyzing the portfolio performance with different selection criteria's, and
4) use the non-parametric Wilcoxon Signed Rank test, not dependent on normal distribution of stock returns, for significance test of return and risk differences.
5) Applying the adjusted for skew Sharpe ratio when ranking the portfolios.

The rest of the thesis shall proceed as follows: Section 2 explains the data collection process and portfolio composition, section 3 covers the theoretical fundament for the thesis, section 4 analyses and compare the performance of the portfolios, section 5 will discuss the findings, and section 6 consists of concluding remarks.

3. Data

In this section, the research methods, data collection and the techniques for portfolio composition are presented.

3.1. Research Method

The paper mainly uses a quantitative research approach with focus on testing and verification. Return and risk measures are calculated for the portfolios created with different criteria's for selecting stocks. Differences in return and risk are analyzed to see if grounded conclusions can be drawn. The concluding remarks will be based on empirical evidence, observations, and valuation theory.

3.2. Data Collection

The paper relies on secondary data from Datastream which is viewed as a reliable source. Secondary data was used because of its availability and to obtain transferable results to practice, which is of high importance when testing investment strategies. Company's income statements, share prices, market values and dividend reports are therefore from Datastream.

A quality check was performed on the dataset from Datastream by comparing the data with the released annual reports on randomly selected companies. No mismatch was found and the numbers are therefore assumed to be correct.

Oslo stock exchange provided an Excel file with companies included in the two indexes over the years 1999-2009. The reason for retrieving the list was to replicate the index over the years in study and avoid 'survivorship' bias in the dataset. 'Survivorship' bias is avoided by including the companies that went bankrupt or got delisted during the period. Gøran Næss (personal communication, April 29. 2009) from Oslo stock exchange notified over mail that companies at Oslo stock exchange are assigned to the index after the Global Industry Classification Standard (GICS). The four levels are sector, industry group, industries and sub-sectors (MSCI-Barra 2009).

The thesis studies two four level indexes viewed in Table 1. In the first index a four level index separate between Oil & Gas Drilling and Oil & Gas Equipment & Services. In the second index it separate between Marine and Airlines. Both exclusions are seen reasonable to obtain highly comparable companies. The Oil & Gas Equipment & Services index includes "manufacturers of equipment, including drilling rigs and equipment, and providers of supplies and services to companies involved in the drilling, evaluation and completion of oil and gas wells", while the Marine index includes "companies providing goods or passenger maritime transportation. Excludes cruise-ships classified in the Hotels, Resorts & Cruise Lines Sub-Industry". (MSCI-Barra 2009)

Sector	Industry group	Industry	Sub-sector
10101020 Energy	Energy	Energy Equipment & Services	Oil & Gas Equipment & Services
20303010 Industrials	Transportation	Marine	Marine

Table 2: Classification of the two the Marine- and Energy index.

The criteria used in this thesis for companies to be included in the portfolio selection, is being listed in the index on March 31, in the period from 2000 to 2008. The total dataset consists of 84 companies, 39 are in the Energy, Oil & Gas Equipment & Services Index and 45 - in the Marine Index. The number of companies in each index is varying each year, since some companies have been delisted and new companies are listed in the index. The lowest number of available companies for portfolio creation in the Energy Index was 7 companies (P/E portfolios in 1999), while the lowest number in the Marine Index was 16 (P/E portfolios in 2000).

This paper calculated multiples based on the company's market value and enterprise value on March 31, and divide it by the relevant account statistic from the income statement or balance sheet the previous year. To give an example, the EV/EBIT multiple on 31 of March 2008 for a company is calculated using the enterprise value at March 31, 2008 divided by EBIT from the income statement for 2007 collected from Datastream. The date 31, March was selected on the basis of that most annual reports are released and the annual reports are then available information.

When data needed to calculate the multiple were unavailable, the relevant multiple were treated as missing value. Therefore not all companies listed in the index in the period were assigned to portfolios. This is however not viewed as critical for the results in the analysis.

3.3. Portfolio Composition

The first portfolios are created in March 31, 2000 and the last at March 31, 2008. Each year the portfolios are rebalanced on March 31. The companies' performance is measured by the stock returns adjusted for dividends[2] and capital actions from March 31, in year t to March 31, in year t plus one. The performance of the portfolios is measured by the average return of the companies' included. Thereby assuming exactly equal amount invested in each stock in the portfolio.

The analysis of portfolio return does not consider transaction costs or taxes. Taxes are assumed to have no effect, but transaction costs will have marginal effect on the portfolio return. Transaction costs are hard to estimate, since it does not only involve the brokerage commission. Damodaran (2005) identifies three factors that also affects the transactions costs/trading costs. The first is the spread – difference between the price you can buy an asset (ask price) and the price you can sell an asset (bid price). A second is the price impact the investor can have by pushing the price down when selling. The third not relevant here, is the opportunity cost characterized as the lost of profit from a trade that would have been profitable if done instantaneously. (Damodaran 2005)

The stock's standard deviations for each year are calculated using daily stock prices from 31, March in year t to March 31, in year t plus one. The daily standard deviation is the annualized by multiplying it with the rout of measurements each year[3] (Bodie, Kane and Mercus 2008).

[2] Stock prices collected from Datastream (P default) is adjusted for capital actions. The following formula was used to include dividends in the yearly return calculations. $r_i = \left[\frac{P_t + Div_t}{P_{t-1}} - 1\right] * 100\%$

[3] $\sigma_{yearly} = \sigma_{daily} * \sqrt{d}$, were trading days (d) per year are about 260.

The analysis of risk is based on the average standard deviation of the companies with low and high multiple values. This choice was made to identify the total risk by investing in companies with low and high multiple vales versus the passive strategy by holding the index. The portfolios created should therefore be interpreted as the aggregated return and risk measurements of the L, H and BM group. Excluding covariance is controversial, but is done to obtain a better analysis of the riskiness of companies' with low- and high multiple values. It also improves the comparison with the BM portfolio, since this portfolio have in average twice the number of companies as the L and H portfolio. The diversification effect through the companies' covariance would therefore be larger and hence the risk lower because of more companies in the portfolio, and not because of the characteristics of the companies.

The paper analyze the portfolios performance using both median and harmonic average to determine the industry average multiple. To further extend the analysis, a market value criteria and multiple band is connected to the calculations. A multiple band is a percent added and subtracted from the industry multiple to widen the criteria for being viewed as a high or low priced company. If the multiple 'band' is 15 percent and the industry multiple is 10, the industry multiple would be in the area 8.5-11.5. This could be a reasonable tool to adjust for a non-perfect accuracy of the multiples in relative valuation. The analysis uses a 15% and 30% multiple band.

The paper creates four portfolios for each of the six multiples:

1) 'Multiple value' > Industry multiple: Consists of companies with high multiple values and therefore assumed to have a high stock priced relative to comparables.
2) 'Multiple value' < Industry multiple: Consists of companies with low multiple values and therefore assumed to have a low stock price relative to comparables.
3) 'Multiple value' = Industry multiple: With median measure for industry multiple and odd numbers of companies, one company will reflect the industry multiple. No companies will be in this portfolio when harmonic average is used (most likely). When the multiple

'band' is used, the number of companies in this group will increase. The creation of this portfolio is mostly used to control for bias in the formulas.

4) Benchmark portfolio (BM): Consists of all companies available for each multiple. Numbers of companies in this portfolio is the sum of companies included in the above mentioned portfolios. The BM portfolio is used to compare portfolio performance.

To shorten the names of each portfolio, the portfolios based on high priced companies is referred to as the H portfolio and low priced the L portfolio. The portfolio consisting of companies with industry multiple is referred to as the M portfolio, while the benchmark portfolio is referred to as BM portfolio.

4. Theoretical Framework

The theoretical framework will review the relevant background theory for the thesis.

4.1. The Efficient Market Hypothesis

The efficient market hypothesis (EMH) is the idea that stock prices already reflect all available information (Bodie, Kane and Mercus 2008). Investors can therefore not consistently outperform the stock market. Studies testing the success of quantitative portfolio strategies in stock selection, are questioning the strength of market efficiency.

Theory distinguishes between three forms of market efficiency that differ in the level of information already included in the stock prices. The first is the weak-form hypothesis were the stock prices reflects all information retrieved from market trading data which involves the history of past prices, trading volume, or short interests. Signals or trends in these data would then already been included in the price. (Bodie, Kane and Mercus 2008) In this form, technical analysis would not be profitable.

The semistrong-form states that stock prices include all public information regarding the future outlook for a company. In addition to past prices, this includes fundamental data about a companies' product line, the quality of the management, balance sheet, patents, earnings forecast and accounting practices. (Bodie, Kane and Mercus 2008) With a semistrong-form, neither technical nor fundamental analysis of public information would yield consistently abnormal return.

The strong-form is quite extreme and stock prices would here reflect all information relevant to the firm, including information available only to insiders. (Bodie et al. 2008) In this form, active trading would not be profitable even with insider information. It serves mostly as a benchmark to highlight the importance of deviation from an efficient market with strong form (Fama and Fama 1970). Security and Exchange Commission follow the trading activities and tries to prevent illegal insider trading (Bodie, Kane and Mercus 2008).

4.2. Portfolio Management

Portfolio management is based on two main approaches: active and passive. Active portfolio managers try to arbitrage from mispricing in the market by buying (selling) stocks that are priced below (above) their intrinsic value. Active investors take a long or short position in stocks with the intention of obtaining higher return that the market. On the contrary, passive investment strategy tries to follow the market, not outperform it. These investors create a portfolio designed to reflect the index, or buys an index they believe broadly represents the market, for example the S&P 500. (O'Shaughnessy 2005)

The two strategies, passive and active, differ in their view of the degree of market efficiency. Active portfolio managers would argue for either a non efficient market or a weak form of market efficiency, dependent of their use of either technical or fundamental analysis. Passive portfolio managers suggest the market efficiency to be semistrong. No abnormal return can then be obtained without luck.

What is the best strategy is highly debated, but the majority of investment funds use an active investment strategy. O'Shaughnessy (2005) states that "S&P 500 consistently beats 80 % of traditionally managed funds over the long-term by doing nothing more than making a disciplined bet on large capitalization stocks" (p. 5). This is explained by that portfolio managers lack the discipline to maintain the investment strategy, and therefore loose consistency which is critical for long-term performance (O'Shaughnessy 2005).

Data from Norwegian funds shows better results. When the index has a return above zero, the investment funds obtained 4.24 % in average excess return from active portfolio management. When the index had negative return, investment funds had an average negative excess return of -1.24 %. (Slyngstadsli 2009)

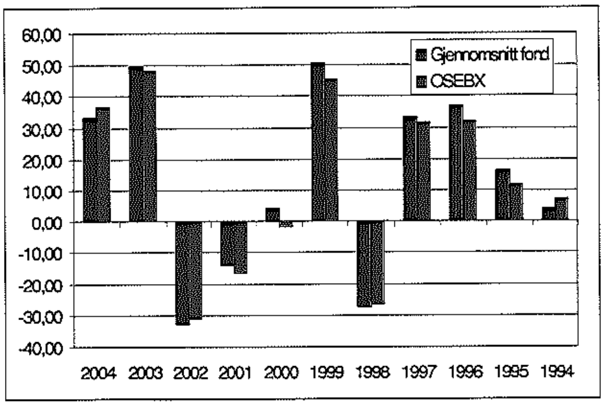


Figure 2: Performance of 80 Norwegian funds versus OSEBX.

Source: Holbergfondene, by Slyngstadsli.

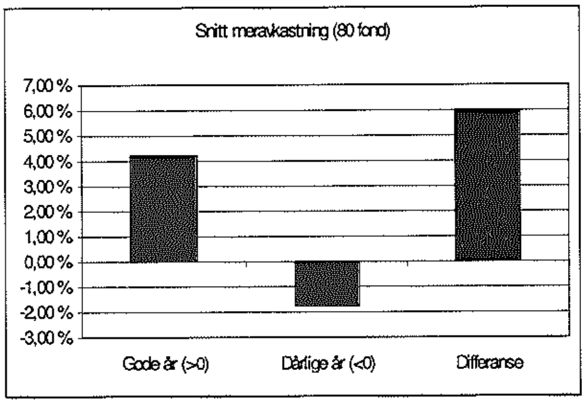


Figure 3: Average excess return for funds versus OSEBX.

Source: Holbergfondene, by Slyngsladsli.

O'Shaughnessy (2005) claims that consistency is the key. "Finding exploitable investment opportunities do not mean it's easy to make money, however. To do so requires the ability to consistently, patiently, and slavishly stick with a strategy, even when it's performing poorly relative to other methods" (p. 4) A simple and well known investment strategy is "The Dow of the Dow". The strategy starts with the 30 internationally famous Blue Chip stocks (Dow Jones Industrial Average), and buys each year the 10 companies with the highest dividend yield. This strategy has consistently beaten the S&P500 in six rolling 10-year periods from 1930-2000, except in the 1990s and 2000-2003, S&P500 obtained higher return. (O'Shaughnessy 2005)

Success of quantitative portfolio strategies, such as relative valuation using multiples based on historical accounting numbers, would imply that the market is not efficient. One characteristic frequently studied is mean reversion in performance and stock prices. Mean reversion is relevant for market efficiency and investment strategies. The question many studies seek to answer is whether such trends exist, and whether they are included in the expectations of future stock prices?

4.3. Mean Reversion

Mean reversion is the process were large deviation tends to mean revert back towards the average. If mean reversion exists, investors could use this as an investment strategy by taking a short position in high performing companies' and long position in poor performing companies'. On the contrary if the returns show a random walk, this would not be possible. Random walk implies that any shocks on share prices are permanent. This means that there is no reason for returning to a trend path over time. (Chaudhuri 2004)

There are many studies that documents mean reversion in stock prices. Fama & French (1988) found mean reversion in the U.S. equity market using long-horizon regression. Poterba and Summers (1988) found evidence for mean reversion using variance ratio test. Richards (1997) finds support for long term reversal of the performance for winner and looser equity indexes for sixteen countries. Balvers, Wu and Gilliland (2000) studied mean reversion across eighteen developed equity markets and found significant evidence of mean reversion. They suggested that mean reversion can be used as investment strategy. Chaudhuri (2004) rejected the null hypothesis of random walk in favor for of mean reversion for seventeen emerging stock index prices at a five percent significance level. (Chaudhuri 2004)

On the other side, there are studies supporting the non existence of mean reversion. Lo and MacKinley (1988) found some evidence against mean reversion in weakly U.S. data. Kim, Nelson and Starz (1991) suggest that mean reversion only exists in the pre-war period. Richard and Stock (1989) and Richardson (1993) have arguments for that the analysis done by Fama and French (1988) and Poterba and Summers (1988) are "not robust because of small-sample-biases". (Chaudhuri 2004, p. 2)

Companies' such as Coca Cola and Wal-Mart seems to be able to maintain abnormal return over time. Explanations for this could be their brand name and/or their organizational structure, which competitors have a hard time to copy. Buus (2008) states that some companies could maintain abnormal return and profit over a long time, while others get financial problems or go bankrupt. Long term under- and over performance of companies based on different factors like "anomalies (David and French 2000), quality management systems (Hendricks and Singhal 2001) or (Powel 1995), is rather rare phenomenon" (p. 3). Based on the literature on mean reversion, abnormal profits are in most cases not sustainable over time. (Buus 2008)

There are different reasons for why mean reversion can occur. Poor performing companies can become better through new management, restructuring of operations or just the fact that they try harder to reach their target. Companies performing good will have restrains on how well they can perform, and another problem is copying and attacks of the market leader. Companies can in some cases adapt to their operations or copy their products. (Kinserdal 2009)

Successful businesses also generate excess cash. Cash reinvested through buying companies or investing in new branches, could turn out to be unprofitable diversification. In addition being number one can result in a "Fat and lazy" management. Not giving the same effort as before. (Kinserdal 2009)

The mean reversion process could also be industry-specific, company-specific and involve situations when companies' challenge each other. If an industry is highly profitable, new companies' will be established which increase competition. Also customers and suppliers could increase the pressure putting the companies' margins at stake. (Kinserdal 2009)

Company-specific mean reversion is reasonable in situation where a company has a patent that will expire. Authorities could also affect companies' margins by removing the market dominance to for example increase competition and support the buildup of new companies'. It is also worth mentioning that a high performance in the past could have been pure luck. (Kinserdal 2009)
Companies' can challenge each other through product price reduction, product innovation, lower production costs, imitation of successful firms and as mentioned new entering in industries with abnormal returns. These factors could lead to a mean reversion in companies' stock price and margins. (Kinserdal 2009)

Research performed by MSCI and Alliance Capital show that by investing in growth (red line); you are working against reversion while by investing in value (blue line) you are working with reversion. (Slyngstadsli 2009)

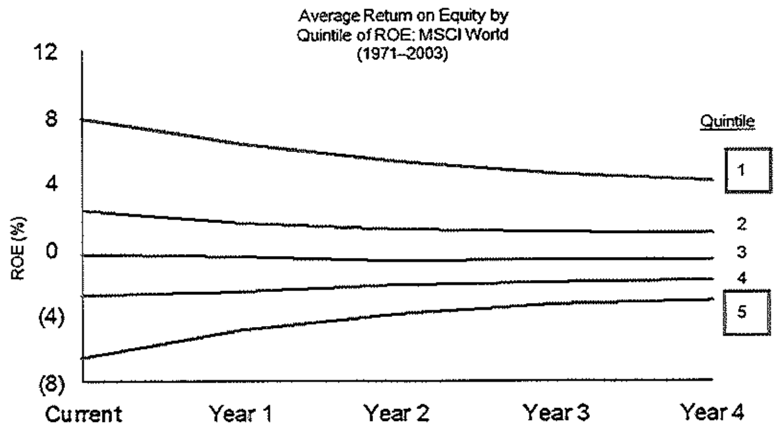


Figure 4: The MSCI World is a monthly average of the largest stocks by capitalization from Morgan Stanley's world stock database and is comprised of more than 600 developed-market large-cap stocks divided into quintiles of ROE at the beginning of each year, and is comprised of more than 600 developed-market large-cap stocks divided into quintiles of ROE at the beginning of each year, and those same constituents were tracked over the next five years. This process was performed for each starting year from 1971 through 1999, and 29 sets of results for each quintile over five years were averaged together. Source: CRSP, Compustat, MSCI and Alliance Capital.

Research also shows that high growth is not sustainable over time and the results viewed in Figure 5 shows that one company maintained a 10 % growth over 13 years and two companies maintained a 25 % growth rate over 8 years (zero over 9 years).

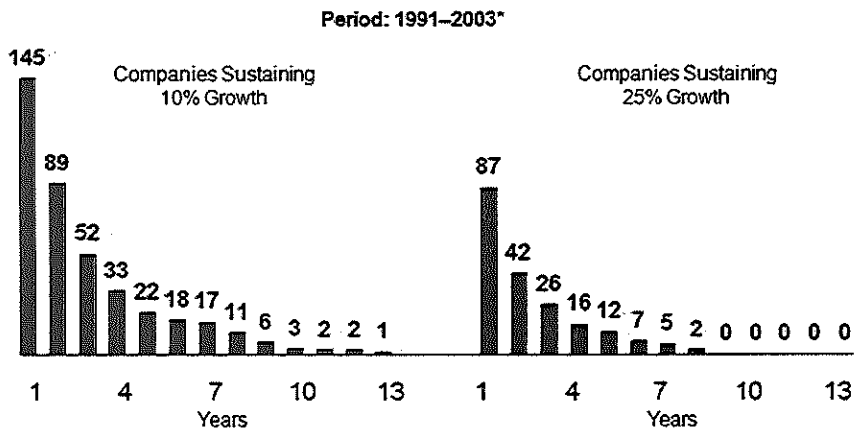


Figure 5: As of 31 Dec 2003. Past performance does not guarantee future results. Source: Holbergfondene, by Slyngsladsli.

What about mean reversion in market value? The market value of companies does not reflect their true performance, but rather investors' expectations of future performance. If investors take mean reversion into account in their valuation. If they believe that performance of companies' converge to the industry average. Then companies' with above average present performance would have a below industry average value on for example the price-to-earnings multiple. This opinion of mean reversion in both valuation multiples and profitability ratios are supported by recent findings (Pàstor and Veronesi, 2003), (Chung and Kim, 2002) and older studies (Fama, 1997). (Buus 2008)

Mean reversion has been known for decades, and is also in general accepted as a process that can occur in the stock market. Thomas Buus (2008) found in his study that investors do not take mean reversion into account in their valuations. In other words, their expectations for future performance do not consider the mean reversion process. This would imply overvaluation of companies' that have performed well and undervaluation for those that have performed poorly. (Buus 2008)

Mean reversion is an important success factor for relative valuation when using backward-looking multiples. Valuation multiples identifies low priced companies, without applying future expectations. A low relative price can be explained by poor performance and low expectations of future performance. The price would therefore likely increase by a mean reverted company performance.

4.4. Valuation theory

The two main equity valuation methods are technical analysis and fundamental analysis. Bodie et al. (2008) states that technical analysis "search for recurrent and predictable patterns in stock prices" (p. 361). The success of technical analysis is based on sluggish response of stock prices to fundamental factors affecting supply-and-demand. By identifying trends in the sluggish adjustment period one could after the theory arbitrage from the price movements. Such price patterns seems however to be self destructing. Once a reasonable rule or price pattern is uncovered, the mass of traders would exploit it. The power of demand-and-supply would then lead to elimination of the arbitrage associated with the rule or pattern. (Bodie et al. 2008)

Fundamental analysis has the base in a company's earnings and dividend prospects, expectations of future interest, risk evaluation of the company's earnings, and industry risk evaluation. The market consist of many well informed investors, and return above the index can then only be achieved by either being more informed than the rest of the investors or achieve abnormal return due to luck. Fundamental analysis needs not to identify companies with good prospect not accounted for in the stock price. To make money, your analysis must be better than your competitors. (Bodie et al. 2008)

4.5. Valuation methods

There are three main approaches for estimating shareholder value in the valuation literature. The first is direct valuation were the stock value is estimated by the expected future cash flow. Examples of direct valuation methods are the dividend discount model (DDM), the residual income model (RIM), liquidation value, the discounted cash flow model (DCF), the adjusted present value (APV) and more. (Bhojraj and Lee 2001)

DCF and APV are commonly used by investment bankers. The DCF calculates the present value of free cash flow, subtract the company' dept obligations and divide the value of total shares. The APV method calculates the present value of free cash flow to equity, add the tax savings from debt obligations and divide the value of total shares. (Bhojraj and Lee 2001)

Another approach is contingent claim valuation, based on option pricing theory. It is a method for valuing traded assets with finite lives. Bhojrai and Lee (2001) states that "this approach encounters significant measurement problems when applied to equity securities" (p. 414). (Bhojraj and Lee 2001)

The third one is relative valuation and explained in the next section.

4.6. Relative Valuation

Relative valuation uses the pricing of comparable assets to value of a company. The approach applies accounting-based market multiples to retrieve a relative or definite value estimate. The multiple ratios can be backward looking (based on actual earnings) or forward looking (based on expected earnings). The underlying assumption for the method is that the company you are valuing, "deserves" the industry multiple value calculated from a group of comparable companies'. (Bhojraj and Lee 2001)

The stand alone value of a multiple does not give much information. The multiple ratios must be placed in a context to give meaningful information. Fernandez (2002) mentions three relative valuations:

1) Compared to the company's own history
2) Compared to the market
3) Compared to the industry

(Fernandez 2002)

<u>Compared to the company's own history</u>

History-referenced multiple= current multiple value / mean multiple of recent years' multiple

Here you can analyze the development of the companies multiple, if it has improved or not. One problem with this is the exogenous factors that will affect a company's performance. Possible exogenous factors are interests, market return, oil price etc. (Fernandez 2002)

<u>Compared to the market</u>

Market-referenced multiple = firm multiple/market multiple

The market multiple, average of all companies or the biggest companies, is mostly used as information to indicate were the economy is on the business cycle. The market is little comparable for most individual companies, but multiples used for this purpose is price-to-earnings and price-to-book value multiple.

Compared to the industry

Industry-referenced multiple = firm multiple/industry multiple

This comparison is more appropriate than the two above. It compares the firms multiple with the mean multiple value of comparable companies. However, when the general industry is overvalued, most companies in it are also overvalued. One example is the internet bubble up to 2000. (Fernandez 2002)

Relative valuation is in fact subject to error when the economy is in the top of a business cycle. The recent subprime crisis changed the fundamental balance between demand and supply, leading to overvaluation of all companies. Relative valuation has a weakness in that it identifies low priced companies and not necessarily cheap companies, which more fundamental methods can uncover.

Relative valuation is illustrated in Figure 6 when using median to identify the industry multiple represented by the solid line. The upper and lower line, represent a multiple 'band'. This is used to adjust for the inaccuracy of multiples. In the example, a 15% multiple band is used. The main idea is that companies' with a multiple ratio above (below) the line is priced high (priced low). In the illustration the five companies to the right would be buy candidates, while the six to the left would be sell candidates[4].

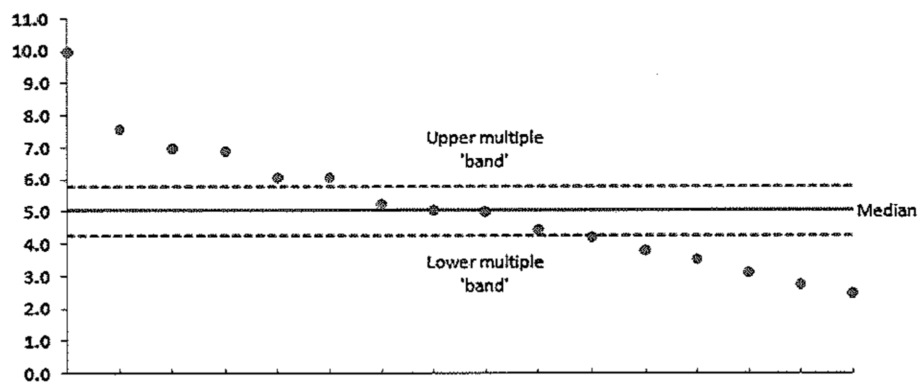


Figure 6: Illustration of relative valuation using the P/E multiple in the dataset. Source: Compiled by the author

[4] There is a large risk difference between selling a stock you currently own, and going short in a stock you do not own. When companies are classified as sell candidates, the author refers to selling currently owned stocks.

4.7. Valuation Multiples

"The efficacy of multiple-based techniques will depend on:

(1) the choice of the accounting variable, and (2) the judicious selection of comparable firms."

(Bhojraj, Lee and NG 2003, p. 2)

Valuation multiples is a ratio between the market value relative to an important statistic for the value. Suozzo et al. states that the statistic "must bear a logical relationship to the market value observed; to be seen, in fact, as the driver of that market value" (p. 3). Choosing the multiple used for relative valuation is a matter of individual judgment and common sense. There is a trade-off between the cost and time involved in adjusting the multiples and comparability. (Souzzo, et al. 2001)

Multiples bypass explicitly projections and calculations of present value. However, they rely on the same principles as other more advanced valuation methods. A company's value has a positive relationship with future payoff and negative relationship with risk. (Liu, Nissin and Thomas 2002)

To uncover the underlying value drivers for each multiple, the multiples used in this thesis are derived from a one period[5] discounted cash flow formula in the next section.

4.7.1. Multiples versus the FCF model

The multiples are connected to the discounted cash flow model using the calculations by Souzzo et al. (2001). They start with a standard DCF model and for simplicity assume a constant growth rate in free cash flow (FCF) of g% into perpetuity (Souzzo, et al. 2001).

The enterprise value (EV) of a perpetuity free cash flow (FCF) with the growth rate g, and discounted by the company's weighted average cost of capital (WACC) equals:

[5] It can also be derived from a two period DCF by separating the value into the growth face and terminal value. These calculations can be found in the report by Suozzo et al. (2001).

$$EV = \frac{FCF_1}{(WACC-g)} = \frac{NOPLAT_1 + D - \Delta WC - CAPEX}{(WACC-g)} \tag{1}$$

, were NOPLAT = net operating profit less adjusted taxes, D = depreciation, ΔWC = change in working capital and CAPEX= capital expenditure.

First the link between NOPLAT, FCF and the reinvestment rate (r) is defined. The reinvestment rate is percent of NOPLAT reinvested into the business and can be calculated by:

$$\mathrm{r} = \frac{NOPLAT_1}{(\Delta WC + CAPEX) - \mathrm{D}} \tag{2}$$

The free cash flow can then be formulated by:

$$FCF = NOPLAT * (1 - r) \tag{3}$$

The link between growth (g), post-tax return on invested capital (ROIC) and reinvestment rate (r) is:

$$g = ROIC * r \text{ or } \qquad r = g/ROIC \tag{4}$$

Equation 1 can be rewritten by substituting FCF using equation 2 and 3, and r using equation 4. The equation to the right is simplified by multiplying the nominator and denominator with ROIC:

$$EV = \frac{NOPLAT_1 * \left(1 - \frac{g}{ROIC}\right)}{(WACC-g)} = \frac{NOPLAT_1 * (ROIC-g)}{ROIC * (WACC-g)} \tag{5}$$

Equation 4 will result in error when g = WACC and give a negative value when g > WACC. Therefore the equation is only suitable for situation where g < WACC.

With the assumptions of a constant corporate tax of T%, depreciation as a percentage of EBITDA of D%, and EBIT margin of M%, we can formulate the following relations:

Sales * M = EBIT	Sales * M * (1-T) = NOPLAT
EBIT * (1-T) = NOPLAT[6]	EBITDA * (1-D) * (1-T) = NOPLAT
EBITDA * (1-D) = EBIT	

[6] NOPLAT is a normalized statistic, were only profit and loss from continuing operations with exceptions of 'one-time losses are included. EBIT after tax (or the other statistics) has not been normalized in this thesis and but the relation serves to establish the connection between the multiple and the FCF model.

The enterprise-to-sales multiple can then be formulated as:

$$EV = \frac{Sales * M * (1-T) * (ROIC-g)}{ROIC * (WACC-g)} \rightarrow \frac{EV}{Sales} = \frac{(ROIC-g)}{ROIC * (WACC-g)} * M * (1-T) \quad (6)$$

The enterprise-to-EBITDA can be formulated as:

$$EV = \frac{EBITDA * (1-D) * (1-T) * (ROIC-g)}{ROIC * (WACC-g)} \rightarrow \frac{EV}{EBITDA} = \frac{(ROIC-g)}{ROIC * (WACC-g)} * (1-D) * (1-T) \quad (7)$$

The enterprise-to-EBIT can be formulated as:

$$EV = \frac{EBIT * (1-T) * (ROIC-g)}{ROIC * (WACC-g)} \rightarrow \frac{EV}{EBIT} = \frac{(ROIC-g)}{ROIC * (WACC-g)} * (1-T) \quad (8)$$

To further analyze the factors affecting the enterprise multiple, the formula for the weighted average cost of capital can be viewed.

$$WACC = \frac{E}{EV} * COE + \frac{D}{EV} * r_d * (1-T) \quad (9)$$

, were the cost of equity (COE) after CAPM is:

$$COE = r_f + \beta_i(r_m - r_f) \quad (10)$$

Common for all enterprise multiples is that they are affected by the return on invested capital, the growth rate, taxes and weighted average cost of capital. Implicitly through WACC, they are affected by the cost of equity and hereby the risk-free interest rate, market premium (r_m-r_f) and the company's equity beta. In addition they are affected by the cost of debt and the capital structure. Even though the statistics used for enterprise value multiples is unaffected by capital structure, one can see that the multiples are not completely unaffected by it, because of the indirect effect through WACC.

Similar equation can also be applied to equity multiples, by substituting FCF with FCF to equity, and using earnings instead of NOPLAT, ROE instead of ROIC, and COE instead of WACC. (Souzzo, et al. 2001)

$$P = \frac{FCF\ to\ equity_1}{(COE-g)} = \frac{Earnings_1 * (ROE-g)}{ROE * (COE-g)} \quad (11)$$

To define the equity multiples, we first defines the following relations.

$$ROE = \frac{Earnings_1}{Book\ value_0} \rightarrow Earnings_1 = Book\ value_0 * ROE$$

The relation is similar for book value excluding intangible assets except ROE is calculated without intangible assets.

The price-to-earnings multiple can be formulated as:

$$P = \frac{Earnings_1 * (ROE - g)}{ROE * (COE - g)} \rightarrow \frac{P}{Earnings_1} = \frac{(ROE - g)}{ROE * (COE - g)} \quad (12)$$

The price-to-book value multiple can be formulated as:

$$P = \frac{Book\ value_0 * (ROE - g)}{(COE - g)} \rightarrow \frac{P}{Book\ value_0} = \frac{(ROE - g)}{(COE - g)} \quad (13)$$

The price-to-tangible book value multiple can be formulated as:

$$P = \frac{Tangible\ book\ value_0 * (ROE_{tangible} - g)}{(COE - g)} \rightarrow \frac{P}{Tangible\ book\ value_0} = \frac{(ROE_{tangible} - g)}{(COE - g)} \quad (14)$$

Common for all equity multiples is that they are affected by the return on equity, the growth rate and cost of equity. Implicitly through COE, they are affected by the risk free interest rate, market premium (r_m-r_f) and the company's equity beta. Since the equity beta is affected by the company capital structure, all equity multiples will implicitly be affected by that through the discount rate.

Few people use the one period model in practice, but it is simplistic and suitable to identify the important factors for value creation. A company's value and the multiple value is dependent on the return on capital (ROIC or ROE), the growth rate and the cost of capital (WACC or COE). Critical for profitable growth is higher return from operation than cost of capital. If the cost of capital is higher, the growth signals the rate of value destruction.

4.7.2. The choice of the accounting variable

From the derivation of the multiples, one can see that there are two main types of multiples: those based on enterprise value and those based on the equity value. Enterprise value is the value of all claims[7] on the business, and represents the cost of buying a right to the whole enterprise cash flow. Equity value is the shareholders' claims on the company's assets and cash flows. Enterprise multiples must therefore use statistic related to the entire enterprise, while equity multiples use statistic relates only to shareholders. (Souzzo, et al. 2001)

4.7.2.1. Enterprise Multiples

The enterprise multiples discussed below is EV-to-Sales, EV-to-EBITDA and EV-to-EBIT.

Enterprise-to-Sales multiple

The enterprise-to-sales multiple is defined as:

$$EV = \frac{EV}{Sales} = \frac{(ROIC-g)}{ROIC*(WACC-g)} * M * (1-T)$$

Sales as a value driver has lower theoretical basis, relative to the other multiples. This multiple is more commonly used for emerging industries, cyclical- and start-up companies were earnings and cash flow gives little information, and could be negative. (Liu, Nissin and Thomas 2002) and (Souzzo, et al. 2001)

The companies' margins are important success factor for this multiple. Large differences in margins reduce the quality of the multiple for relative valuation. (Souzzo, et al. 2001)

An advantage with the multiple is that is least affected by accounting differences and sales is more stable than the other statistics. This statistic should generally not be used for companies with variable, periodic sales. Example of such companies is property developers. It is often used for technology firms, which are likely to have negative earnings in the growth face. However,

[7] Theoretical one should separate between core value and non-core value. Similar, to be consistent, the statistic should be adjusted for non-core assets and normalized to be representative for future operations. This thesis has chosen quantity in companies and multiples over quality in comparison. These adjustments will therefore not be explained, but for special interested the report "Valuation Multiples: A Primer" by Souzzo et al. (2001) is recommended.

these companies have often very volatile sales, which make the multiple less comparative. (Souzzo, et al. 2001)

Even though sales are least affected by accounting policy, the statistic is affected by revenue recognition policies. Therefore the different interpretations of accounting standard in areas such as completed contract method, treatment of sales to customers with the right of return, etc. (Souzzo, et al. 2001)

Enterprise-to-EBITDA multiple

The enterprise value-to-EBITDA multiple is defined as:

$$\frac{EV}{EBITDA} = \frac{(ROIC-g)}{ROIC*(WACC-g)} * (1-D) * (1-T)$$

EBITDA is earnings before interest, taxes depreciation and amortization. There is a close connection between EBITDA and free cash flow, which can be seen from the calculation below:

$$FCF = EBITDA - \text{“Cash” taxes on } EBIT - \Delta WC - CAPEX \qquad (15)$$

(Koller, Goedhart and Wessels 2005)

This multiple is one of the most popular multiple, and it is unaffected by depreciation policy and to a little extend affected by differences in capital structure. Even though EBITDA is close to FCF, it does however not consider depreciation, amortization capital expenditure or the change in working capital. It is also a pretax measure, so any value added activities from skilled tax management will not be considered. (Souzzo, et al. 2001)

EBITDA is a popular multiple, since depreciation is a noncash expense, reflecting sunk costs, not future investments. However, an important shortcoming for this statistic is when comparing one company (A) using their own equipment with company (B) that outsources manufacturing to a supplier. Company A will have a higher EBITDA, since company B will pay more for the raw materials. All else equal, these should have the same multiple while in this case company A will have a "falsely" higher multiple. (Koller, Goedhart and Wessels 2005)

EBITDA is also affected by capital intensity, were all else being equal, a company with higher capital intensity will have a lower EV/EBITDA multiple. The multiple is therefore most useful for comparing companies, or a company with the industry average, when the level of capital intensity is similar. Typically the retail sectors have large differences in capital intensity, while the oil sector is more similar. (Souzzo, et al. 2001)

Enterprise-to-EBIT multiple

The enterprise value-to-EBIT multiple is defined as:

$$\frac{EV}{EBIT} = \frac{(ROIC-g)}{ROIC*(WACC-g)} * (1-T)$$

EBIT is earnings before interest and taxes and is more suitable than EBITDA when capital intensity differs, since it is a figure post maintenance capital spending. It will however, be affected by accounting policy differences for depreciation. The statistic is therefore most suitable when the treatment of depreciation is similar. (Souzzo, et al. 2001)

This multiple seems to have low popularity in the studies of multiples, even though there is a close link to free cash flow as can be seen from equation 14. One likely reason for its low popularity is that it includes noncash expenses such as depreciation and amortization.

4.7.2.2. Equity Multiples

The enterprise multiples discussed below is Price-to-Earnings, Price-to-Book value and Price-to-Book value excluding interests.

Price-to-earnings multiple

The price-to-earnings multiple is defines as:

$$\frac{P}{Earnings_1} = \frac{(ROE-g)}{ROE*(COE-g)}$$

The price equals the current market capitalization and earnings the net income. This is one of the most common multiple. Reasons for that is its simplicity and data availability. In addition to historical, also the company's forecasted earnings are easily available. There are three main application of the P/E ratio. One can use current earning, forward earnings, called forward P/E ratio, and the trailing P/E ratio. The last form uses trailing four quarters earnings as denominator. . (Souzzo, et al. 2001)

The statistic is however highly affected by factors such as accounting policies, non operating gains and losses, and nonrecurring cost and income. Thise figures which the equity value is independent of, could lead to artificial differences in the P/E multiple when used for relative valuation. (Souzzo, et al. 2001) and (Koller, Goedhart and Wessels 2005)

Since the earnings represent the company's bottom line, the probability of a negative multiple is therefore higher than with the other multiples. A negative multiple cannot be used, and the practitioners handle this by setting the multiple values equal to N/A or zero. (Souzzo, et al. 2001)

This multiple is best suitable if earnings are viewed as representative for future earnings. The multiple is most suitable for comparing companies, sectors and markets with similar accounting policies. In addition different capital structure does also significantly affect the multiple by the gearing effect. This gearing effect on the cost of equity[8], impose an important weakness, since the multiple does not account for the balance sheet risk. The multiple does also not account for the investment required to maintain or increase the future growth. (Souzzo, et al. 2001)

Price-to-book value multiple

The price-to-book value multiple is defined as:

$$\frac{P}{Book\ value_0} = \frac{(ROE-g)}{(COE-g)}$$

The book value has a close connection to return on equity[9], and this multiple is therefore useful when tangible assets are the main source of value generation. It is less useful measure with

[8] $\beta_{equity} = \frac{D}{E}(\beta_{asset} - \beta_{debt})$, source: (Souzzo, et al. 2001)

[9] $ROE = \frac{Earnings_1}{Book\ value_0}$

industrial companies, because net assets are based on historical cost book value, which is viewed as an unreliable indicator of economic value. (Souzzo, et al. 2001)

This multiple is a useful measure in cases which a company has negative earnings. Price-to-book ratio measure the abnormal return over the cost of capital. However, the book value of a company's assets and the true value can in some cases be very different. The price-to-book ratio is not recommended to use for pharmaceutical companies because the value of their patents on drugs is not reflected in the book value of assets. In addition, the book value is also not suitable for comparing companies that revalues their assets. The multiple is widely used for valuing financial institutions, especially banks. (Souzzo, et al. 2001)

Price-to-tangible book value multiple

The price-to-tangible book value multiple is defined as:

$$\frac{P}{Tangible\ book\ value_0} = \frac{(ROE_{tangible} - g)}{(COE - g)}$$

The multiple is similar to the price-to-book value multiple, with the exception of excluding intangible assets such as intellectual capital (patents and trademarks), brand recognition, goodwill, etc. Intangible assets can be an important factor for a company's value but on the other hand, differences in accounting policies can cause the price-to book value to "falsely" differ.

4.7.2.3 Enterprise versus equity multiples

Table 3 summarizes the relative advantages of using enterprise value multiples versus equity multiples, and vice versa.

Enterprise value multiples	Equity multiples
• The statistics are less affected by accounting differences. • Not (or little) affected by differences in capital structure. • Applies to the entire enterprise and therefore more	• Higher relevance for equity valuation. • More reliable since the share prices are traded, while calculation of the enterprise value requires subjective assumption. • Investors are more familiar with equity multiples.

comprehensive.

- Wider range of multiples.
- Easier to connect to cash flow.
- Give the opportunity to exclude non-core assets.

Table 3: Enterprise versus equity based multiples. Source: UBS Warburg.

4.7.3. Pros and cons for multiples

Multiples are a useful tool in valuation, but it is important to be aware of its advantages as well as its disadvantages. The first advantage is its usefulness. It can provide a framework for value judgments and "when used properly, multiples are a robust tools that can provide useful information about relative value". (p. 4, Souzzo, et al. 2001)

The simplicity of multiples is a second advantage. The calculation is simplistic and easy to apply, making it a tool that does not require extensive knowledge about valuation and avoids potentially misleading precision from approaches such as discounted cash flow. (Souzzo, et al. 2001)

Multiples relevance is seen as a advantage. Investors in aggregate move the prices, and the most commonly used statistics and multiples will impact the stock price movements. Multiples are based on the same key statistics that investors use, and can therefore be a useful tool for investment decisions. (Souzzo, et al. 2001)

Multiples simplicity is also a disadvantage since a multiple captures much information, in a single number or a series of numbers. This point estimate makes it difficult to separate the effects from different value drivers, such as growth, on value. (Souzzo, et al. 2001)

A second disadvantage is its static characteristic. The multiple ratios represent a snapshot of a company's state at a point in time, but does not capture the continuously developing nature of business and competition. (Souzzo, et al. 2001)

The quality of comparison could also be questioned. Multiples are primarily used for comparison of value, but not all factors explaining the differences are related to value. Different accounting policies is an example of a non value related factor that can cause difference in the multiple value. (Souzzo, et al. 2001)

4.7.4. The judicious selection of comparable firms

Valuation literature states that comparable companies should be selected on the basis of the variables which drive cross-sectional differences in the multiple, such as profitability, growth and cost of capital.

Research identifies different methods to identify companies with similarities in these variables. Alford (1992), states that using industry membership defined by the first three Standard Industrial Classification (SIC) digits, is a relatively effective method for identifying comparable companies. Similar accuracy is found using risk and growth to construct the portfolio of comparable firms, while neither variable perform well alone. The results found no support for controlling for differences, or combining industry membership with the variables risk and growth to identify comparable companies. This result supports the general idea behind using industry membership, that companies in the same industry are expected to be similar in terms of risk and earnings growth. Another advantage by using industry is similarities in accounting policy (Alford 1992)

Industry classification systems have been used for many years. One problem with this method is that companies can have more than one line of business, and thereby making it difficult to classify the company's into industry groups. (Drake 2005)

According to Drake (2005), the companies' should be similar with respect to (p. 2):

- "Line of business and, specifically, products
- Asset size
- Number of employees
- Growth in revenues and earnings
- Cash Flow"

Another method suggested by Bhojraj et al. (2001 and 2003), is to developing a regression model containing these variables, that explains the future multiple. The model then estimates each company's "warranted multiple". The comparable companies' is then those with the most similar "warranted multiple". This method relies to a large extent on valuation theory and its advantage is that it can simultaneously control for the effect and of profitability, growth, and cost of capital. Compared to using industry and size matches, this method increases significantly the explanatory power of predicting the future (one to three years ahead) target firm multiple. (Bhojraj and Lee 2001) and (Bhojraj, Lee and NG 2003).

To narrow the sample of companies they use criteria's such as stock price above $3, sales above $100, noted to the same industry based on two-digit SIC codes with minimum five companies. In addition they excludes companies with negative common equity, negative current and/or one year forecasted earnings, and companies with missing data to perform the regression. (Bhojraj, Lee and NG 2003)
When using a regression model, one assumes the existence of a linear model and normal distribution of stock return and multiples.

Bhojraj, et al. (2003) states that that selecting comparable companies should be based on the fundamentals underlying valuation theory. Using an industry-based approach with firm specific adjustments is also a sensible approach to capture some key concepts from valuation theory. (Bhojraj, Lee and NG 2003)

5. Methodology

When comparable companies have been identify, the next step is to separate the companies into three groups; high priced, "correctly" priced and low priced companies.

Practitioners often use the simple or the median measure to define the industry multiple. Baker et al. compare results using the simple mean, the harmonic mean, the value-weighted mean, and the median with the results from the Gibbs method (minimum variance estimate). The requirements underlying the Gibbs approach, makes it an impractical method but can be used as benchmark for studies. The simple mean is the sum of multiples divided by number of companies. The harmonic mean is estimated by the numbers of companies divided by the sum inverse of the multiples. (Baker and Ruback 1999)

$$Harmonic\ mean = \frac{N}{\sum_{i=1}^{N}\left[\frac{1}{M_i}\right]} \quad (16)$$

The value-weighted mean is the sum each company's multiple multiplied by their respective weight measured by their enterprise value divided by the sum of enterprise value in the industry.

$$Value\ weighted\ mean = \sum_{i=1}^{N} M_i * \frac{EV_i}{\sum_{i=1}^{N} EV_i} \quad (17)$$

The median is the mid value of the multiples. With paired number of companies, it becomes the average of the two mid numbers, and with odd numbers, one company has the median multiple.

Baker et al. (1999) find that the value-weighted and simple mean are the worst performing methods approaches. The median performs better, but not as good as the harmonic mean. The success of harmonic mean is also can also be explained by economic reasoning. Baker et al. (1999) states that

"by averaging the yields, the harmonic mean gives equal weight to equal dollar investments". The results also indicates that simple mean overestimate the industry multiple since median is always lower than the simple mean. (Baker and Ruback 1999)

5.1. Econometrical model

The thesis seeks to test if the L portfolio obtains higher return than the BM portfolio without a significantly increase in risk. In addition, the analysis will test if the H portfolio obtains lower return than the BM portfolio without having a significantly decrease in risk. Statistical tests can be separated into two main groups: parametric tests and non-parametric tests. The two methods differ in their assumption of the variables distribution.

If stock returns can be assumed to be normally distributed is frequently questioned in theory. One can start questioning normal distribution just by studying the business cycle. The periods of positive return in the stock markets indexes are usually longer than the periods with negative returns. In addition, when crisis appear such as the current subprime crisis or the IT bubble, the negative return are usually of a more extreme nature, and as mentioned, over a short time period. In addition, the return measured by percent change in stock or index value, cannot be lower than 100 %, while the positive value has in principal no upper limit. Based on the difference length of business cycles, one would expect the right tail of the distribution to stretch towards positive values (positive skew) and with the existence of fat tails from the extreme returns in certain periods.

A number of studies support the non-normality of stock returns. Ford (nd) refers to Bai et al (2002), Fama (1976), Brooks (2002) for studies reporting non-normality in stock returns (Ford nd). Studies also support the finding of "fat tails" in stock return (Officer 2009). Andersen et al. (2000) found that the distribution of stock returns volatility is leptokurtic, and heavily skewed to the right (positive skew), and often has "fat tails". Relative to a normal distribution, a leptokurtic distribution is characterized with more measurements around the mean, a positive skew has more positive relative to negative values, and a "fat tail" is characterized by more measurements of extreme values (kurtosis). (Andersen, et al. 2000)

Ford and Kline (2006) states that with the existence of both kurtosis and skew, both over- and under rejection of the null hypotheses using t-test is possible. Methods robust to non-normality should therefore be applied on stock returns (Ford and Kline 2006). When the population is non-normal, the t-tests and F-tests are invalid (Gerald and Warrack 2003). Previous findings of non normal distribution of stock return, supports therefore using non-parametric methods for statistical tests.

Non-parametric methods tests characteristics of the population, weather the population location differ, without referring to specific parameters, hence the name non-parametric tests. These methods have the null hypotheses identical population distribution. By that they assume identical variances, and distribution. Therefore, to tests weather one group is higher, it is assumed equal distribution shape. (Gerald and Warrack 2003)
Figure 7 explains the data collection process and the assumption that can be made between the different groups. The two indexes are picked because of their importance for the Norwegian market, but are assumed to appropriately reflect a random sample of the population. The two indexes are then sorted after multiples, to test for differences in return and standard deviation between these groups. The return and variance of the benchmark group in the sample will be dependent on the return and variance in the groups (Ph and Pl), since the companies included in both groups are also included in the benchmark group.

The two groups (Ph and Pl) are on the other hand viewed as partly independent. The outcome of one group should not be affected by the outcome of the other. However, they are mutually dependent on the industry multiple and therefore on the existence of each other. This because all companies are used to calculate the industry multiple and by the use of this, separate the index into the L and H portfolio. In addition, their performance is likely to be affected by similar economic factors.

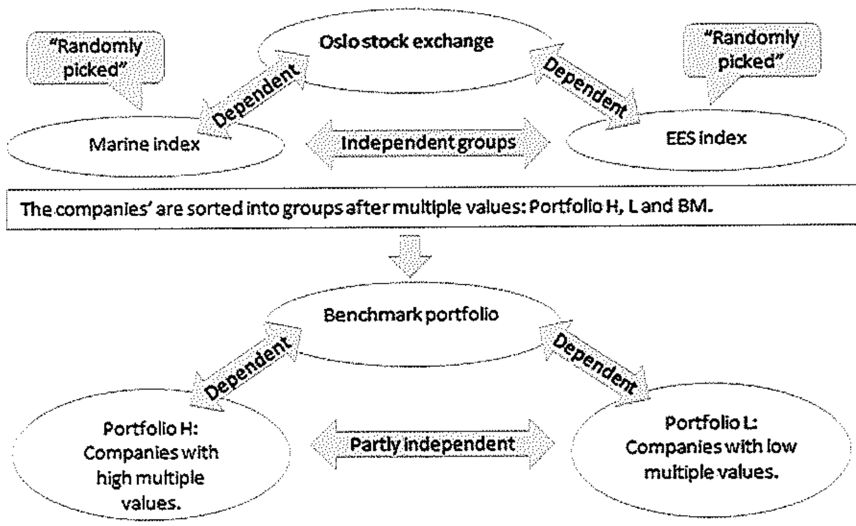


Figure 7: Illustration of the dataset.

To test for weather the L portfolios have higher and the H portfolios have lower return than the benchmark index, this thesis will apply the Wilcoxon signed rank test, which is a suitable test for dependent groups when normal distribution cannot be assumed.

5.1.2. The Wilcoxon Signed Rank Sum Test

The Wilcoxon Signed Rank test a powerful non-parametric test when the variables are dependent and one cannot assume normal distributed variables (Sheskin 2004). The method is appropriate for comparing two populations were the data are interval but not normally distributed, and the samples are matched pairs (Gerald and Warrack 2003, p. 577).

The tests start by calculating the paired differences and thereby rank them after size. The sum of ranks for positive values is denoted as T^+ while negative values T^-. The test statistic is defined by:

$$Z = \frac{T^+ - E(T)}{\sigma_T} \quad (18)$$

, were the expected value (left equation) and standard deviation (right equation) equals:

$$E(T) = \frac{n(n+1)}{4} = \frac{T^+ + T^-}{2} \qquad \sigma_T = \sqrt{\frac{n(n+1)(2n+1)}{24}}$$

(Gerald and Warrack 2003)

If T is larger than the critical value, hence a small p-value, we can reject the null hypotheses of no differences between the groups. (Gerald and Warrack 2003) The two populations than have a difference in mean likely not to be due to chance. The test can perform two-sided tests (difference in mean) and one-sided tests (grater or lower mean). The latter will be used in the thesis and the p-value for a one sided test equal the half of the p-value for a two sided test.

The assumptions of the Wilcoxon test are:

1. The paired values in the two groups are randomly and independently drawn;
2. The dependent variable is intrinsically continuous;

3. The measurements in the two groups/samples are at least an ordinal scale;
4. The distribution of the difference (d) between X_i and Y_i is symmetrical. Meaning no significant deviation from the mean difference over time and across the measurements (Gerald and Warrack 2003)

The test will have less power when there is exact number value in the two groups (tied ranks). A common method for handling with this issue is to assign the average of the two ranks for the two measurements, to both groups. This is unlikely to be a problem when using simple percent return.

Relevant advantages of using a non-parametric tests have its advantages in this thesis is first of all that it is a good method when the sample size is small. Applying t-tests is then less reliable. The second advantage is that these methods do not assume normal distribution, which makes these methods more appropriate for statistical tests of stocks return and volatility. (Weaver 2002)

There are however one important disadvantages that is important to be aware of. Non-parametric methods uses ranks, they therefore use less information available in the numbers, and hence will be less powerful than a t-test. (Weaver 2002)

6. Analysis

To answer the thesis question the analysis is divided into four sections:

1) Comparison of real return.
2) Measuring risk vs. return.
3) Significance test of higher/lower return.
    a. Comparing portfolio performance when varying the industry measure method, and applying different portfolio selection criteria's.
4) Portfolio Performance Evaluation.

The two first sections are used to identify if investing in companies with low multiple values is (at all) profitable. The results when using harmonic mean and median for measuring industry multiple is presented. These sections will not include different criteria's for portfolio selection, but will serve as an indicator for performing one or two sided statistical tests in section three.

In contrary with previous research using a market index for benchmark, this thesis will use the actual index from which the L and H portfolio is created. The reason for this is two folded. First efficiency of multiples in selecting attractive companies is viewed as best measured against the average of companies available in from selection. Any deviation from the average (BM portfolio) will then signal the multiples performance in portfolio selection. The second reason us that both indexes have given substantially higher return than the Oslo stock exchange over the period, which can be seen from Figure 8.

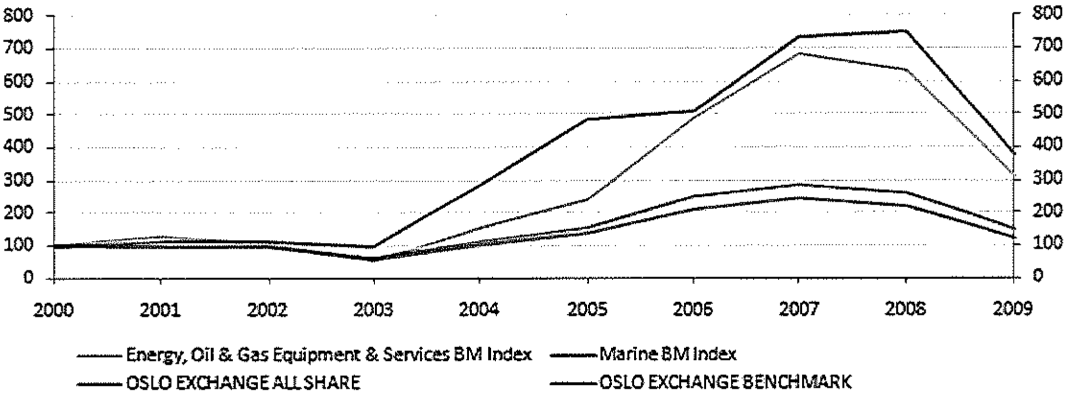


Figure 8: Oslo stock exchange versus the Marine- and EES index. Source: *Compiled by the author.*

6.1. Comparison of Real Return

The portfolios real value development is reviewed in this section. Here we have a base value of 100 on March 31, 2000 and calculate the change in real value over the nine year period to March 31, 2009. The equation is:

$Value_{ti} = 100 * (1 + r_{ti})$, for t=0,..,9 and i = H, L and BM.

The analysis will review the results from the Marine index followed by the EES index.

6.1.1. Real return in the Marine Index

In Figure 9 the yearly real value of the different portfolios in the marine index are compared when using median to estimate industry average. We can see that all L portfolios (green), performs better than both the H portfolio and the benchmark for all multiples except with EV/Sales multiple. The performance of the portfolios based on the EV/Sales multiple are relatively similar and it is actually the BM portfolio (purple) that performs best. For the others we can also see that the H portfolio performs worse than the BM portfolio.

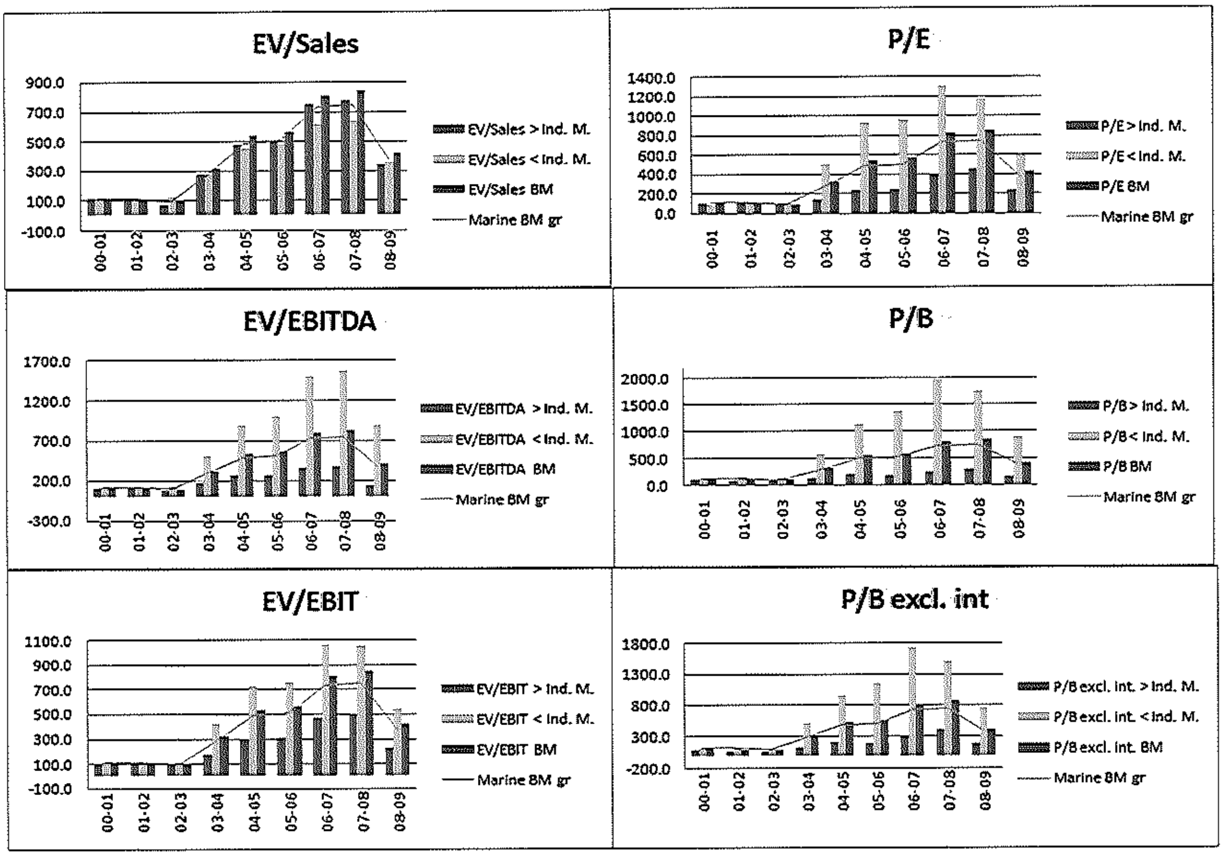


Figure 9: Comparing real return of the different portfolios in the Marine index using median. The line is the index with all companies, while the benchmark (BM) index has only the companies with available data to calculate the relevant multiple.

Next the same comparison is made using harmonic mean to estimate the industry multiple in the Marine index. Similar results are viewable in Figure 10. There are two important differences. The EV/EBITDA multiple performs worse when using harmonic mean. In addition there is a bigger difference between the L and H portfolio when using the P/B and P/Bxint[10] multiple especially in the years 2005, 2006, 2007 and 2008.

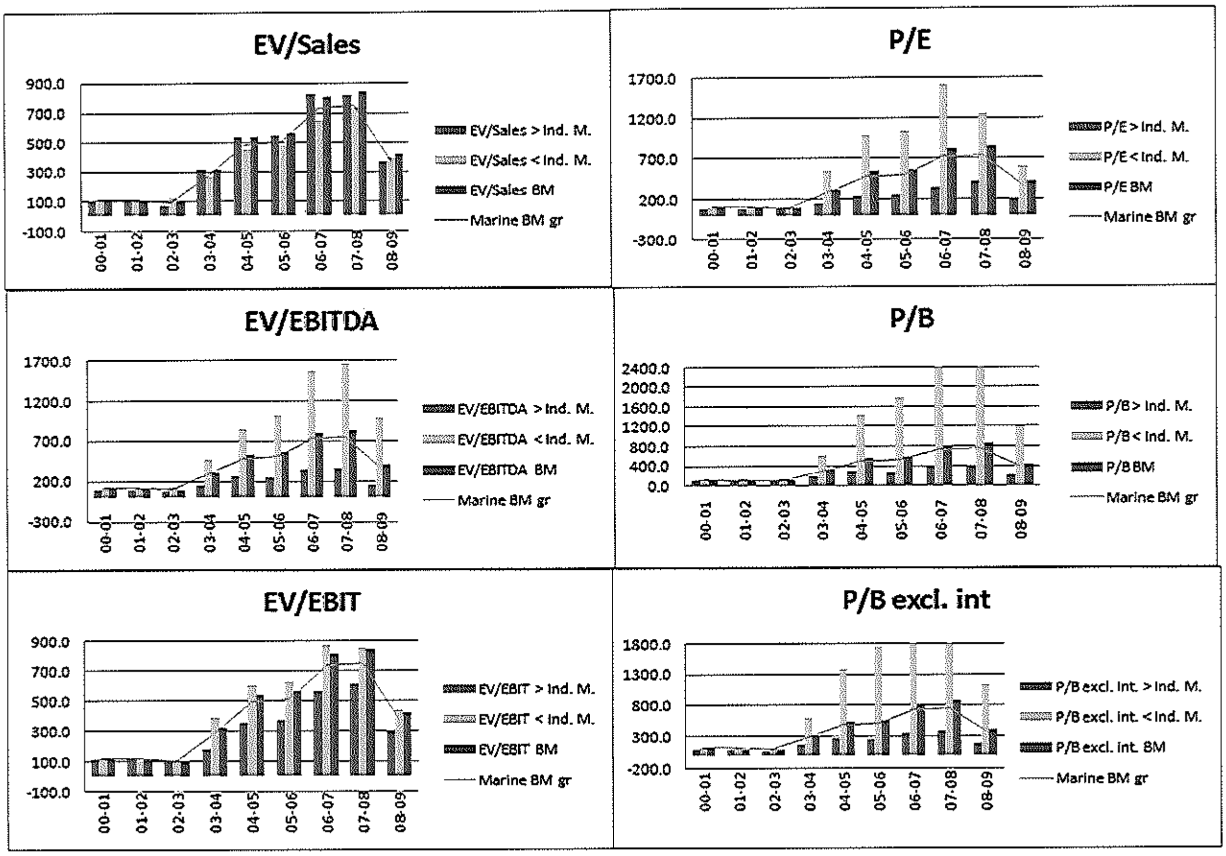


Figure 10: Comparing real return of the different portfolios in the Marine index using harmonic mean. The line is the index with all companies, while the benchmark (BM) index has only the companies with available data to calculate the relevant multiple.

6.1.2. EES Index

Figure 11 graphs the results using median. In the EES index, all L portfolios perform better than H and BM portfolio. In addition all H portfolios perform worse than the BM portfolio. With the P/E multiple, there is an extremely large difference between the L and H portfolio in the years 2006-2008. The EV/EBIT multiple has only marginal excess return of the benchmark the last year.

[10] P/Bxint refers to price-to-book value excluding intangible assets, which is also called price-to-tangible book value.

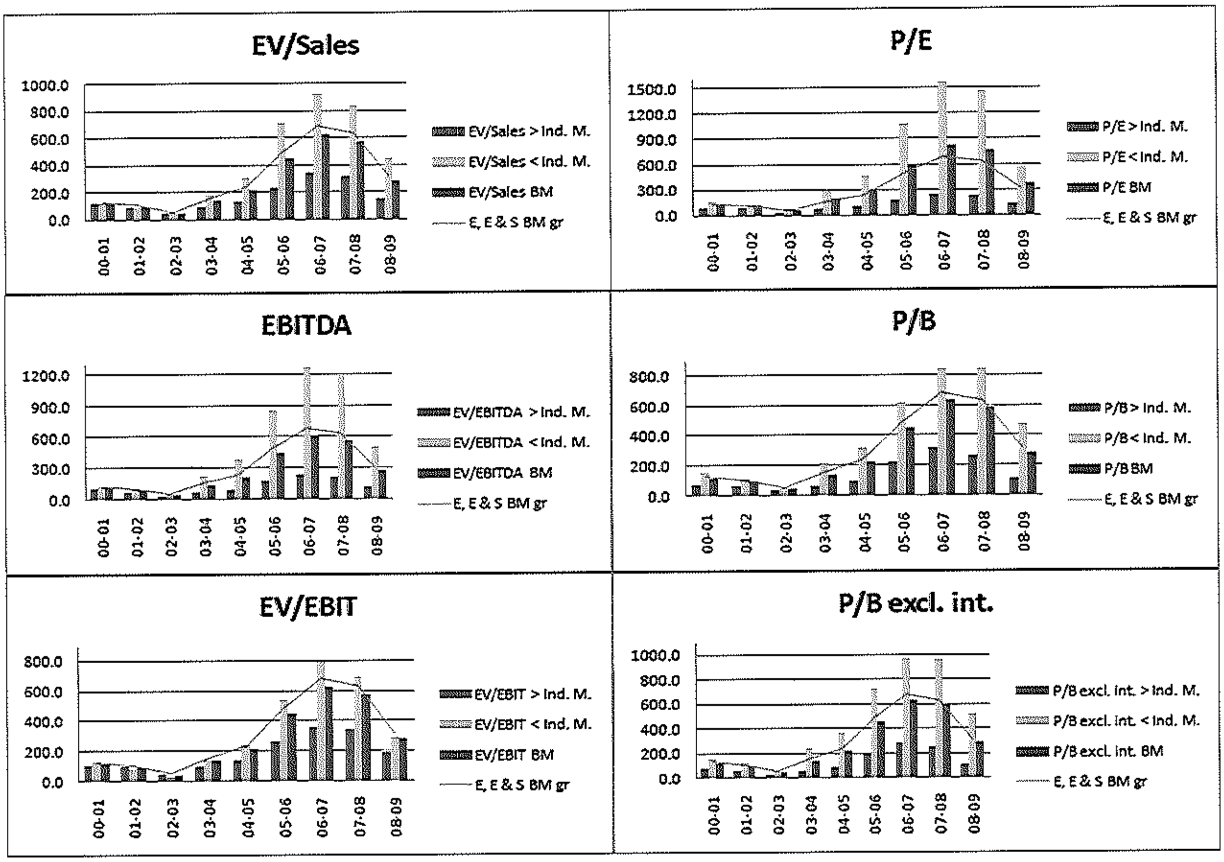


Figure 11: Comparing real return of the different portfolios in the Energy, Oil & Gas Equipment & Services (EES) index using median. The line is the index with all companies, while the benchmark (BM) index has only the companies with available data to calculate the relevant multiple.

When using the harmonic mean in the EES index (Figure 12), the results are consistent with the results using median. One major difference is the strong performance of the L portfolio with the EV/Sales multiple. This is one of the best performing portfolios, and strongly outperforms the benchmark and the H portfolio. The other multiples show similar results, but worth noticing is that on average the difference between L and H portfolio seems lower for the EV/EBITDA and P/E, and higher for the rest.

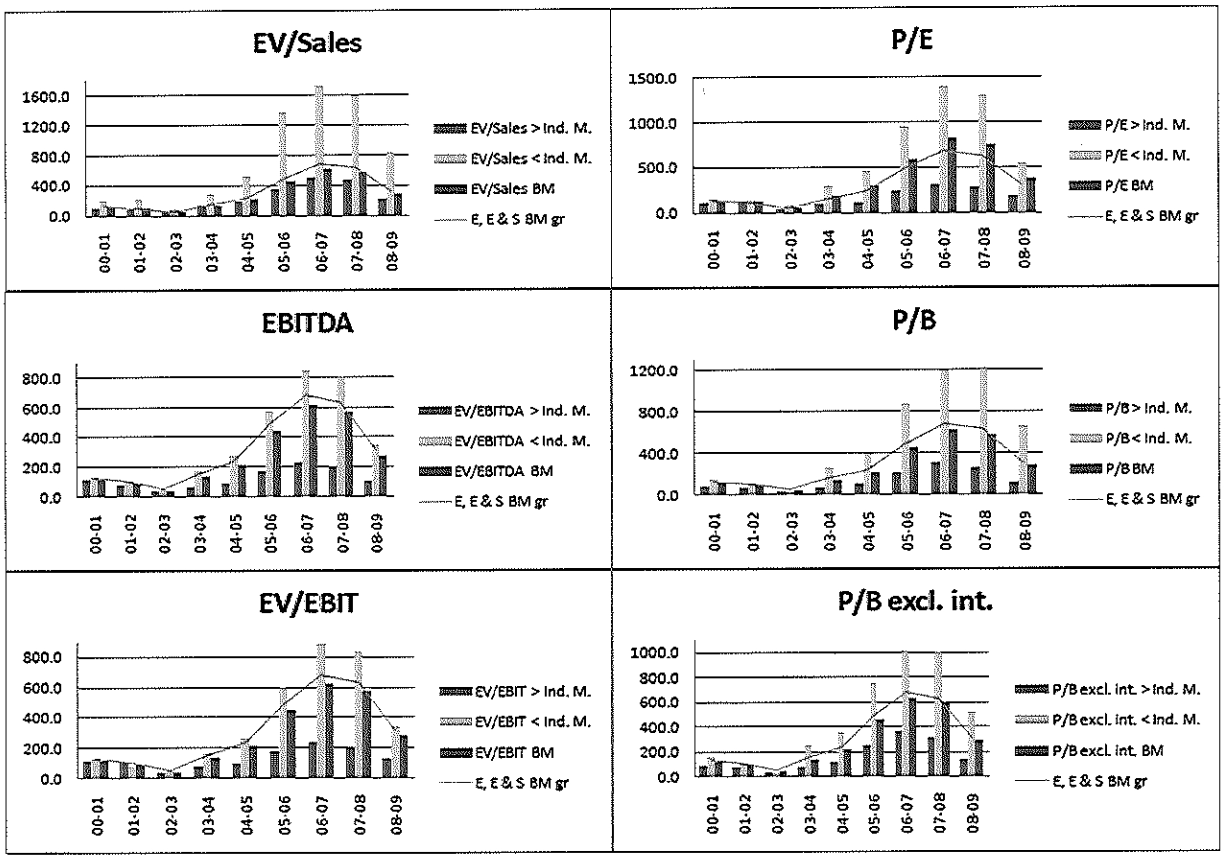


Figure 12: Comparing real return of the different portfolios in the Energy, Oil & Gas Equipment & Services index using harmonic median. The line is the index with all companies, while the benchmark (BM) index has only the companies with available data to calculate the relevant multiple.

6.1.3. Evaluation of results

The truly best portfolio in retrospect, and unconcerned about the risk, would be the one giving highest real return over the period. The total return over the period will be measured by the equation:

$$\%\ increase\ in\ value = \frac{Value_{t=9}}{Base\ value} - 1$$

Table 4 and Table 5 shows the ranking of the multiple-based portfolios measured after % increase in value from 2000 (base value of 100) until 2009. From the two tables below we can see that in the marine index, the L portfolio outperforms the H portfolio for all multiples. Among the L portfolios, the EV/Sales multiple has poorest performance and does not even outperform its respective benchmark portfolio. On the other hand, all portfolios above industry average are outperformed by the benchmark. When median is applied the EV/EBITDA multiple performs best, while the P/B multiple performs best when harmonic average is used.

Rank of Portfolios Real Return			
Marine Index: Median for estimation of industry multiple			
EV/Sales > Ind. M.	13	P/E > Ind. M.	14
EV/Sales < Ind. M.	12	P/E < Ind. M.	4
EV/Sales BM	8	P/E BM	7
EV/EBITDA > Ind. M.	17	P/B > Ind. M.	18
EV/EBITDA < Ind. M.	1	P/B < Ind. M.	2
EV/EBITDA BM	11	P/B BM	10
EV/EBIT > Ind. M.	15	P/B excl. int. > Ind. M.	16
EV/EBIT < Ind. M.	5	P/B excl. int. < Ind. M.	3
EV/EBIT BM	9	P/B excl. int. BM	6

Table 4: Rank of portfolios real return using median.

Rank of Portfolios Real Return			
Marine Index: Harmonic mean for estimation of industry multiple			
EV/Sales > Ind. M.	13	P/E > Ind. M.	15
EV/Sales < Ind. M.	12	P/E < Ind. M.	4
EV/Sales BM	8	P/E BM	7
EV/EBITDA > Ind. M.	18	P/B > Ind. M.	17
EV/EBITDA < Ind. M.	3	P/B < Ind. M.	1
EV/EBITDA BM	11	P/B BM	10
EV/EBIT > Ind. M.	14	P/B excl. int. > Ind. M.	16
EV/EBIT < Ind. M.	5	P/B excl. int. < Ind. M.	2
EV/EBIT BM	9	P/B excl. int. BM	6

Table 5: Rank of portfolios real return using harmonic mean.

In the table below compares the difference between each multiples real return when using median and harmonic average. The difference is simply the real return in percent using median minus the same measurement using harmonic mean. There should be no difference between the benchmark portfolios. This is just included to control that no bias is present. Of the portfolios with companies below industry average, only the EV/EBIT multiple has a better performance when using the median. For the companies above industry average, only the P/E performs better when median is used to determine the industry multiple.

Marine: Harmonic Mean - Median			
EV/Sales > Ind. M.	19.3%	P/E > Ind. M.	-16.3%
EV/Sales < Ind. M.	32.3%	P/E < Ind. M.	19.1%
EV/Sales BM	*0.0%*	*P/E BM*	*0.0%*
EV/EBITDA > Ind. M.	15.9%	P/B > Ind. M.	57.3%
EV/EBITDA < Ind. M.	95.3%	P/B < Ind. M.	298.4%
EV/EBITDA BM	*0.0%*	*P/B BM*	*0.0%*
EV/EBIT > Ind. M.	69.2%	P/B excl. int. > Ind. M.	9.2%
EV/EBIT < Ind. M.	-104.1%	P/B excl. int. < Ind. M.	391.1%
EV/EBIT BM	*0.0%*	*P/B excl. int. BM*	*0.0%*

Table 6: Total portfolio return using harmonic average minus total return using median for each portfolio.

The ranking procedure is also performed in the EES index. Here all L portfolios outperform both the H portfolio and the benchmark portfolio. In addition, and similar to in the marine index, all portfolios with high priced companies are outperformed by their respective benchmark portfolio. The main difference is that also the EV/Sales multiple are a good portfolio selection strategy, in fact when harmonic average is used, this is the best performing multiple of the portfolios based on low priced companies. When median is applied, the P/E multiple performs best.

Rank of Portfolios Real Return			
EES Index: Median for estimation of industry multiple			
EV/Sales > Ind. M.	14	P/E > Ind. M.	15
EV/Sales < Ind. M.	5	P/E < Ind. M.	1
EV/Sales BM	12	P/E BM	6
EV/EBITDA > Ind. M.	16	P/B > Ind. M.	17
EV/EBITDA < Ind. M.	3	P/B < Ind. M.	4
EV/EBITDA BM	10	P/B BM	9
EV/EBIT > Ind. M.	13	P/B excl. int. > Ind. M.	18
EV/EBIT < Ind. M.	8	P/B excl. int. < Ind. M.	2
EV/EBIT BM	10	P/B excl. int. BM	7

Table 8: Rank of portfolios real return using the median.

Rank of Portfolios Real Return			
EES Index: Harmonic mean for estimation of industry multiple			
EV/Sales > Ind. M.	13	P/E > Ind. M.	14
EV/Sales < Ind. M.	1	P/E < Ind. M.	3
EV/Sales BM	12	P/E BM	5
EV/EBITDA > Ind. M.	18	P/B > Ind. M.	17
EV/EBITDA < Ind. M.	6	P/B < Ind. M.	2
EV/EBITDA BM	10	P/B BM	9
EV/EBIT > Ind. M.	16	P/B excl. int. > Ind. M.	15
EV/EBIT < Ind. M.	7	P/B excl. int. < Ind. M.	4
EV/EBIT BM	10	P/B excl. int. BM	8

Table 7: Rank of portfolios real return using harmonic mean

When comparing the difference between performances of the multiples using harmonic average versus median, the result is not equally convincing for the EES index as for the Marine index. There are three portfolios with companies above industry average that performs better with median (EV/EBITDA, EV/EBIT and P/B) and two of the portfolios with companies below industry average (EV/EBITDA and P/E). EV/EBITDA is the third best performing multiple when using median, while the second worst performing among the L portfolios when harmonic mean is used. The difference in performance improvement using median and harmonic mean shows low consistency regarding which industry multiple measure is best.

EES: Harmonic Mean - Median			
EV/Sales > Ind. M.	76.4%	P/E > Ind. M.	47.8%
EV/Sales < Ind. M.	384.0%	P/E < Ind. M.	-32.2%
EV/Sales BM	*0.0%*	*P/E BM*	*0.0%*
EV/EBITDA > Ind. M.	-14.0%	P/B > Ind. M.	-2.7%
EV/EBITDA < Ind. M.	-163.5%	P/B < Ind. M.	187.7%
EV/EBITDA BM	*0.0%*	*P/B BM*	*0.0%*
EV/EBIT > Ind. M.	-64.6%	P/B excl. int. > Ind. M.	33.7%
EV/EBIT < Ind. M.	47.5%	P/B excl. int. < Ind. M.	3.8%
EV/EBIT BM	*0.0%*	*P/B excl. int. BM*	*0.0%*

Table 9: Total portfolio return using harmonic average minus total portfolio return using median for each portfolio.

6.2. Risk versus return

Financial theory suggests that a higher return can only be achieved by accepting higher risk. If in line with theory, the higher return of the portfolio based on companies with multiple below industry average should be explained by higher risk. Balser (2000) plots the portfolios relative return on the Y axis and relative risk on the X axis to analyze the relationship (Balzer 2000). The same method is used in this section. This section compares the relative return and relative risk of P_L and P_H for all six multiple based portfolios. The Y- and X axis are scaled to capture all measurements, but has the same negative as positive number to create four equally sized squares. Relative return measured by the L and H portfolios yearly return minus the yearly return of the BM portfolio. Relative risk is the standard deviation of L and H portfolios, minus the standard deviation of the BM portfolio. To avoid misunderstanding, the figure below explains the different areas. The best place to be is in the top left, while the worst place is the bottom right.

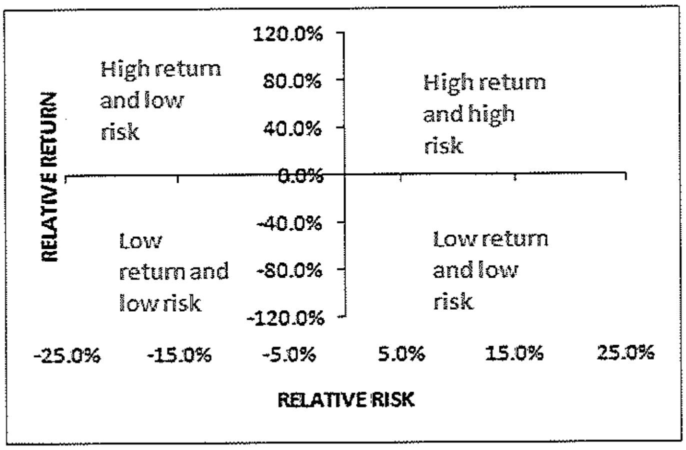


Figure 13: Relative risk versus relative return.

6.2.1. Marine Index

Figure 14 reveals interesting findings. The first finding is that most returns are centered around plus minus 20 %, which indicates that high (low) performance is largely explained by the present of extreme positive (negative) values. The EV/Sales multiple based L portfolio has a poor performance with low or negative relative return, but is compensated by a relative lower standard deviation compared to the BM portfolio. The EV/Sales multiple is the only multiple with a negative extreme value for the L portfolio, which explains the poor performance. All other multiples outperformed the high price based portfolios.

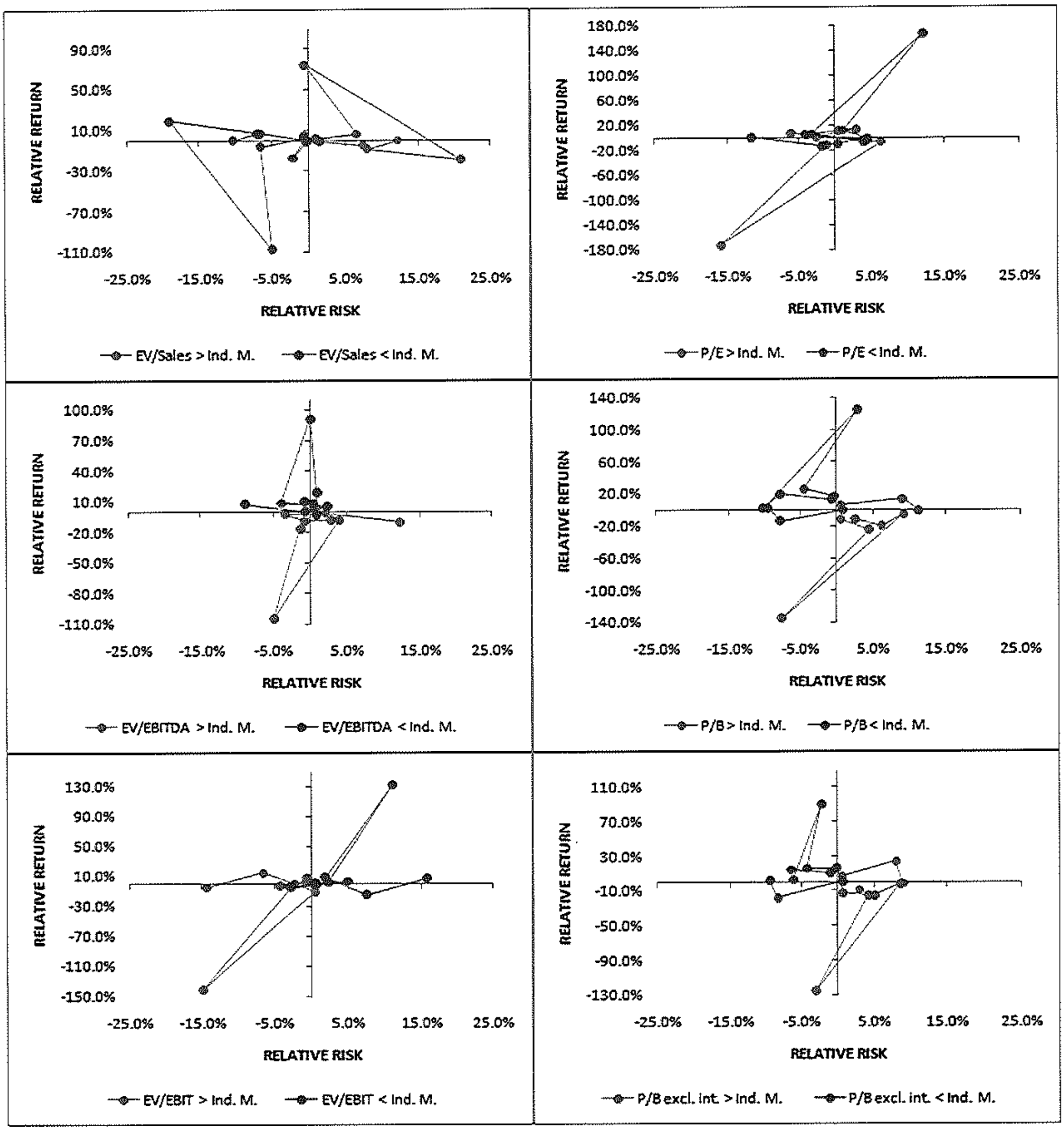


Figure 14: Marine index using median: Relative risk versus relative return.

The second finding is the relation between risk and return. The multiples EV/EBITDA, P/B and P/B excluding intangibles show sign of superiority. The risk is equal or below the industry average and even the extreme value for the EV/EBITDA and P/B excluding intangible was respectively obtained with equal or lower risk than the benchmark. The P/B had a relatively small increase in risk with the extreme value. For the other portfolios based on low price companies, there is a clear trade-off between risk and return in line with theory. The portfolios based on high priced companies shows opposite results and performs poorly both with respect to return and risk. An exception here is the EV/Sales multiple which outperform its counterpart the portfolio based on low priced companies.

The same analysis is performed in Figure 15 with the difference that harmonic mean is used to determine the industry multiple. Similar results are found, but worth noticing is that the P/B and P/B excluding intangibles have increased the extreme positive value measure with respectively 54 % and 89 % without a large increase in risk. The P/B portfolio increased risk by only a half percent while the P/B excluding intangible portfolio increased the risk with 5%. These are clearly the best performing multiples from the authors view, with high return and a risk in line with the benchmark portfolio. The EV/EBITDA on the other hand had both a decrease in return and increase in risk, when using harmonic mean.

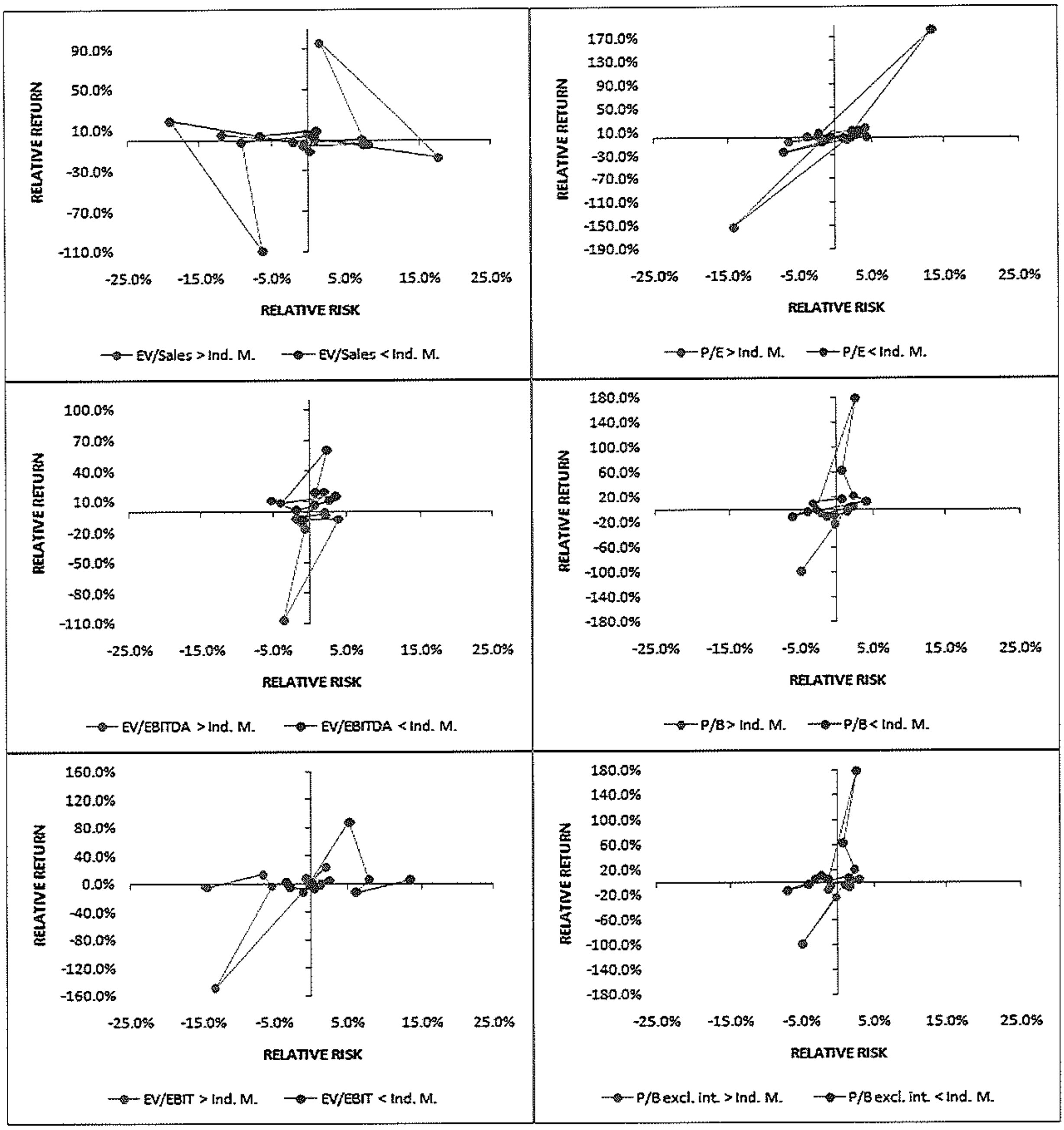
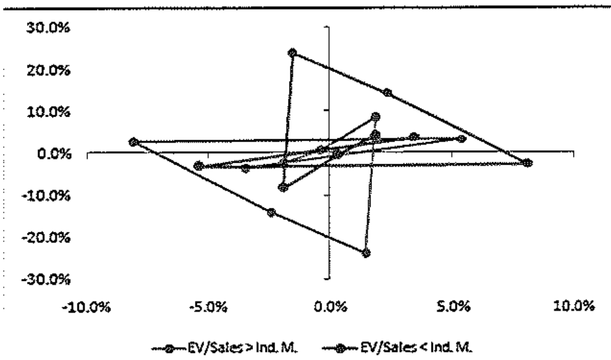
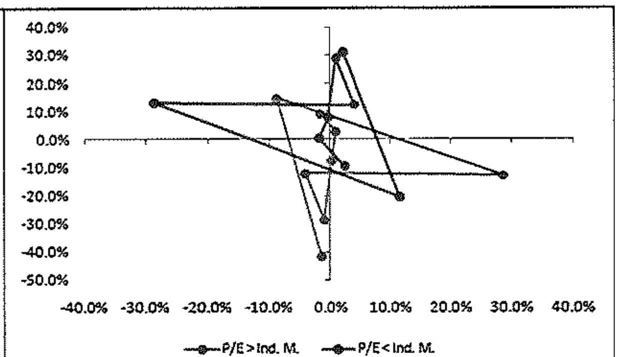


Figure 15: Marine index using harmonic mean: Relative risk versus relative return.

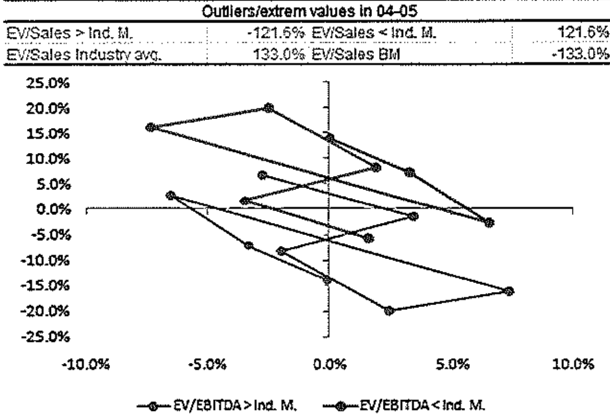
6.2.2. EES Index

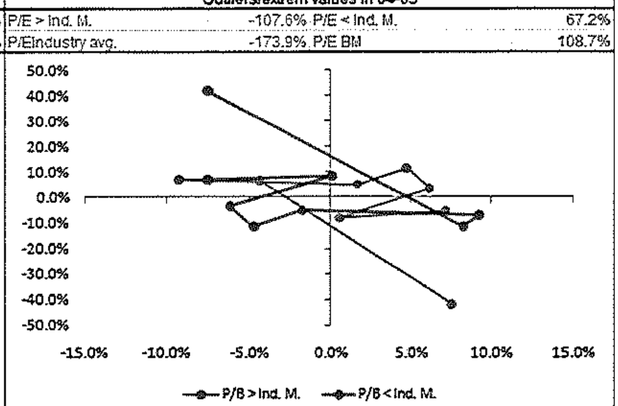
The portfolios in the EES index are highly affected by extreme values on the standard deviation in the period 31, March 2003 – 31, 2004. In the measurements with extreme standard deviation is tabulated below for visual purpose. The benchmark portfolio has also extremely high standard



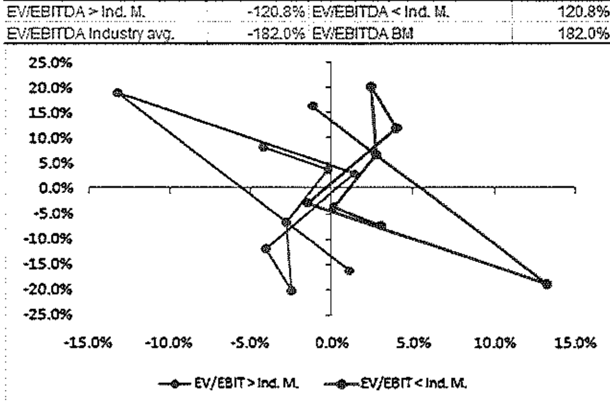


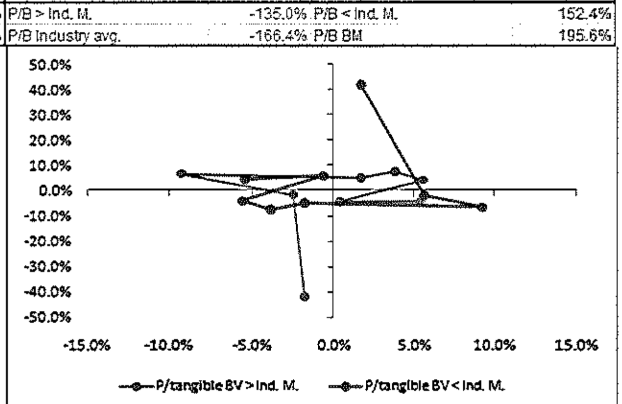
Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/Sales > Ind. M.	-121.6%	EV/Sales < Ind. M.	121.6%	P/E > Ind. M.	-107.6%	P/E < Ind. M.	67.2%
EV/Sales Industry avg.	133.0%	EV/Sales BM	-133.0%	P/Eindustry avg.	-173.9%	P/E BM	108.7%





Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/EBITDA > Ind. M.	-120.8%	EV/EBITDA < Ind. M.	120.8%	P/B > Ind. M.	-135.0%	P/B < Ind. M.	152.4%
EV/EBITDA Industry avg.	-182.0%	EV/EBITDA BM	182.0%	P/B Industry avg.	-166.4%	P/B BM	195.6%





Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/EBIT > Ind. M.	-113.2%	EV/EBIT < Ind. M.	80.9%	P/tangible BV > Ind. M.	-135.0%	P/tangible BV < Ind. M.	152.4%
EV/EBIT Industry avg.	-187.4%	EV/EBIT BM	133.9%	P/tangible BV. Industry avg.	-166.4%	P/tangible BV BM	195.6%

Figure 16: EES index using median: Relative risk versus relative return.

deviation in the period (205.6 % - 211.3 %), which leads to large differences when the companies responsible for the high standard deviation are included or not in the portfolios.

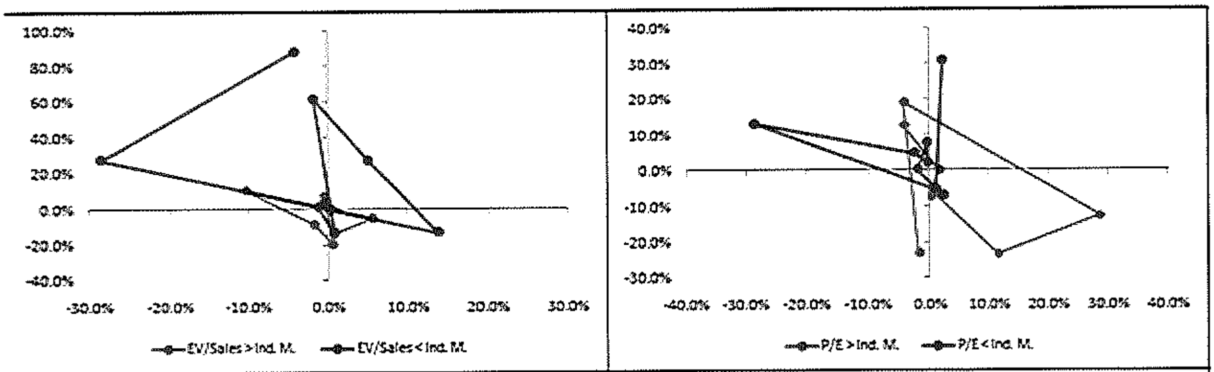
The EV/Sales multiple shows tendencies of an inverse relation between risk and return. High returns and low risk in the graph, and in addition, the extreme value in return for the L portfolio (122%) is obtained with a risk reduction of 133% relative to the benchmark portfolio. For the EBITDA multiple, the results indicates an almost parallel upward shift when investing in the L-versus H portfolio, although the extreme value in return is obtained at extremely high risk. For the extreme value, similar findings are evident in the rest of the multiples, were high return is obtained at the cost of high risk. However, the L portfolios for the enterprise multiples are in general placed above the H portfolio signaling higher return.

Looking closer at the numbers, we can see that there are three main companies which are responsible for the extreme values. Crystal Production has a standard deviation of 1907 %, Altinex 180 % and PGS 112 %. With a market value criteria of above 100.000 would exclude many of the most risky stocks, but on the other hand reducing the selection of companies from 13 to 8.

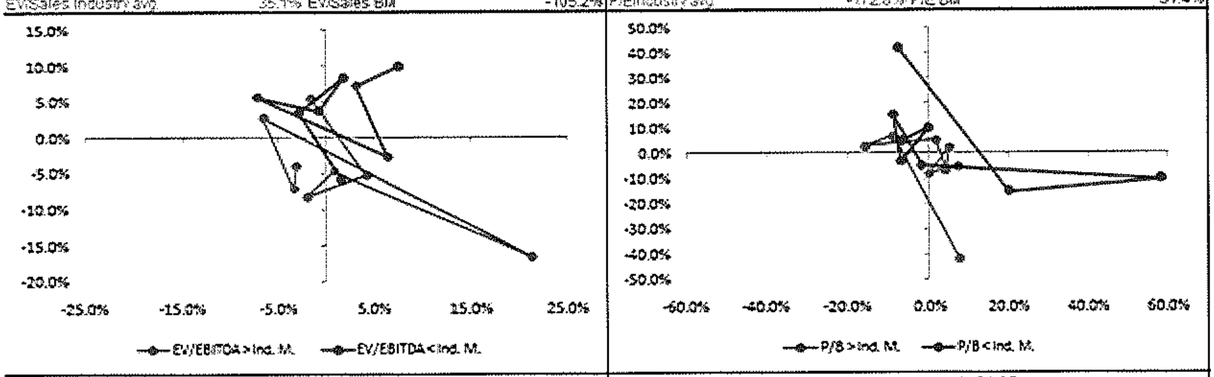
Company	MV in 1000 NOK	P/B	Return	Std. Dev
	31.03.2003	31.03.2003	31.03.03-31.03.04	31.03.03-31.03.04
HYDRALIFT A	1 643 560	#DIV/0!	0.0%	0.0%
TGS-NOPEC GEOPHS.	1 419 900	1.1	112.5%	43.5%
PROSAFE	3 599 440	1.1	94.0%	27.2%
SUBSEA 7	684 950	1.0	137.8%	46.4%
FARSTAD SHIPPING	1 640 000	0.9	62.2%	33.1%
ROXAR	81 790	0.8	4.9%	79.6%
HAVILA SUPPLY	641 080	0.7	12.1%	20.7%
DOF	554 960	0.7	101.2%	33.1%
SOLSTAD OFFSHORE	998 650	0.6	120.4%	34.3%
GLOBAL GEO SERVICES	57 100	0.2	175.4%	99.6%
ACERGY	554 910	0.1	153.2%	89.9%
CRYSTAL PRODUCTION	**3 110**	**0.0**	**66.7%**	**1907.4%**
ALTINEX	**5 550**	**0.0**	**662.5%**	**180.0%**
PETROLEUM GEO SERVICES	**108 510**	**0.0**	**970.2%**	**111.8%**

Figure 17: P/B selection portfolio in 31, March 2003. Hydralift A has no available data from Datastream to calculate the P/B multiple and is there not included in neither the H, L or BM portfolio.

The results using harmonic mean is seen Figure 19 and 19. The L portfolio of the EV/Sales multiple performs particularly well. The returns are on average higher for the L portfolio without a worrying risk increase. In addition, similar to the results when using median, the portfolio has obtained extreme return (62%) at extremely low risk (-105%). The EV/EBITDA multiple also favors the L portfolio, while the EV/EBIT has less visible differences. The P/E multiple shows a general risk reduction when investing in the L portfolio, while the two book value multiples show a tendency to a risk increase with relatively low return increase. In general, the extreme values for the multiples, except for the EV/Sales multiple, are obtained at the cost of higher risk.

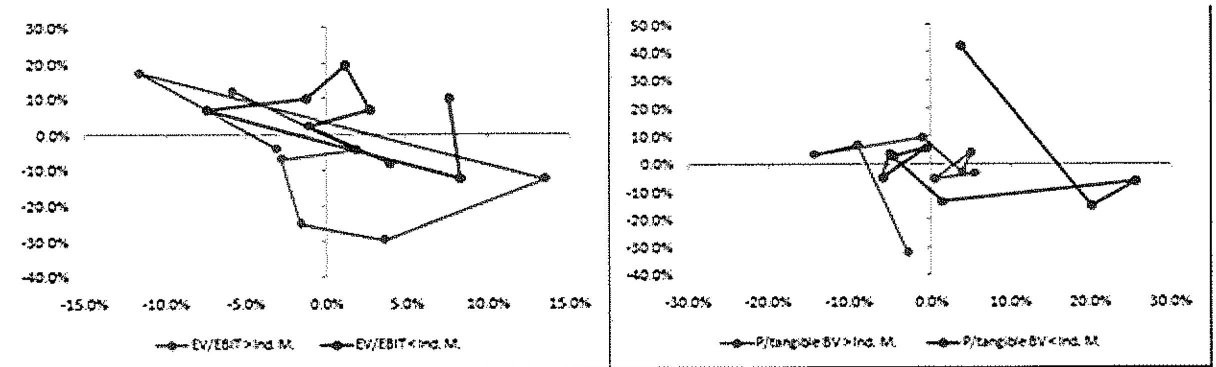


Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/Sales > Ind. M.	-20.8%	EV/Sales < Ind. M.	62.3%	P/E > Ind. M.	-102.4%	P/E < Ind. M.	18.6%
EV/Sales Industry avg.	35.1%	EV/Sales BM	-105.2%	P/EIndustry avg.	-172.8%	P/E BM	31.4%



Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/EBITDA > Ind. M.	-158.2%	EV/EBITDA < Ind. M.	31.6%	P/B > Ind. M.	-109.2%	P/B < Ind. M.	360.8%
EV/EBITDA Industry avg.	-197.7%	EV/EBITDA BM	39.5%	P/B Industry avg.	-157.5%	P/B BM	524.9%

Figure 18: EES index using harmonic mean: Relative risk versus relative return.



Outliers/extrem values in 04-05				Outliers/extrem values in 04-05			
EV/EBIT > Ind. M.	-106.1%	EV/EBIT < Ind. M.	35.4%	P/tangible BV > Ind. M.	-116.9%	P/tangible BV < Ind. M.	263.1%
EV/EBIT Industry avg	-190.1%	EV/EBIT BM	63.4%	P/tangible BV Industry avg	-162.9%	P/tangible BV BM	366.5%

Figure 19: EES index using harmonic mean: Relative risk versus relative return.

6.2.3. Evaluation of results

The risk versus return graph supports the findings in section 6.1, and in addition uncovers multiples that could be superior, meaning obtaining higher (positive) relative return and lower (negative) relative risk.

In the Marine index when using the median measure, the multiples EV/EBITDA, P/B and P/B excluding intangibles obtains higher return than the benchmark with equal or lower risk than the benchmark. With the harmonic mean the increase in return is large for the P/B and P/Bxint with only a marginal increase in risk. These are the best performing multiples in the Marine index. Consistent with findings in 6.a, the EV/EBITDA has a reduced performance when using harmonic mean in the Marine index.

In the EES index, there are extreme returns and standard deviation measurements from mainly three stocks in the period 31.03.2003 to 31-03-2004. This graph explains the good performance of the L portfolios, which is mainly due to the extreme high return values in 2003 to 2004. The H portfolios do not select these stocks and have therefore a low relative return for the extreme values. The extreme values in return do however in general result in extreme high risk in the period. One exception is the L portfolio created by the EV/Sales multiple, which obtains a extreme value in return, while in addition having extremely low relative risk (-133%).

When using harmonic mean in the EES industry, the performance of the EV/Sales multiple improves, resulting in higher return than the BM index with no or a small risk increase. The extreme values in return are now reduced, but the risk is on average lower than using the median. The EV/EBITDA has an ok performance, while the P/B and P/Bxint has on average a risk increase when using the harmonic mean.

6.3. Significance Test of Portfolios Mean Differences

The result from 6.1 indicates that the L portfolios obtain higher return than the BM portfolio and the H portfolio for most of the multiples. In addition, the H portfolios generally obtain lower return than the BM portfolio. The result from 6.2 indicates that some multiples are superior in creating portfolios with high return at no or little increase in risk level. This section therefore applies one sided significance tests using the Wilcoxon signed rank test to determine if the L portfolios gives significantly higher return, and if the H portfolio gives significantly lower return than the BM portfolio. In addition, this section will test for significantly higher or lower risk in the L and H portfolio relative to the BM portfolio.

The significance test will be tested with additional criteria's. Studies by Schreiner and Spremann (2007), Liu et al. (2002), Kim and Ritter (1999) and more, show that the accuracy of multiples varies between 10 % and 30%. This paper therefore introduces a multiple based 'band', with the objective to adjust for mispricing. The second criterion is limits regarding market value. By having no limits for low market value, one might see higher risk attached to the portfolio with a large portion of companies with low market value. It is also worth mentioning that companies with low market value might have low trading volumes, and therefore less popular. This paper has not collected numbers of trading volume and therefore lack control over this factor. On the other hand, the market value criteria of above 100 000 could to some extent control for this[11].

The analysis have applied the criteria's such as market value[12], 15% and 30% multiple band separately, and in addition applied a combination of the market value and multiple band criteria in the portfolio selection process.

It is assumed to be no autocorrelation which is reasonable when using percent measures. The dataset has too few samples to perform the DW test and in addition the test assumes normality which would be inconsistent with using a non-parametric test. Mun et al. (1999), among others, also uses a non-parametric tests on stock returns and find no support for correcting for autocorrelation nor heterogeneous variance (Mun, Vasconcellos and Kish 1999).The Wilcoxon signed rank test assumed that the variance of the difference between the compared groups are stable and not significantly different over the period, which is viewed as a reasonable assumption.

The tables present the constant average growth rate (CAGR) as a measure of the return:

$$CAGR = \left(\frac{end\ value - base\ value}{base\ value}\right)^{\frac{1}{N}} - 1$$

, were the base value is set to 100 and grows gradually with the portfolios yearly return over the period 31.03.2000-31.03.2009 resulting in N equals 9. Note that CAGR is the same measure as geometric mean.

The average standard deviation over the period is used as a measure of portfolio risk (σ):

$$\bar{\sigma} = \frac{1}{N}\sum_{i=1}^{N} \sigma_{i,j\ portfolio}$$

[11] The market values are collected both in the currency in which the income statement are presented in Datastream and in NOK. Calculations of multiples use the same currency as in the income statement, but the MV criteria is connected to market value in NOK for all companies.

[12] The market value criterion is only tested for the harmonic mean, because the median formula could not be connected to the market value criterion in Excel. An alternative, not chosen in this thesis is to estimate the median on all companies and then select the companies above or below median that are also above the median. One problem with this is that the companies' not considered for portfolio selection will affects the median. Another solution is manually adjusting the median formula.

, were N=9 and j = L, H and BM.

CAGR is chosen over arithmetic average because it reflects better the actual return, and using arithmetic average results in less weight on the negative returns because it does not account for the relatively larger effect on value from a 50% decrease have after a 50% increase. Accounting for both positive and negative return (equally weighted) is important when evaluating the portfolio performance. The interpretation of the results is done relative to the BM portfolio and the results can be seen in Appendix 1:. Hence, significant excess/higher return should be interpreted as significantly higher return than the BM portfolio. The results when using the median measure will be reviewed first followed by the results using harmonic mean.

6.3.1. Median Measure of the Industry Multiple

The EV/SALES multiple performs poorly and have no significant excess return for neither indexes. On the other hand, by investing in the L portfolio in the marine index, one would obtain significantly lower risk at the 1% level. The H portfolio has higher risk significant at a 5 % level.

The best performing multiple measured after statistical significance of excess return is clearly the EV/EBITDA. The L portfolios (H portfolio) have significantly higher (lower) return than the BM portfolio on the 5% level when using no criteria, 15% multiple band and 30% multiple band in Marine index. For the EES index, the same results was found and significant at a 5% level with no criteria, while at a 1% level when using the two multiple bands. The results for excess return therefore shows high strength. In addition, the risk is not significantly higher (lower) for the L portfolio (H portfolio), when no additional criteria is used for neither of the two indexes. When using 15% multiple band and 30% multiple band, in the marine index, the L portfolios have significantly lower risk at the 10% level, while the H portfolios does not have significantly different risk in the marine index. In the EES index the L portfolios have lower and the H portfolios have higher risk when using a 15%- and a 30% multiple band, all significant at the 10% level.

The EV/EBIT multiple are performing poorly in the marine index, with no significantly different returns. With no criteria, investing in the L portfolio (H portfolio) gave significantly higher (lower) risk. In the EES index the L portfolios (H portfolios) have higher (lower) risk significant at a 5% level. When using a 15%- and a 30 % multiple band, the L portfolio (H portfolio) have significantly higher (lower) return on a 10% level, while the risk were not significantly different.

The P/E multiple have no significant results in the Marine index. In the EES index the L portfolios (H portfolios) have a higher (lower) return significant at the 10% level with no criteria and with a 15% multiple band. The risk is also higher (lower) for the L portfolio (H portfolio) with these criteria's, significant at the 5% level.

The P/B multiple perform well in the Marine index with no criteria's. Here the L portfolio (H portfolio) has higher (lower) return significant at the 5% level. Excess return was also significantly higher for the L portfolio with a 30% multiple band, now at the 10% level. Interestingly, the L portfolios have lower risk while the H portfolios have higher risk significant at the 5% level for no criteria's, 15% and 30% multiple band. On the other hand, in the EES index no significantly difference was found neither for the return, nor for the risk.

The P/B excluding intangibles (P/Bxint) also performs well in the marine index with no criteria's. Here the excess return for the L portfolio with lower risk is significant at the 5% level, and the H portfolio has lower return and higher risk significant respectively at the 10% and 5% level. Similar to the P/B multiple, the L portfolios (H portfolios) have lower (higher) risk with 15% and 30 % multiple band, significant at the 5% level. Also this multiple have no significant difference in risk or return in the EES index.

6.3.2. Harmonic Mean Measure of the Industry Multiple

The harmonic mean will be analyzed as mentioned under more assumptions. Also here, the multiples are analyzed with criteria's, 15% and 30% multiple band, and in addition with a market value criteria and a combination of the market value criteria multiple bands. The review of the results will be divided in two sections, were section one comment the results using the same criteria's as with the median and section two comments on the results from combining the market value criteria with a multiple band.

6.3.2.1. Harmonic mean with no criteria and multiple band

The EV/SALES multiple are one of the best performing when using the harmonic mean. The results from the Marine index show a higher (lower) return for the L portfolios (H portfolios) when a 15% and 30% multiple band are used. The findings are significant at the 5% level with the exception of the L portfolio with a 15% multiple band, which is significant at the 10% level. The risk is significantly lower (higher) for the L portfolios (H portfolios) at a 5% level with no criteria', and at a 1 % level with the 15% and 30% multiple band. In the EES index the L portfolios have significantly higher return at a 5% level with no criteria's and 15% multiple band, while at the 10% level when the 30% multiple band was used. The H portfolios have significantly lower return at a 10% level under all scenarios. No significant difference in risk was found in the EES index.

The EV/EBITDA also performs very well when using harmonic mean. The L portfolios have significantly higher return under all criteria's and in both indexes but at different strength. In the Marine index the L portfolios excess returns are significant at a 5% level with no criteria and a 30% multiple, while at the 10% level with the 15% multiple band. The H portfolio had significantly lower return at a 5% level with no criteria. In the EES index the L portfolios (H portfolios) have significantly higher (lower) return at the 5% level with no criteria, and at a 1% level when a 15% and 30% multiple band is used. The only difference in risk is for the L portfolio in the Marine index, with a 30% multiple band which is significantly lower at a 5% level.

The EV/EBIT multiple have no significant differences in the marine index. In the EES index, the L portfolios have a significantly higher return and higher risk at the 10% level with no criteria's. In addition, the excess return is also significant at a 10% level with a 30% multiple band. The H portfolios have significantly lower return at the 10% level for all scenarios, with no difference in risk.

The P/E multiple performs fairly good with no criteria, were the L portfolios (H portfolios) have significantly higher (lower) return at a 10% level for both indexes. The H portfolio has significantly lower risk in the Marine index with no criteria. In the EES index with 15% multiple band, the L portfolio has significantly higher risk and the H portfolio has lower risk, both at a 10% level.

The P/B multiple have a good performance in the marine index. The L portfolios (H portfolios) have significantly higher (lower) return at a 5% level in all scenarios. In addition, with a 30% band the L portfolio (H portfolio) have a significantly lower (higher) risk. On the other hand, in the EES index the L portfolio (H portfolio) have significantly higher (lower) return on a 10% level only with a 15% multiple band.

P/Bxint performs well in the marine index, but have no significant differences in the EES index. The L portfolios (H portfolios) have significantly higher (lower) return at a 5% level with no criteria and a 15% multiple band. The L portfolio also has significantly higher return at a 10% level with a 30% multiple band, and in this scenario, the L portfolio (H portfolio) has lower (higher) risk significant at a 5% level.

6.3.2.2. Harmonic mean with market value- and multiple band criteria

This section will refer to the scenarios with different criteria's for portfolio selection when commenting the results. The three scenarios are:

S1: Market value above 100 MNOK,

S2: Market value above 100 MNOK and a 15% multiple band, and

S3: Market value above 100 MNOK and a 30% multiple band.

The EV/SALES multiple have no significantly differences in the EES for neither scenarios. In the Marine index, S3 has the best results were the L portfolio (H portfolio) have significantly higher (lower) return and lower (higher) risk at a 5% level. In S1 and S2 the L portfolios have significantly lower risk at a 5% level, and the H portfolio has significantly higher risk at a 10% level in S1 and at a 5% level in S2.

Also here the EV/EBITDA multiple has a high performance and especially in the EES index. The L portfolios have significantly higher return at a 5% level for S1 and S3 in the Marine index and for all scenarios in the EES index. The H portfolio has significantly lower return for S1 in the Marine index and for all scenarios in the EES index. No significant difference in risk was found with this multiple.

The EV/EBIT multiple performs poorly in the Marine index, with no significant differences in return and a significantly higher (lower) risk for the L portfolio (H portfolio) in S3. In the EES index the L portfolios have significantly higher return at a 10% level in S1 and at a 5% level in S3. The H portfolios have significantly lower return at a 10% level in S1 and S2, and at a 10% level in S3.

The P/E multiple performs best in S1, were in the marine index the L portfolio (H portfolio) has significantly higher return at a 5% level and at a 10% level in the EES index. The only difference in risk was in the EES index in S2 were the L portfolio has a significantly higher risk at the 10% level.

The P/B multiple perform best in the marine index. Here the L portfolios have significantly higher return in all scenarios at a 5% level and in addition, a significantly lower risk in S2 and S3 at a 10% level. In the Marine index, the H portfolios have significantly lower return at a 5% level in S1 and S2, while at a 10% level in S3. In the EES index the L portfolio (H portfolio) has significantly higher (lower) return in S2.

The P/Bxint performs well in the marine index, while has no significant differences in the EES index. In the marine index, the L portfolios (H portfolios) have significantly higher (lower) return than at a 5% level in S1 and S2. In addition, the L portfolios in the marine index have in addition significantly lower risk at a 10% level in S2 and S3. The H portfolio has significantly higher risk in the marine index in S3.

6.3.3. Portfolios Performance Evaluation

Total number of H and L portfolios equals 216 (108 BM portfolios) with equal number of measurements in both indexes. There are a total of 72 measurements when using the median, and 144 for the harmonic mean. From the table we can see that almost 50% of the L portfolios have significantly higher return than the BM portfolio at a 10% level. Out of all the H portfolios, 44% have significantly lower return than the BM at a 10% level. This indicates that multiples based on historical accounting statistic, both could identify companies that will yield higher and lower future return than the industry average.

		Count	% of total
P > Z (< 5%)	LMBM	33	31%
P > Z (< 10%)	LMBM	51	47%
P < Z (< 5%)	HMBM	28	26%
P < Z (< 10%)	HMBM	48	44%

**Total measurements = 216*

Figure 20: Counts the number of LMBM portfolios with significantly higher return than the BM portfolio, and the number of H portfolio with significantly lower return.

The ranking of the best performing multiple will evidently highly depend on the ranking method. Popular methods for measuring stocks and portfolios performance in the financial literature is Jensen's alpha, Treynor's measure, and the Sharpe ratio. All three are connected to the Capital Asset Pricing Model (CAPM) and by that assumes normal distribution of the return. The main difference is that Jensen's alpha identifies abnormal return relative to the CAPM model, while Treynor's measure and the Sharpe ratio measure reward per unit, respectively, systematic risk and total risk. The benchmark in these two methods is commonly set to the risk free rate.

In this thesis the focus is on total risk because, as mentioned earlier, the effects of diversification in reducing the risk when numbers of companies vary are hard or impossible to control for when using systematic risk by beta, or using the true covariance affected total standard deviation for the different portfolios. A reasonable ranking method is therefore the Sharpe ratio. The Sharpe ratio is however inconsistent with the previous assumptions of non-normality in stock return[13]. The formula for the Sharpe ratio can be written as excess return to excess risk above the benchmark, commonly used set to the risk free rate. Since the risk free rate is assumed to have zero risk, the equation can therefore be divided by the portfolio risk measured by the standard deviation. Implicitly, this assumes that both upward movements and downward movement are equally risky (or "undesirable").

$$SR = \frac{E(r_i)-r_f}{\sigma_i-\sigma_{rf}} = \frac{E(r_i)-r_f}{\sigma_i} \qquad (19)$$

(Bodie, Kane and Mercus 2008)

, were r_i and r_{rf} are respectively the expected return for the portfolios and the return of the risk free rate, and r_i and r_{rf} are respectively the standard deviation of the portfolio and the risk free rate.

In the paper by Koekebakker and Zakamouline (2007) they present and derive an extension of the Sharpe ratio which accounts for investors preferences towards positively skewed return distributions. The adjusted for skewness Sharpe ratio (ASR), decreases the ratio value for portfolios with left-tail risk (negative skew) relative to the SR, and increases the ratio for portfolios with right-tail potential (positive skew)[14]. The ASR depends on the relation between investor's aversion towards variance (Arrow-Pratt measure of risk aversion) and skewness. (Koekebakker and Zakamouline 2007)

The equation for the adjusted Sharpe ratio is given by[15]:

$$ASR = SR * \sqrt{1 + \frac{b*S}{3} * SR} \qquad (20)$$

[13] The Sharpe ratio is based on the mean-variance theory and assumes thereby either normal distributed returns or quadratic preferences. (Koekebakker and Zakamouline 2007)

[14] A further extension of the Sharpe ratio, not used in this paper, is the Generalized Sharpe Ratio (GSR) by Hodges (1998) which also accounts for kurtosis. (Koekebakker and Zakamouline 2007)

[15] The derivation of the model can be found in the article by Koekebakker and Zakamouline (2007).

, were SR is the Sharpe ratio and b is some constant were the value depends on the assumption of the utility function in the Arrow-Pratt measure of absolute risk. (Koekebakker and Zakamouline 2007)

Koekebakker and Zakamouline (2007) suggest assuming that relevant investors have "either a constant absolute risk aversion or a constant relative risk aversion when the value of the risk aversion coefficient is greater than 1, that is, ρ >> 1)" (p. 11). The value of b in the equation 21 then equals to 1. The ASR method is suitable for value of the Sharpe ratio between [.5, 1.5] and skewness between [-2, 2]. For large positive numbers the equation will underestimate the true value of ASR, while for small numbers it will overestimate the value. For large number it is therefore recommended to use the calibration technique used by Judd (1998), which is more accurate for large numbers. (Koekebakker and Zakamouline 2007)

The ranking process will first assess the performance of all multiples when no criteria's are used. The results from both the L portfolio and H portfolios are viewed in Appendix 2: (Marine index) and Appendix 3: (EES index). The results shows that all L portfolio perform better than the H portfolios in both indexes, when ranked after the adjusted for skew Sharpe ratio (ASR). In the Marine index, the EV/Sales multiple with both mean measures, was the only ones to underperform the benchmark in return. The best performing multiple in the Marine is the P/B multiple followed by the P/B excluding intangible assets and the EV/EBITDA. In the EES index the results are contradictory, EV/Sales were the poorest performing multiple in the Marine index, and now are the best performing multiple in the EES index. In addition, the P/E which performs relatively poorly in the Marine index, while in the EES is the second best performing.

Another finding, only visible in the Marine index, is a strong negative relationship between the ranking of the L and H portfolios for the multiples. For example, the P/B L portfolios is ranked number one, while the P/B H portfolio is ranked last.

In both indexes the two best portfolios, were created using harmonic mean. However, no strong support for excess return using harmonic mean is visible from these results.

The next part analyze the best performing portfolios independent of selection criteria and industry mean measure, but separated into the two indexes. The results from the top fifteen best performing portfolios can be seen in Appendix 3: (Marine index) and Appendix 4: (EES index). The analysis starts by limiting the ranking to the portfolios with a significantly higher return than the BM portfolio at a 10% or lower level. The companies' are then sorted after the rank using the ASR ratio, but the ranking with the SR is also calculated.
The results, regarding which multiple creates the best performing portfolio seems to be industry dependent. In the Marine index, only three multiples can be seen in the top fifteen, were the P/Bxint followed by the P/B and the EV/EBITDA are the three best multiples for portfolio selection. In the EES index, the results are more scattered over more multiples. Also here the P/B multiple perform well and in fact best, but has only one portfolio included which reduces the power of the result. When taking into account ranking and the number of portfolios among top fifteen, the best performing multiples in this index after the authors view is the EV/Sales, P/E and EV/EBITDA.

Looking at the method for industry mean measure, we can see that the top ten in the Marine index and top nine in the EES index uses harmonic mean. Relatively few portfolios when using median are among the top fifteen, and those who are, are at the bottom of the fifteen. This indicates that harmonic mean could be a better method for measuring the industry mean multiple.

Quite surprisingly is that the exact same combination of portfolio are the best performing in both indexes. This is the P/B when using harmonic mean measure, limiting the selection to companies with market cap above 100MNOK, and using a 15% multiple band. This gives the combination strong power for being a consistent well performing method for portfolio selection, versus the contrary that the results could be due to luck, or coincidence. In addition, the results in the Marine index indicate that using a market value criteria could be useful in improving the portfolio performance when the P/B multiple is used. A part from these two findings, no clear advantage is evident from the two tables regarding the use of criteria.

The Sharpe ratio and hence also the ASR, assumes that all multiples have the same companies to select from, a common "universe". This because the risk free rate is used as benchmark. The next step will analyze the portfolio performance in a "micro universe", by using their BM portfolio in the ASR model instead of the risk free rate. One advantage with this method it that in accounts for differences between companies' available for selection as a result of missing accounting statistics. This method could therefore be as a better measure of the multiples ability to select stocks with high reward to risk ratio. On the other side, the multiples did have the exact same companies available, and the reason for different BM portfolio comes from the availability of the data required to calculate the multiple. Using the risk free rate will then to some extent account for the availability of the required accounting statistic, which can be seen as a measure of the multiples usefulness in practice.

When using an index one problem arise. A portfolio with lower risk will have a negative Sharpe ratio, while one with lower risk and lower return will have a positive Sharpe ratio. To solve this problem, the ranking is now limited to the portfolios with a significantly higher return and significantly lower risk at a 10% level. There are 16 portfolios that fulfill theses criteria, and among those sixteen, two had a higher average standard deviation over the period, which could be due to extreme value. These two portfolios are also excluded from the ranking to avoid comparison of positive versus negative ratios. This results in 14 portfolios which all are from the marine index. To rank the portfolios, the ASR is used, and to avoid error from a negative root, a minus in front of the relative return in the SR is used, leading to a positive value for the Sharpe ratio since all portfolios have positive relative return and negative relative standard deviation. For comparison, the ranking for each of the 14 portfolios among all companies, using the SR and ASR with risk free rate, are also viewed in Table 10. The results shows that the two best (after ASRbm) are also ranked high after SR and ASR with risk free rate, while from number three and downward, substantial ranking differences exists. This leads to a trade-off between assessing the portfolio performance using the risk free rate, which decrease the information or relative performance, and with the benchmark which account less for the total return and risk of the portfolios. For an investor the total return and risk, and more precisely the systematic risk, is relevant when assessing the portfolio performance relative to alternative investment opportunities. When analyzing whether multiples are useful tools for portfolio selection, the relative performance will be of high importance although the total return and risk can evidently not be ignored. From Table 10 we can see that the reason for the low rank of the portfolios below rank 2 (ASRbm), is low total return relative to the other portfolios, implying that the multiples have performed less well in selecting stocks that yields high future return. Hence, they are a less attractive multiple used for portfolio selection.

Multiple		Rel. CAGR	Avg. Rel. σ	Count	CAGR	σ	Skew	Kurtosis	Sharpe ratio	R	ASR	R	ASRbm	R	Index	Industri mean measure	Selection criteria
P/B	LMBM	16.7%	-4.1%	4.4	33.8%	44.7%	2.4	6.1	0.65	4	0.80	4	8.3	1	Marine	Harmonic mean	MV > 100" & 15% multiple band
P/Bxint	LMBM	17.7%	-4.5%	4.2	35.3%	44.4%	2.4	6.1	0.69	1	0.85	1	7.8	2	Marine	Harmonic mean	MV > 100" & 15% multiple band
P/B	LMBM	11.0%	-3.0%	4.1	28.1%	47.4%	2.4	6.2	0.49	10	0.58	10	7.2	3	Marine	Harmonic mean	30% multiple band
EV/EBITDA	LMBM	5.5%	-1.8%	4.6	22.6%	48.6%	2.2	5.6	0.37	26	0.41	25	5.5	4	Marine	Harmonic mean	30% multiple band
P/Bxint	LMBM	8.8%	-3.0%	4.3	26.3%	47.6%	2.5	6.7	0.45	16	0.53	15	5.4	5	Marine	Harmonic mean	30% multiple band
EV/EBITDA	LMBM	4.9%	-1.7%	5.6	22.0%	48.8%	2.3	5.8	0.35	28	0.40	29	5.3	6	Marine	Median	30% multiple band
EV/EBITDA	LMBM	6.6%	-2.3%	7.9	23.7%	48.2%	2.4	6.5	0.39	23	0.45	22	5.3	7	Marine	Median	15% multiple band
P/B	LMBM	10.4%	-4.1%	10.1	27.5%	46.4%	2.4	6.4	0.49	12	0.58	11	4.5	8	Marine	Median	No criteria
P/B	LMBM	11.3%	-4.7%	3.4	28.4%	44.1%	2.3	5.9	0.53	9	0.63	9	4.0	9	Marine	Harmonic mean	MV > 100" & 30% multiple band
P/Bxint	LMBM	7.8%	-4.2%	10.0	25.4%	46.4%	2.3	6.1	0.44	17	0.51	17	2.9	10	Marine	Median	No criteria
P/B	LMBM	5.3%	-3.3%	5.8	22.3%	47.1%	2.3	6.0	0.37	25	0.42	24	2.4	11	Marine	Median	30% multiple band
EV/Sales	LMBM	7.4%	-5.7%	4.3	24.3%	43.1%	2.4	6.3	0.45	15	0.53	16	1.9	12	Marine	Harmonic mean	MV > 100" & 30% multiple band
EV/Sales	LMBM	5.8%	-6.8%	4.4	22.9%	43.6%	2.2	5.7	0.42	19	0.48	20	1.1	13	Marine	Harmonic mean	30% multiple band
EV/Sales	LMBM	5.3%	-6.3%	7.3	22.3%	44.1%	2.4	6.2	0.40	21	0.46	21	1.1	14	Marine	Harmonic mean	15% multiple band

Table 10: Rank of portfolios with excess return and lower risk both significant at a 10% level.

7. Discussion

7.1. Results and findings

The findings are in line with previous research stating that companies with a low multiple value (value stocks) outperforms companies with a high multiple value (growth stocks). The results show that 47% of all the L portfolios had a significantly higher return than the benchmark portfolio at a 10 % level. At the same significance level, 44% of the H portfolios underperformed the benchmark portfolio.

There are two main explanations for the high performance of companies with low multiple values: compensation for risk and market inefficiency. The results in this thesis rank the performance after different reward to risk ratio methods all based on the Sharpe ratio. The high performance cannot be explained by increased risk measured by standard deviation. In fact, some L portfolios have lower risk and higher return than the benchmark portfolio.

Market inefficiency could be arising from two closely connected factors, overreactions to news and mean reversion. The overreaction hypotheses states that people tend to overreact to both positive and negative dramatic events. In line with this, and with more directly connected to multiples, research also shows that companies with low multiple values (low price to statistic ratio) tend to be undervalued in periods because investors are becoming very pessimistic after a series of bad earnings reports or bad news for the companies' profitability. When the earning prospect improves and in addition are seemingly sustainable the price will adjust upward. (Mun, Vasconcellos and Kish 1999)

If investors fail to adjust for mean reversion when analyzing cooperate growth and profitability trends. This overreaction, and hence over and under valuation of companies can occur systematically and then be used as stock selection strategy. (O'Shaughnessy 2005)

The results states that the performance of the multiples are depended on the index. Without applying criteria for portfolio selection, the P/B followed by the P/xint, and the EV/EBITDA multiple are the best performing multiples in the Marine index. In the EES index, the EV/Sales performs best followed by the P/E and P/Bxint multiple. Previous studies shows varying results, but P/E and P/B are generally good performing multiples and are popular multiples for studies testing the market efficiency, multiples valuation accuracy and excess return from portfolios based on low multiple values.

The analysis also compares the performance using harmonic mean and median measure, were the performance of in particular for the L portfolios is improved when using the harmonic mean. The use of harmonic mean is most profitable in the Marine index, but not recommended when using the EV/EBIDTA in the Marine index. This is in line with studies by Baker and Ruback (1999) and Liu et al. (2001. Both these studies found a decreased valuation error from multiples when using the harmonic mean.

The portfolio performance can be improved when using additional criteria's for portfolio selection. Which criteria is best, is however dependent on the multiple. In the Marine index, the portfolios based on P/B and P/Bxint improved the performance by limiting the selection to companies with a market value above 100 MNOK. The performance of the EV/EBITDA is also improved with the market value criteria, but the improvement is marginal. In the EES index the market value criteria improves the performance of the P/B multiple and in addition, results in a relatively strong improvement in the L portfolio performance using the P/E multiple. The multiple band criteria shows varying results, were some multiples perform better when using the multiple band, while others performs best without. Even though applying a multiple band on average increase the portfolio performance, no general conclusions for all multiples can be drawn.

The results show that portfolios with a market criteria above 100 MNOK are among the best performing multiples in the Marine index, indicating that higher reward to risk are obtained by avoiding investments in companies with a low market value. The market distress hypothesis states that smaller firms are relatively more distressed, and higher return could be expected from these stocks to compensate for the extra risk. Another view is the under reaction to bankruptcy risk hypothesis, were investors does not properly assess the bad news, leading to continuous underperformance of financial distressed firms. (Agarwal and Taffler 2007)

In regards to the performance of the multiples, the P/B multiple are the best performing one, when measuring relatively to a reward-to-risk ratio with and without accounting for investors preference for a skewed distribution in returns.

Previous studies find support for that equity multiples outperforms enterprise multiples, which is contradictory to theory stating that enterprise multiples are better because they are less affected by differences in capital structure and different accounting standards. The explanations for why equity outperforms enterprise value multiples is mainly that the enterprise value is not visible in the market. Different assumptions and assessment regarding how to value all claim in the company lead to noise in the estimation procedure and reduces the reliability of enterprise multiples. (Schreiner 2006)

Based on the results, the equity multiple P/Bxint performs best in the Marine index while the enterprise multiple EV/Sales perform best in the EES index. In an attempt of explaining the different multiples performance in the two indexes, the margins, capital intensity, ROE, ROCE and equity ratio was studied. For all variables, the two indexes showed large variations, with no evidently large differences by one varying less than the other for a factor which could link performance of a multiple to theory.

7.2. Statistical model

From Appendix 2-5 we can see that a common characteristic of the L portfolios is the high skewness coefficient ranging between 1 and 2 on average, while the H portfolio on average have between 1 and 0. This highlights the importance of including preferences for return distribution with positive skew when comparing portfolio performance. On the other hand, it reduces the reliability of the statistical test performed in this thesis. The Wilcoxon signed rank test, compare differences in means. The test assumes an equal distribution, but one group could have a parallel shifted to the right (or left). The high significance from the tests can then be because of difference in the distribution of return, and therefore less from differences in return. However, the findings do not support the use of parametric tests, since portfolio returns are generally not normally distributed. This is a highly debated problem in comparing portfolio performance.

7.3. Validity and Reliability of the results

The multiples used in this thesis have practical advantages, but has theoretically shortcomings. The multiples are calculated in their simplest form, and there by not using numbers that represents only operating earnings and values. There is a common trade-off between using the theoretical correct multiple and the ability to transfer the results. By making subjective preferences for the enterprise value calculation one could obtain results that is much due to the assumption made, and to a less extent connected to the efficiency of a enterprise multiple.

Transaction costs have not been assessed and will reduce the advantage of performing active portfolio management versus passive indexed portfolio management. The transaction cost is though minor while the results indicate a large advantage of investing in L portfolios. The results would therefore be insignificantly affected by including transaction cost.

One of the more critical caveats of this study is the choice regarding investment date. Here March 31, were set as an investment date, since the annual reports are likely to be available at this time. This is likely an ambitious assumptions leading to a certain aspect of forward knowledge in the dataset. The bias from this is unknown, and can only be assessed by changing the date.

8. Conclusion

In this thesis the performance from portfolios based on a multiple selection strategy is analyzed, where both enterprise and equity multiples are used. The studied multiples are EV/Sales, EV/EBITDA, EV/EBIT, P/E, P/B and P/B when excluding intangible assets (also called price-to-tangible book value).

Based on the results, when creating portfolios by investing in companies with low multiple values, 47 % of the portfolios in study yields significantly higher return than the benchmark index at a 10% level. In addition, 44 % of the portfolios created by investing in companies with high multiple values, yield significantly lower return than the benchmark index at a 10 % level. Relative valuation can therefore both be used to identify stocks likely to obtain high return, and indentify stocks that are likely to obtain low return.

The excess return of the L portfolios could in few cases be explained by increased risk. The performance of the L portfolios, are ranked after the adjusted for skew Sharpe ratio and the Sharpe ratio. The best performing multiples in the Marine index with no criteria is the P/B followed by the P/Bxint and the EV/EBITDA. In the EES index the EV/Sales followed by the P/E and P/Bxint are the best multiples.

The L portfolios have higher return and return-to-risk ratio when using the harmonic mean for measuring the industry multiple. Harmonic mean are also viewed as the most reasonable measure, since by averaging the yields, it gives equal weight to equal dollar invested (Baker and Ruback 1999). The median on the other hand, splits the index in half assuming equal number of underpriced and overpriced companies.

The performance of the multiples can be further improved by applying a market value criterion. The P/B and P/Bxint multiple improves performance when only investing in companies with a market value above 100MNOK. The EV/Sales multiple improves the performance by using a 15% multiple band.

The conclusion of the thesis is that a multiple selection strategy will most likely yield a higher return-to-risk ratio than the benchmark index. The recommended multiple and strategy, is to invest in companies with a P/B multiple below the harmonic mean industry multiple, and a market value above 100MNK.

However, a general principle in relative valuation is to use a variety of multiples, and look for consistency across those multiples before investing.

8.1. Suggestions for further research

A suggestion for further research is to try to identify the 'optimal' weight an investor should put on the different valuation multiples in relative valuation, when using a multivariate portfolio selection strategy.

Appendix

Appendix 1:

Rel. CAGR is the relative constant average growth rate of the L and H portfolio minus the BM portfolio, and Rel. σ is the relative average standard deviation of the L and H portfolios minus the BM portfolio. LMBM equals L minus BM and HMBM equals H minus BM. CAGR is the total average constant growth rate and σ is the total average standard deviation. These measures for the L portfolio are presented beside LMBM under CAGR and σ and beside HMBM for the H portfolio. A positive Z value for returns (Z to the left) and standard deviation (Z to the right) indicates higher return and standard deviation compared to the BM portfolio. The p-value is one-sided and equals the two-sided p-value divided by two. The count measure is the average number of companies in the portfolios over the period 31.03.2000-31.03.2009. Green shaded areas signals a significance level of 5% or below, while blue signals 10% or below.

H_0: The portfolio returns are not significantly different

H_1: The returns of the L portfolios are significantly higher and significantly lower for the H portfolio, compared to the benchmark portfolio.

H_0: Excess portfolio return leads to increased risk.

H_1: Excess returns do not significantly increase the portfolio risk.

Median ind. multiple: No criterias

			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	-1.9%	0.06	0.476	-6.3%	-2.67	0.004	10.1	15.2%	44.1%
		HMBM	-2.4%	-0.06	0.476	6.3%	2.31	0.010	10.2	14.7%	56.7%
	EV/EBITDA	LMBM	10.5%	2.31	0.010	-1.1%	-0.42	0.339	10.1	27.6%	49.3%
		HMBM	-12.8%	-2.31	0.010	1.2%	0.42	0.339	10.2	4.3%	51.7%
	EV/EBIT	LMBM	3.5%	0.42	0.339	4.6%	2.07	0.019	10.1	20.6%	55.0%
		HMBM	-7.6%	-0.42	0.339	-4.7%	-2.31	0.010	10.2	9.5%	45.7%
	P/E	LMBM	4.5%	0.30	0.384	0.1%	0.18	0.430	8.7	21.9%	48.0%
		HMBM	-7.8%	-0.06	0.476	-1.7%	-0.42	0.339	8.8	9.6%	46.2%
	P/B	LMBM	10.4%	1.95	0.025	-4.1%	-1.84	0.033	10.1	27.5%	46.4%
		HMBM	-13.5%	-1.72	0.043	4.1%	1.96	0.025	10.2	9.6%	54.5%
	P/Bxint	LMBM	7.8%	1.72	0.043	-4.2%	-2.43	0.008	10.0	25.4%	46.4%
		HMBM	-9.8%	-1.36	0.087	4.1%	2.31	0.010	9.9	7.7%	54.6%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	6.1%	1.24	0.107	-14.0%	0.18	0.430	8.8	18.2%	61.9%
		HMBM	-7.7%	-1.01	0.157	14.0%	-0.06	0.476	8.8	4.5%	89.8%
	EV/EBITDA	LMBM	7.8%	2.07	0.019	20.2%	0.53	0.297	8.8	20.0%	96.0%
		HMBM	-9.7%	-2.07	0.019	-20.3%	-0.65	0.257	8.8	2.4%	55.5%
	EV/EBIT	LMBM	0.4%	1.01	0.157	17.5%	2.07	0.019	8.9	12.6%	93.9%
		HMBM	-4.5%	-1.01	0.157	-23.5%	-2.07	0.019	8.7	7.7%	52.9%
	P/E	LMBM	5.7%	1.60	0.055	11.0%	1.24	0.107	8.1	21.5%	80.9%
		HMBM	-12.9%	-1.48	0.069	-17.9%	-1.24	0.107	7.8	2.8%	52.0%
	P/B	LMBM	6.5%	0.42	0.339	20.6%	0.30	0.384	8.8	19.0%	94.7%
		HMBM	-10.6%	-0.42	0.339	-16.9%	0.30	0.384	8.8	1.9%	57.2%
	P/Bxint	LMBM	7.4%	0.30	0.384	21.7%	0.42	0.339	8.7	20.0%	95.9%
		HMBM	-11.3%	-0.30	0.384	-18.1%	-0.06	0.476	8.7	1.4%	56.1%

Multiple band = 15%

			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	-1.8%	0.53	0.297	-5.7%	-2.55	0.005	8.4	15.3%	44.7%
		HMBM	-2.7%	-0.53	0.297	8.3%	2.55	0.005	8.3	14.4%	58.7%
	EV/EBITDA	LMBM	6.6%	1.84	0.033	-2.3%	-1.48	0.069	7.9	23.7%	48.2%
		HMBM	-13.2%	-1.84	0.033	3.1%	0.89	0.187	8.8	3.9%	53.5%
	EV/EBIT	LMBM	2.1%	-0.18	0.430	2.2%	1.01	0.157	7.7	19.2%	52.7%
		HMBM	-6.4%	0.18	0.430	-2.9%	-0.89	0.187	9.1	10.7%	47.6%
	P/E	LMBM	2.5%	-0.06	0.476	1.1%	0.77	0.221	7.4	19.9%	49.0%
		HMBM	-7.6%	0.06	0.476	-1.9%	-0.65	0.257	7.3	9.8%	46.0%
	P/B	LMBM	5.6%	1.24	0.107	-3.5%	-1.84	0.033	8.0	22.6%	46.9%
		HMBM	-8.2%	-0.77	0.221	5.7%	1.72	0.043	7.6	8.9%	56.2%
	P/Bxint	LMBM	4.7%	1.24	0.107	-3.7%	-2.19	0.014	8.1	22.2%	46.9%
		HMBM	-8.3%	-0.77	0.221	5.0%	1.84	0.033	7.9	9.3%	55.6%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	5.6%	1.24	0.107	-14.5%	-0.53	0.297	10.3	17.8%	61.3%
		HMBM	-9.4%	-1.13	0.130	20.2%	0.53	0.297	7.3	2.7%	96.0%
	EV/EBITDA	LMBM	7.3%	2.43	0.008	7.6%	-1.36	0.087	11.7	19.5%	83.4%
		HMBM	-14.9%	-2.43	0.008	-14.8%	1.36	0.087	6.0	-2.8%	61.0%
	EV/EBIT	LMBM	3.3%	1.36	0.087	16.2%	1.13	0.130	10.6	15.5%	92.0%
		HMBM	-10.2%	-1.48	0.069	-21.6%	-0.89	0.187	7.1	1.9%	54.3%
	P/E	LMBM	5.3%	1.60	0.055	13.1%	2.31	0.010	9.2	21.0%	83.0%
		HMBM	-9.9%	-1.36	0.087	-20.9%	-2.31	0.010	7.1	5.8%	48.9%
	P/B	LMBM	4.1%	0.42	0.339	9.7%	-0.30	0.384	10.8	16.6%	83.8%
		HMBM	-10.3%	-0.30	0.384	-16.0%	0.30	0.384	7.2	2.2%	58.1%
	P/Bxint	LMBM	6.1%	0.77	0.221	10.5%	-0.18	0.430	10.4	18.8%	84.8%
		HMBM	-11.3%	-0.77	0.221	-17.2%	0.06	0.476	7.2	1.3%	57.0%

Multiple band = 30 %

			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	3.7%	1.01	0.157	-5.2%	-2.67	0.004	6.4	20.8%	45.3%
		HMBM	-7.8%	-1.01	0.157	8.1%	2.67	0.004	7.2	9.3%	58.5%
	EV/EBITDA	LMBM	4.9%	1.84	0.033	-1.7%	-1.60	0.055	5.6	22.0%	48.8%
		HMBM	-13.2%	-1.72	0.043	2.1%	1.13	0.130	7.2	3.9%	52.5%
	EV/EBIT	LMBM	0.4%	-0.42	0.339	2.0%	1.01	0.157	5.8	17.5%	52.4%
		HMBM	-5.7%	0.53	0.297	-3.3%	-1.01	0.157	7.9	11.4%	47.1%
	P/E	LMBM	1.1%	-0.18	0.430	1.4%	1.01	0.157	6.2	18.5%	49.3%
		HMBM	-6.7%	0.18	0.430	-2.8%	-1.01	0.157	6.7	10.7%	45.1%
	P/B	LMBM	5.3%	1.36	0.087	-3.3%	-1.84	0.033	5.8	22.3%	47.1%
		HMBM	-3.9%	-0.89	0.187	9.0%	2.07	0.019	6.2	13.2%	59.5%
	P/Bxint	LMBM	5.1%	1.24	0.107	-3.5%	-1.96	0.025	5.8	22.6%	47.1%
		HMBM	-10.7%	-0.77	0.221	7.8%	2.07	0.019	6.1	6.9%	58.4%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	1.1%	0.65	0.257	-13.2%	-0.18	0.430	12.0	13.3%	62.6%
		HMBM	-4.3%	-0.53	0.297	23.3%	0.18	0.430	5.7	7.9%	99.1%
	EV/EBITDA	LMBM	6.6%	2.55	0.005	1.9%	-1.48	0.070	13.2	18.7%	77.7%
		HMBM	-24.1%	-2.55	0.005	-14.7%	1.48	0.069	4.4	-11.9%	61.1%
	EV/EBIT	LMBM	3.5%	1.36	0.087	16.0%	1.01	0.157	11.2	15.6%	91.8%
		HMBM	-9.8%	-1.36	0.087	-21.5%	-0.89	0.187	6.4	2.3%	54.3%
	P/E	LMBM	4.2%	1.24	0.107	13.0%	1.96	0.025	10.0	19.9%	82.9%
		HMBM	-7.8%	-1.01	0.157	-20.7%	-1.96	0.025	6.3	7.9%	49.1%
	P/B	LMBM	5.2%	0.53	0.297	6.2%	-0.89	0.187	12.0	17.6%	80.2%
		HMBM	-10.5%	-0.53	0.297	-15.6%	0.77	0.221	6.0	2.0%	58.5%
	P/Bxint	LMBM	3.6%	0.42	0.339	10.8%	0.06	0.476	11.2	16.2%	85.0%
		HMBM	-8.2%	-0.42	0.339	-17.5%	-0.18	0.430	6.4	4.4%	56.7%

Harmonic mean ind. multiple:			No criterias								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	-0.8%	0.42	0.339	-5.9%	-1.95	0.025	9.0	16.3%	44.5%
		HMBM	-1.7%	-0.42	0.339	4.6%	1.96	0.025	12.1	15.4%	55.1%
	EV/EBITDA	LMBM	11.9%	2.31	0.010	-0.3%	-0.30	0.384	9.1	29.0%	50.1%
		HMBM	-11.6%	-2.31	0.010	-0.3%	-0.06	0.476	12.0	5.5%	50.1%
	EV/EBIT	LMBM	0.7%	-0.53	0.297	2.9%	1.24	0.107	10.4	17.7%	53.3%
		HMBM	-4.3%	0.42	0.339	-3.8%	-1.24	0.107	10.7	12.8%	46.6%
	P/E	LMBM	4.9%	1.36	0.087	2.1%	1.24	0.107	8.6	22.3%	50.0%
		HMBM	-8.7%	-1.36	0.087	-2.6%	-1.36	0.087	9.6	8.7%	45.3%
	P/B	LMBM	14.6%	1.84	0.033	-0.7%	-0.53	0.297	6.8	31.7%	49.8%
		HMBM	-9.4%	-1.84	0.033	-0.3%	-0.06	0.476	14.3	7.7%	50.2%
	P/Bxint	LMBM	13.7%	1.84	0.033	-1.2%	-0.89	0.187	7.2	31.2%	49.4%
		HMBM	-9.3%	-1.95	0.025	0.1%	0.65	0.257	13.4	8.3%	50.7%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	14.4%	1.84	0.033	-13.5%	-0.89	0.187	4.8	26.6%	62.3%
		HMBM	-2.7%	-1.48	0.069	3.3%	0.77	0.221	12.9	9.4%	79.2%
	EV/EBITDA	LMBM	2.8%	1.95	0.025	5.6%	1.24	0.107	9.7	15.0%	81.4%
		HMBM	-11.1%	-1.95	0.025	-20.8%	-0.89	0.187	8.0	1.1%	55.0%
	EV/EBIT	LMBM	2.3%	1.36	0.087	8.6%	1.48	0.069	10.3	14.5%	84.4%
		HMBM	-9.2%	-1.48	0.069	-21.8%	-0.89	0.187	7.3	3.0%	54.0%
	P/E	LMBM	5.0%	1.60	0.055	0.4%	0.18	0.430	10.1	20.7%	70.3%
		HMBM	-9.2%	-1.48	0.069	-15.5%	-0.06	0.476	6.2	6.5%	54.3%
	P/B	LMBM	11.0%	0.77	0.221	63.5%	0.18	0.430	7.2	23.4%	137.6%
		HMBM	-10.8%	-1.24	0.107	-17.4%	-0.18	0.430	10.8	1.6%	56.7%
	P/Bxint	LMBM	7.5%	0.18	0.430	44.6%	0.77	0.221	7.7	20.1%	118.8%
		HMBM	-8.3%	-0.30	0.384	-19.5%	-0.77	0.221	10.0	4.3%	54.8%

Harmonic mean ind. multiple:			Multiple band = 15%								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	5.3%	1.60	0.055	-6.3%	-2.67	0.004	7.3	22.3%	44.1%
		HMBM	-9.7%	-1.72	0.043	6.9%	2.31	0.010	10.3	7.4%	57.3%
	EV/EBITDA	LMBM	5.8%	1.36	0.087	-0.9%	-0.77	0.221	7.1	22.9%	49.6%
		HMBM	-9.6%	-1.24	0.107	0.4%	0.65	0.257	9.9	7.5%	50.8%
	EV/EBIT	LMBM	0.2%	-0.18	0.430	2.1%	1.13	0.130	7.9	17.3%	52.5%
		HMBM	-6.2%	0.30	0.384	-4.0%	-1.13	0.130	9.8	10.9%	46.5%
	P/E	LMBM	4.5%	0.65	0.257	2.2%	1.24	0.107	7.1	21.9%	50.1%
		HMBM	-9.0%	-0.65	0.257	-3.2%	-1.36	0.087	8.6	8.4%	44.7%
	P/B	LMBM	13.6%	1.95	0.025	-2.3%	-1.01	0.157	5.3	30.6%	48.1%
		HMBM	-11.9%	-2.19	0.014	1.6%	1.01	0.157	12.2	5.1%	52.0%
	P/Bxint	LMBM	15.8%	1.95	0.025	-2.4%	-1.01	0.157	5.1	33.4%	48.2%
		HMBM	-12.8%	-2.19	0.014	1.7%	0.89	0.187	11.9	4.8%	52.3%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	15.8%	1.84	0.033	-14.1%	-1.13	0.130	5.0	28.0%	61.7%
		HMBM	-3.3%	-1.48	0.069	3.6%	1.01	0.157	12.7	8.9%	79.4%
	EV/EBITDA	LMBM	5.1%	2.43	0.008	1.0%	-0.30	0.384	11.6	17.2%	76.8%
		HMBM	-18.6%	-2.43	0.008	-18.9%	0.42	0.339	6.1	-6.5%	56.9%
	EV/EBIT	LMBM	1.0%	1.01	0.157	5.2%	0.89	0.187	11.6	13.2%	81.0%
		HMBM	-9.9%	-1.36	0.087	-20.4%	-0.42	0.339	6.1	2.2%	55.4%
	P/E	LMBM	2.0%	1.01	0.157	4.2%	1.48	0.069	10.8	17.7%	74.0%
		HMBM	-7.4%	-0.89	0.187	-18.3%	-1.36	0.087	5.6	8.4%	51.5%
	P/B	LMBM	11.2%	1.48	0.069	40.4%	0.30	0.384	8.1	23.7%	114.5%
		HMBM	-13.2%	-1.48	0.069	-16.4%	0.06	0.476	9.9	-0.7%	57.7%
	P/Bxint	LMBM	8.6%	0.42	0.339	29.9%	0.42	0.339	8.9	21.2%	104.1%
		HMBM	-10.2%	-0.42	0.339	-18.5%	-0.18	0.430	8.8	2.4%	55.7%

Harmonic mean ind. multiple:			Multiple band = 30 %								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	5.8%	2.19	0.014	-6.8%	-2.67	0.004	4.4	22.9%	43.6%
		HMBM	-12.1%	-2.19	0.014	10.1%	2.67	0.004	9.1	4.9%	60.5%
	EV/EBITDA	LMBM	5.5%	1.72	0.043	-1.8%	-1.60	0.055	4.6	22.6%	48.6%
		HMBM	-10.6%	-1.24	0.107	1.7%	1.13	0.130	8.1	6.4%	52.2%
	EV/EBIT	LMBM	-0.1%	-0.42	0.339	2.7%	1.01	0.157	5.9	17.0%	53.1%
		HMBM	-6.0%	0.42	0.339	-4.1%	-1.01	0.157	8.8	11.1%	46.3%
	P/E	LMBM	3.3%	0.42	0.339	0.7%	1.01	0.157	6.3	20.7%	48.6%
		HMBM	-10.8%	-0.53	0.297	-2.2%	-1.01	0.157	7.6	6.6%	45.7%
	P/B	LMBM	11.0%	1.72	0.043	-3.0%	-1.84	0.033	4.1	28.1%	47.4%
		HMBM	-12.4%	-1.72	0.043	2.9%	2.07	0.019	10.0	4.7%	53.4%
	P/Bxint	LMBM	8.8%	1.36	0.087	-3.0%	-1.96	0.025	4.3	26.3%	47.6%
		HMBM	-10.1%	-1.24	0.107	2.9%	2.07	0.019	10.0	7.5%	53.5%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	15.8%	1.48	0.069	-12.7%	-0.65	0.257	5.4	24.0%	63.1%
		HMBM	-3.3%	-1.36	0.087	3.6%	0.53	0.297	12.2	9.3%	79.4%
	EV/EBITDA	LMBM	5.1%	2.43	0.008	0.2%	-0.89	0.187	12.8	17.3%	76.0%
		HMBM	-18.6%	-2.43	0.008	-16.2%	1.24	0.107	4.9	-9.2%	59.7%
	EV/EBIT	LMBM	1.0%	1.60	0.055	1.6%	0.77	0.221	12.8	14.3%	77.5%
		HMBM	-9.9%	-1.48	0.069	-18.2%	-0.18	0.430	4.9	-0.1%	57.6%
	P/E	LMBM	2.0%	0.53	0.297	3.8%	0.77	0.221	11.4	16.7%	73.7%
		HMBM	-7.4%	-0.53	0.297	-17.8%	-0.77	0.221	4.9	11.7%	52.1%
	P/B	LMBM	11.2%	0.30	0.384	28.6%	-0.18	0.430	9.9	20.3%	102.7%
		HMBM	-13.2%	-0.53	0.297	-16.6%	0.42	0.339	8.1	0.9%	57.5%
	P/Bxint	LMBM	8.6%	0.53	0.297	30.0%	0.18	0.430	9.8	21.1%	104.2%
		HMBM	-10.2%	-0.77	0.221	-18.4%	-0.18	0.430	7.9	1.4%	55.8%

Harmonic mean ind. multiple:			MV > 100'								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	-1.4%	0.06	0.476	-4.2%	-1.84	0.033	8.1	15.4%	44.6%
		HMBM	-2.2%	-0.30	0.384	3.5%	1.48	0.069	10.8	14.6%	52.2%
	EV/EBITDA	LMBM	11.7%	2.19	0.014	0.0%	-0.53	0.297	7.7	28.7%	48.9%
		HMBM	-13.0%	-2.19	0.014	-0.6%	-0.18	0.430	11.1	4.1%	48.2%
	EV/EBIT	LMBM	1.3%	0.06	0.476	4.2%	0.89	0.187	8.8	18.4%	53.0%
		HMBM	-6.0%	-0.06	0.476	-3.2%	-1.13	0.130	10.0	11.1%	45.6%
	P/E	LMBM	8.1%	1.72	0.043	0.2%	0.65	0.257	7.4	25.0%	46.7%
		HMBM	-10.8%	-1.72	0.043	-0.7%	-0.89	0.187	9.1	6.1%	45.8%
	P/B	LMBM	17.2%	1.95	0.025	-3.5%	-1.13	0.130	5.8	34.3%	45.3%
		HMBM	-12.0%	-2.19	0.014	0.6%	0.77	0.221	13.0	5.1%	49.4%
	P/Bxint	LMBM	16.7%	1.84	0.033	-3.9%	-1.13	0.130	6.0	34.3%	45.1%
		HMBM	-11.7%	-1.96	0.025	1.2%	0.77	0.221	12.3	5.9%	50.2%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	11.8%	1.01	0.157	4.5%	0.53	0.297	4.6	21.2%	59.4%
		HMBM	-2.8%	-0.77	0.221	-2.6%	-0.53	0.297	12.4	11.8%	52.3%
	EV/EBITDA	LMBM	5.1%	2.07	0.019	1.2%	0.53	0.297	9.1	17.3%	56.1%
		HMBM	-21.4%	-2.07	0.019	-0.7%	-0.30	0.384	7.9	1.1%	54.2%
	EV/EBIT	LMBM	2.2%	1.48	0.069	2.4%	1.13	0.130	9.8	16.5%	57.2%
		HMBM	-12.2%	-1.48	0.069	-1.6%	-0.89	0.187	7.2	3.1%	53.2%
	P/E	LMBM	1.0%	1.60	0.055	-2.6%	0.06	0.476	9.7	20.6%	49.5%
		HMBM	-4.0%	-1.48	0.069	2.2%	0.06	0.476	6.2	6.5%	54.3%
	P/B	LMBM	7.8%	0.89	0.187	5.7%	-0.18	0.430	7.2	25.4%	60.3%
		HMBM	-11.6%	-1.24	0.107	-0.8%	0.18	0.430	10.1	3.6%	53.7%
	P/Bxint	LMBM	8.4%	0.30	0.384	5.7%	-0.42	0.339	7.4	24.9%	60.4%
		HMBM	-11.2%	-0.42	0.339	-0.6%	0.42	0.339	9.6	5.2%	54.1%

Harmonic mean ind. multiple:			MV > 100' and multiple band = 15 %								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	-1.4%	0.65	0.257	-5.8%	-2.55	0.005	6.9	15.4%	43.0%
		HMBM	-2.2%	-0.89	0.187	7.8%	2.07	0.019	9.1	12.9%	56.5%
	EV/EBITDA	LMBM	11.7%	1.24	0.107	-0.6%	-0.65	0.257	5.9	22.6%	48.2%
		HMBM	-13.0%	-1.01	0.157	-0.5%	-0.30	0.384	9.0	6.0%	48.3%
	EV/EBIT	LMBM	1.3%	-0.06	0.476	2.0%	0.77	0.221	6.7	17.8%	50.8%
		HMBM	-6.0%	0.18	0.430	-2.8%	-1.01	0.157	8.9	12.2%	46.0%
	P/E	LMBM	8.1%	0.89	0.187	0.4%	0.53	0.297	6.3	20.8%	47.0%
		HMBM	-10.8%	-1.13	0.130	-1.6%	-0.89	0.187	7.9	7.3%	44.9%
	P/B	LMBM	17.2%	1.84	0.033	-4.1%	-1.48	0.069	4.4	33.8%	44.7%
		HMBM	-12.0%	-2.07	0.019	2.4%	1.24	0.107	11.6	4.2%	51.3%
	P/Bxint	LMBM	16.7%	2.07	0.019	-4.5%	-1.48	0.069	4.2	35.3%	44.4%
		HMBM	-11.7%	-2.19	0.014	3.0%	1.24	0.107	11.0	3.7%	52.0%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	8.4%	1.01	0.157	3.9%	0.18	0.430	4.8	22.6%	58.7%
		HMBM	-1.0%	-0.77	0.221	-2.3%	-0.30	0.384	12.2	11.3%	52.6%
	EV/EBITDA	LMBM	4.5%	2.43	0.008	-0.3%	-0.65	0.257	10.9	18.4%	54.5%
		HMBM	-11.7%	-2.43	0.008	1.1%	0.77	0.221	6.1	-6.0%	55.9%
	EV/EBIT	LMBM	3.7%	1.13	0.130	1.2%	0.53	0.297	11.0	14.8%	56.1%
		HMBM	-9.8%	-1.48	0.069	-0.3%	-0.30	0.384	6.0	2.3%	54.6%
	P/E	LMBM	5.3%	1.01	0.157	1.1%	1.48	0.069	10.3	17.7%	53.3%
		HMBM	-8.8%	-0.89	0.187	-0.6%	-1.24	0.107	5.6	8.4%	51.5%
	P/B	LMBM	12.3%	1.48	0.069	3.8%	-0.30	0.384	8.0	29.1%	58.4%
		HMBM	-9.5%	-1.48	0.069	0.6%	0.42	0.339	9.3	-1.0%	55.1%
	P/Bxint	LMBM	11.7%	0.89	0.187	0.7%	-0.77	0.221	8.6	25.8%	55.4%
		HMBM	-8.0%	-1.01	0.157	1.2%	1.01	0.157	8.4	1.7%	55.9%

Harmonic mean ind. multiple:			MV > 100' and multiple band = 30 %								
			Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ
Marine Index	EV/Sales	LMBM	7.4%	1.96	0.025	-5.7%	-2.07	0.019	4.3	24.3%	43.1%
		HMBM	-16.0%	-1.96	0.025	8.4%	1.84	0.033	8.2	0.9%	57.2%
	EV/EBITDA	LMBM	6.2%	1.72	0.043	-1.9%	-1.13	0.130	3.9	23.3%	47.0%
		HMBM	-15.4%	-1.24	0.107	1.6%	0.65	0.257	7.3	1.7%	50.4%
	EV/EBIT	LMBM	0.6%	-0.18	0.430	2.7%	1.15	0.069	5.0	17.7%	51.5%
		HMBM	-4.3%	0.42	0.339	-3.5%	-1.60	0.055	8.0	12.7%	45.3%
	P/E	LMBM	3.0%	0.53	0.297	-0.4%	-0.06	0.476	5.6	19.9%	46.2%
		HMBM	-9.1%	-0.42	0.339	-0.8%	-0.30	0.384	7.1	7.8%	45.8%
	P/B	LMBM	11.3%	1.72	0.043	-4.7%	-1.60	0.055	3.4	28.4%	44.1%
		HMBM	-12.2%	-1.48	0.069	4.6%	1.24	0.107	9.1	4.9%	53.5%
	P/Bxint	LMBM	9.9%	1.24	0.107	-4.6%	-1.48	0.069	3.6	27.5%	44.4%
		HMBM	-10.7%	-1.13	0.130	4.6%	1.36	0.087	9.1	7.0%	53.6%
Energy, Oil & Gas Equipment & Services	EV/Sales	LMBM	4.8%	0.53	0.297	2.7%	0.77	0.221	5.3	17.6%	57.5%
		HMBM	-0.5%	-0.18	0.430	-2.3%	-0.65	0.257	11.7	12.3%	52.5%
	EV/EBITDA	LMBM	5.9%	2.67	0.004	-1.5%	-0.89	0.187	12.2	18.7%	53.3%
		HMBM	-22.0%	-2.67	0.004	3.9%	1.13	0.130	4.8	-9.2%	58.8%
	EV/EBIT	LMBM	2.8%	1.60	0.055	-0.4%	0.65	0.257	12.2	15.7%	54.5%
		HMBM	-12.8%	-1.60	0.055	1.9%	-0.18	0.430	4.8	0.0%	56.7%
	P/E	LMBM	1.4%	0.53	0.297	0.8%	0.77	0.221	11.0	16.7%	52.9%
		HMBM	-3.6%	-0.53	0.297	-0.1%	-0.65	0.257	4.9	11.7%	52.1%
	P/B	LMBM	10.8%	0.53	0.297	0.9%	-1.01	0.157	9.8	23.9%	55.5%
		HMBM	-13.5%	-0.77	0.221	1.8%	1.01	0.157	7.6	-0.4%	56.4%
	P/Bxint	LMBM	9.9%	1.13	0.130	-0.3%	-1.24	0.107	9.6	23.2%	54.4%
		HMBM	-12.8%	-1.24	0.107	1.3%	1.24	0.107	7.4	0.4%	56.0%

Appendix 2:

The results from the Marine index are ranked (R) after the adjusted for skew Sharpe ratio (ASR). The ranking using the Sharpe ratio (SR) are also presented, were the ranking number are to the right of the respective method. Index reflects either Marine or EES, industry mean measure views weather median or harmonic mean has been used and which selection criteria has been used can be seen to the right under selection criteria. For explanations of the other variables, see Appendix 1.

Multiple		Rel. CAGR	Z	P > z or P < -z	Avg. Rel. σ	Z	P > z or P < -z	Count	CAGR	σ	Skew	Kurtosis	Sharpe ratio	R	ASR	R	Index	Industri mean measure	Selection criteria
P/B	LMBM	14.6%	1.84	0.033	-0.7%	-0.53	0.297	6.8	31.7%	49.8%	2.3	5.7	0.54	1	0.64	1	Marine	Harmonic mean	No criteria
P/Bxint	LMBM	13.7%	1.84	0.033	-1.2%	-0.89	0.187	7.2	31.2%	49.4%	2.3	5.7	0.54	2	0.64	2	Marine	Harmonic mean	No criteria
P/B	LMBM	10.4%	1.96	0.025	-4.1%	-1.84	0.033	10.1	27.5%	46.4%	2.4	6.4	0.49	3	0.58	3	Marine	Median	No criteria
EV/EBITDA	LMBM	11.9%	2.31	0.010	-0.3%	-0.30	0.384	9.1	29.0%	50.1%	2.3	6.0	0.48	4	0.57	4	Marine	Harmonic mean	No criteria
EV/EBITDA	LMBM	10.5%	2.31	0.010	-1.1%	-0.42	0.339	10.1	27.6%	49.3%	2.5	6.6	0.46	5	0.54	5	Marine	Median	No criteria
P/Bxint	LMBM	7.8%	1.72	0.043	-4.2%	-2.43	0.008	10.0	25.4%	46.4%	2.3	6.1	0.44	6	0.51	6	Marine	Median	No criteria
P/E	LMBM	4.5%	0.30	0.384	0.1%	0.18	0.430	8.7	21.9%	48.0%	2.6	7.3	0.36	7	0.41	7	Marine	Median	No criteria
P/E	LMBM	4.9%	1.36	0.087	2.1%	1.24	0.107	8.6	22.3%	50.0%	2.6	7.1	0.35	8	0.40	8	Marine	Harmonic mean	No criteria
EV/EBIT	LMBM	3.5%	0.42	0.339	4.6%	2.07	0.019	10.1	20.6%	55.0%	2.6	7.1	0.29	9	0.32	9	Marine	Median	No criteria
EV/Sales	LMBM	-0.8%	0.42	0.339	-5.9%	-1.96	0.025	9.0	16.3%	44.5%	1.0	1.7	0.26	10	0.27	10	Marine	Harmonic mean	No criteria
EV/EBIT	LMBM	0.7%	-0.53	0.297	2.9%	1.24	0.107	10.4	17.7%	53.3%	2.6	7.1	0.24	11	0.27	11	Marine	Harmonic mean	No criteria
EV/Sales	LMBM	-1.9%	0.06	0.476	-6.3%	-2.67	0.004	10.1	15.2%	44.1%	1.2	2.4	0.24	12	0.25	12	Marine	Median	No criteria
EV/Sales	HMBM	-1.7%	-0.42	0.339	4.6%	1.96	0.025	12.1	15.4%	55.1%	2.4	6.4	0.19	13	0.21	13	Marine	Harmonic mean	No criteria
EV/Sales	HMBM	-2.4%	-0.06	0.476	6.3%	2.31	0.010	10.2	14.7%	56.7%	2.3	5.9	0.17	14	0.19	14	Marine	Median	No criteria
EV/EBIT	HMBM	-4.3%	0.42	0.339	-3.8%	-1.24	0.107	10.7	12.8%	46.6%	0.3	-0.4	0.17	15	0.17	15	Marine	Harmonic mean	No criteria
P/E	HMBM	-7.8%	-0.06	0.476	-1.7%	-0.42	0.339	8.8	9.6%	46.2%	-0.3	-0.5	0.10	16	0.10	16	Marine	Median	No criteria
EV/EBIT	HMBM	-7.6%	-0.42	0.339	-4.7%	-2.31	0.010	10.2	9.5%	45.7%	0.2	-0.4	0.10	17	0.10	17	Marine	Median	No criteria
P/E	HMBM	-8.7%	-1.36	0.087	-2.6%	-1.36	0.087	9.6	8.7%	45.3%	0.2	-0.2	0.09	18	0.09	18	Marine	Harmonic mean	No criteria
P/Bxint	HMBM	-9.3%	-1.96	0.025	0.1%	0.65	0.257	13.4	8.3%	50.7%	1.4	2.6	0.07	19	0.07	19	Marine	Harmonic mean	No criteria
P/B	HMBM	-9.4%	-1.84	0.033	-0.3%	-0.06	0.476	14.3	7.7%	50.2%	1.5	3.0	0.06	20	0.06	20	Marine	Harmonic mean	No criteria
P/Bxint	HMBM	-9.8%	-1.36	0.087	4.1%	2.31	0.010	9.9	7.7%	54.6%	0.6	0.0	0.05	21	0.05	21	Marine	Median	No criteria
EV/EBITDA	HMBM	-11.6%	-2.31	0.010	-0.3%	-0.06	0.476	12.0	5.5%	50.1%	1.0	1.3	0.01	22	0.01	22	Marine	Harmonic mean	No criteria
EV/EBITDA	HMBM	-12.8%	-2.31	0.010	1.2%	0.42	0.339	10.2	4.3%	51.7%	0.9	1.3	-0.01	23	-0.01	23	Marine	Median	No criteria
P/B	HMBM	-13.5%	-1.72	0.043	4.1%	1.96	0.025	10.2	3.6%	54.5%	0.6	0.1	-0.02	24	-0.02	24	Marine	Median	No criteria

Appendix 3:

The results from the EES index are ranked (R) after the adjusted for skew Sharpe ratio (ASR). The ranking using the Sharpe ratio (SR) are also presented, were the ranking number are to the right of the respective method. Index reflects either Marine or EES, industry mean measure views weather median or harmonic mean has been used and which selection criteria has been used can be seen to the right under selection criteria. For explanations of the other variables, see Appendix 1.

Multiple		Rel. CAGR	Z	P > z or P < -z	Avg. Rel. σ	Z	P > z or P < -z	Count	CAGR	σ	Skew	Kurtosis	Sharpe ratio	R	ASR	R	Index	Industri mean measure	Selection criteria
EV/Sales	LMBM	14.4%	1.84	0.033	-13.5%	-0.89	0.187	4.8	26.6%	62.3%	0.9	0.3	0.35	1	0.37	1	EES	Harmonic mean	No criteria
P/E	LMBM	5.0%	1.60	0.055	0.4%	0.18	0.430	10.1	20.7%	70.3%	1.1	1.5	0.23	2	0.23	2	EES	Harmonic mean	No criteria
EV/Sales	LMBM	6.1%	1.24	0.107	-14.0%	0.18	0.430	8.8	18.2%	61.9%	1.9	3.8	0.22	3	0.23	3	EES	Median	No criteria
P/E	LMBM	5.7%	1.60	0.055	11.0%	1.24	0.107	8.1	21.5%	80.9%	1.3	1.9	0.21	4	0.21	4	EES	Median	No criteria
P/Bxint	LMBM	7.4%	0.30	0.384	21.7%	0.42	0.339	8.7	20.0%	95.9%	2.1	5.1	0.16	5	0.17	5	EES	Median	No criteria
EV/EBITDA	LMBM	7.8%	2.07	0.019	20.2%	0.53	0.297	8.8	20.0%	96.0%	1.8	3.7	0.16	6	0.16	6	EES	Median	No criteria
P/B	LMBM	6.5%	0.42	0.339	20.6%	0.30	0.384	8.8	19.0%	94.7%	2.1	5.1	0.15	7	0.16	7	EES	Median	No criteria
P/B	LMBM	11.0%	0.77	0.221	63.5%	0.18	0.430	7.2	23.4%	137.6%	2.5	6.8	0.14	8	0.14	8	EES	Harmonic mean	No criteria
P/Bxint	LMBM	7.5%	0.18	0.430	44.6%	0.77	0.221	7.7	20.1%	118.8%	2.4	6.2	0.13	9	0.13	9	EES	Harmonic mean	No criteria
EV/EBITDA	LMBM	2.8%	1.96	0.025	5.6%	1.24	0.107	9.7	15.0%	81.4%	1.3	2.1	0.12	10	0.13	10	EES	Harmonic mean	No criteria
EV/EBIT	LMBM	2.3%	1.36	0.087	8.6%	1.48	0.069	10.3	14.5%	84.4%	1.3	1.6	0.11	11	0.12	11	EES	Harmonic mean	No criteria
EV/EBIT	LMBM	0.4%	1.01	0.157	17.5%	2.07	0.019	8.9	12.6%	93.3%	1.5	2.5	0.08	12	0.08	12	EES	Median	No criteria
EV/Sales	HMBM	-2.7%	-1.48	0.069	3.3%	0.77	0.221	12.9	9.4%	79.2%	1.3	1.8	0.06	13	0.06	13	EES	Harmonic mean	No criteria
EV/EBIT	HMBM	-4.5%	-1.01	0.157	-23.5%	-2.07	0.019	8.7	7.7%	52.3%	0.3	-0.8	0.05	14	0.06	14	EES	Median	No criteria
P/E	HMBM	-9.2%	-1.48	0.069	-15.5%	-0.06	0.476	6.2	6.5%	54.3%	0.3	-0.4	0.03	15	0.03	15	EES	Harmonic mean	No criteria
EV/Sales	HMBM	-7.7%	-1.01	0.157	14.0%	-0.06	0.476	8.8	4.5%	89.8%	0.0	-1.3	-0.00	16	-0.00	16	EES	Median	No criteria
P/Bxint	HMBM	-8.3%	-0.30	0.384	-19.5%	-0.77	0.221	10.0	4.3%	54.8%	0.3	-1.5	-0.01	17	-0.01	17	EES	Harmonic mean	No criteria
EV/EBIT	HMBM	-9.2%	-1.48	0.069	-21.8%	-0.89	0.187	7.3	3.0%	54.0%	0.3	-0.3	-0.03	18	-0.03	18	EES	Harmonic mean	No criteria
P/E	HMBM	-12.9%	-1.48	0.069	-17.9%	-1.24	0.107	7.8	2.8%	52.0%	0.2	-0.7	-0.04	19	-0.04	19	EES	Median	No criteria
EV/EBITDA	HMBM	-9.7%	-2.07	0.019	-20.3%	-0.65	0.257	8.8	2.4%	55.5%	0.4	-1.2	-0.04	20	-0.04	20	EES	Median	No criteria
P/B	HMBM	-10.6%	-0.42	0.339	-16.9%	0.30	0.384	8.8	1.9%	57.2%	0.5	-1.0	-0.05	21	-0.05	21	EES	Median	No criteria
P/B	HMBM	-10.8%	-1.24	0.107	-17.4%	-0.18	0.430	10.8	1.6%	56.7%	0.3	-1.6	-0.06	22	-0.06	22	EES	Harmonic mean	No criteria
P/Bxint	HMBM	-11.3%	-0.30	0.384	-18.1%	-0.06	0.476	8.7	1.4%	56.1%	0.5	-1.2	-0.06	23	-0.06	23	EES	Median	No criteria
EV/EBITDA	HMBM	-11.1%	-1.96	0.025	-20.8%	-0.89	0.187	8.0	1.1%	55.0%	0.4	-0.5	-0.07	24	-0.07	24	EES	Harmonic mean	No criteria

Appendix 4:

Top fifteen best performing portfolios in the Marine index ranked after the ASR.

Multiple		Rel. CAGR	z	P > z or P < -z	Rel. σ	z	P > z or P < -z	Count	CAGR	σ	Skew	Kurtosis	Sharpe ratio	R	ASR	R	Index	Industri mean measure	Selection criteria
P/Bxint	LMBM	16.7%	2.07	0.019	-4.5%	-1.48	0.069	4.2	35.3%	44.4%	2.4	6.1	0.69	1	0.85	1	Marine	Harmonic mean	MV > 100'' & 15% multiple band
P/Bxint	LMBM	16.7%	1.84	0.033	-3.9%	-1.13	0.130	6.0	34.3%	45.1%	2.3	6.0	0.65	2	0.80	2	Marine	Harmonic mean	MV > 100MNOK
P/B	LMBM	17.2%	1.96	0.025	-3.5%	-1.13	0.130	5.8	34.3%	45.3%	2.4	6.1	0.65	3	0.80	3	Marine	Harmonic mean	MV > 100MNOK
P/B	LMBM	17.2%	1.84	0.033	-4.1%	-1.48	0.069	4.4	33.8%	44.7%	2.4	6.1	0.65	4	0.80	4	Marine	Harmonic mean	MV > 100'' & 15% multiple band
P/Bxint	LMBM	15.8%	1.96	0.025	-2.4%	-1.01	0.157	5.1	33.4%	48.2%	2.4	6.0	0.59	5	0.72	5	Marine	Harmonic mean	15% multiple band
P/B	LMBM	13.6%	1.96	0.025	-2.3%	-1.01	0.157	5.3	30.6%	48.1%	2.5	6.6	0.54	7	0.64	6	Marine	Harmonic mean	15% multiple band
P/B	LMBM	14.6%	1.84	0.033	-0.7%	-0.53	0.297	6.8	31.7%	49.8%	2.3	5.7	0.54	6	0.64	7	Marine	Harmonic mean	No criteria
P/Bxint	LMBM	13.7%	1.84	0.033	-1.2%	-0.89	0.187	7.2	31.2%	49.4%	2.3	5.7	0.54	8	0.64	8	Marine	Harmonic mean	No criteria
P/B	LMBM	11.3%	1.72	0.043	-4.7%	-1.60	0.055	3.4	28.4%	44.1%	2.3	5.9	0.53	9	0.63	9	Marine	Harmonic mean	MV > 100'' & 30% multiple band
P/B	LMBM	11.0%	1.72	0.043	-3.0%	-1.84	0.033	4.1	28.1%	47.4%	2.4	6.2	0.49	10	0.58	10	Marine	Harmonic mean	30% multiple band
P/B	LMBM	10.4%	1.96	0.025	-4.1%	-1.84	0.033	10.1	27.5%	46.4%	2.4	6.4	0.49	12	0.58	11	Marine	Median	No criteria
EV/EBITDA	LMBM	11.7%	2.19	0.014	0.0%	-0.53	0.297	7.7	28.7%	48.9%	2.4	6.3	0.49	11	0.58	12	Marine	Harmonic mean	MV > 100MNOK
EV/EBITDA	LMBM	11.9%	2.31	0.010	-0.3%	-0.30	0.384	9.1	29.0%	50.1%	2.3	6.0	0.48	13	0.57	13	Marine	Harmonic mean	No criteria
EV/EBITDA	LMBM	10.5%	2.31	0.010	-1.1%	-0.42	0.339	10.1	27.6%	49.3%	2.5	6.6	0.46	14	0.54	14	Marine	Median	No criteria
P/Bxint	LMBM	8.8%	1.36	0.087	-3.0%	-1.96	0.025	4.3	26.3%	47.6%	2.5	6.7	0.45	16	0.53	15	Marine	Harmonic mean	30% multiple band

Appendix 5:

Top fifteen best performing portfolios in the EES index ranked after the ASR.

Multiple		Rel. CAGR	Z	P > z or P < -z	Rel. σ	Z	P > z or P < -z	Count	CAGR	σ	Skew	Kurtosis	Sharpe ratio	R	ASR	R	Index	Industri mean measure	Selection criterias'
P/B	LMBM	12.3%	1.48	0.069	3.8%	-0.30	0.384	8.0	29.1%	58.4%	2.5	6.9	0.42	1	0.48	1	EES	Harmonic mean	MV > 100" & 15% multiple band
EV/Sales	LMBM	15.8%	1.84	0.033	-14.1%	-1.13	0.130	5.0	28.0%	61.7%	0.9	0.4	0.38	2	0.40	2	EES	Harmonic mean	15% multiple band
EV/Sales	LMBM	14.4%	1.84	0.033	-13.5%	-0.89	0.187	4.8	26.6%	62.3%	0.9	0.3	0.35	3	0.37	3	EES	Harmonic mean	No criteria
P/E	LMBM	5.3%	1.60	0.055	-2.6%	0.06	0.476	9.7	20.6%	49.5%	1.1	1.5	0.32	4	0.34	4	EES	Harmonic mean	MV > 100MNOK
EV/Sales	LMBM	11.8%	1.48	0.069	-12.7%	-0.65	0.257	5.4	24.0%	63.1%	1.0	0.9	0.30	5	0.32	5	EES	Harmonic mean	30% multiple band
EV/EBITDA	LMBM	5.9%	2.67	0.004	-1.5%	-0.89	0.187	12.2	18.7%	53.3%	1.3	2.0	0.26	6	0.27	6	EES	Harmonic mean	MV > 100" & 30% multiple band
EV/EBITDA	LMBM	4.5%	2.43	0.008	-0.3%	-0.65	0.257	10.9	18.4%	54.5%	1.2	1.6	0.25	7	0.26	7	EES	Harmonic mean	MV > 100" & 15% multiple band
P/E	LMBM	5.0%	1.60	0.055	0.4%	0.18	0.430	10.1	20.7%	70.3%	1.1	1.5	0.23	8	0.23	8	EES	Harmonic mean	No criteria
EV/EBITDA	LMBM	4.5%	2.07	0.019	1.2%	0.53	0.297	9.1	17.3%	56.1%	1.5	2.5	0.22	9	0.23	9	EES	Harmonic mean	MV > 100MNOK
P/E	LMBM	5.7%	1.60	0.055	11.0%	1.24	0.107	8.1	21.5%	80.9%	1.3	1.9	0.21	10	0.21	10	EES	Median	No criteria
EV/EBIT	LMBM	3.7%	1.48	0.069	2.4%	1.13	0.130	9.8	16.5%	57.2%	1.4	2.1	0.20	11	0.21	11	EES	Harmonic mean	MV > 100MNOK
EV/EBIT	LMBM	2.8%	1.60	0.055	-0.4%	0.65	0.257	12.2	15.7%	54.5%	1.2	1.4	0.20	12	0.21	12	EES	Harmonic mean	MV > 100" & 30% multiple band
P/E	LMBM	5.3%	1.60	0.055	13.1%	2.31	0.010	9.2	21.0%	83.0%	1.4	2.3	0.19	13	0.20	13	EES	Median	15% multiple band
EV/EBITDA	LMBM	5.1%	2.55	0.005	1.9%	-1.48	0.070	13.2	18.7%	77.7%	1.4	2.3	0.18	14	0.19	14	EES	Median	30% multiple band
EV/EBITDA	LMBM	7.3%	2.43	0.008	7.6%	-1.36	0.087	11.7	19.5%	83.4%	1.5	2.7	0.18	15	0.18	15	EES	Median	15% multiple band

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