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**The relationship between stock returns
volatility and price multiples volatility**
Investigating the Danish, Swedish, and Norwegian stock
market

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Abstract

The purpose of this master thesis is to examine the relationship between the volatility of stock returns and the volatility of price multiples. More specifically, we investigate if the volatility of price multiples can explain the variance in the volatility of stock returns. We examine both the price-to-book ratio, the price-earnings ratio and the price-cash-flow ratio. First, we use the GARCH(1,1) model to estimate and model the volatility of the stock returns and price multiples. Second, we use a Linear regression test to analyse how the variation in the volatility of stock returns is affected by the volatility of price multiples. Furthermore, we test if the coefficient of determination is constant in time and if it varies across industries.

For our thesis, we obtain a sample of daily observations of the index stock price, P/E, P/B, and P/C ratio from companies listed on the Datastream Indices for Denmark, Sweden, and Norway in the period 2008-2018. We exclude non-listed companies. To calculate the volatility of the stock prices and price multiples we apply the use of continuously compounded returns.

The results of this thesis show that the volatility of the P/E, P/B, and P/C ratio can explain the variance in the volatility of stock returns. The results show that the volatility of the P/B ratio is the best performer, while the volatility of the P/E ratio performs worst, the results for the P/C ratio are varying. This is evident in both the Norwegian-, Swedish-, and Danish stock market. We find evidence that the explanatory power differs across industries, but there is no clear direction or trend in any of the three stock markets. Furthermore, the results indicate that the volatility of the price multiples performs best at explaining the variance in the volatility of stock returns in periods of high market uncertainty, this holds for all three stock markets.

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1.0 Introduction

The year 2018 was a dream and at the same time, a nightmare. Several records were set in terms of stock performance, and several investors' dreams were crushed. Volatility has returned. However, it is not that 2018 has been unusually volatile, it is that 2017 was unusually calm (Forbes 2018). The Dow has swung 1,000 points in a single session only eight times in its history, and five of those took place in 2018 and signs of global economic slowdown, concerns about monetary policy, political dysfunction, inflation fears and worries about increased regulation of the technology sector drive the volatility (CNN, 2018).

Recent events mean that share prices were not flat over 2018, they fell sharply, this results in not only lower prices but also higher earnings. A consequence of this is that popular earnings-based measures of stock market valuations have been pushed to relatively moderate levels. From a valuation perspective, stock markets are now a much more appealing prospect than before. Investing when valuations are cheap is an excellent long-term strategy even if there are short-term challenges facing markets like geopolitics, tightening monetary policy, and slowing global growth. However, 2018 was not all bad, on September 20th, the S&P 500 set an all-time record, and on October 3rd, the Dow Jones closed at its record (CNN, 2018).

1.1 Background

The expectation of future returns leads to an investment decision. However, as we know apart from expected future returns, there are several other factors that play a role regarding an appropriate investment decision, one of such factors is risk. A common statistical measure of the variance for a given security or market index is volatility. One can measure volatility either by using the standard deviation or variance between returns from that same security or a market index (Investopedia, 2019).

Besides volatility and expected future returns as investment factors, there are also several indicators that can be used to assess the attractiveness of a potential investment opportunity. A widely known indicator are price multiples. Such metrics are understood by investors everywhere around the world and accepted as a standard by all interested parties in a stock (Investopedia, 2019).

Price multiples are any ratio that uses the share price of a company in conjunction with some specific per-share financial metric for a snapshot on valuation (Investopedia, 2018).

The existing academic literature on price multiples is sparse, however there is much literature in textbooks discussing the subject (Sehgal & Pandey, 2010). Nevertheless, has one specific price multiple, the P/E-ratio, been subject to several studies. The P/E ratio is a well-known ratio used by many investors, due to its popularity, it is also the ratio that has received the most attention in research. Often is the existent research on the P/E ratio related to or used in combination with stock returns, stock prices, and portfolio composition. Despite receiving the most attention, the P/E ratio is not the only multiple that has been subject to academic research. The P/B, P/C, and P/S ratio gathered some attention as well. However, the attention is somewhat underwhelming, particularly the P/C and P/S ratio received the least attention. In regards to research regarding the price multiples, they share one particular similarity, namely the fact that research on the relationship between price multiples volatility and stock returns volatility is as good as nonexistent.

1.2 Problem discussion

According to several previous studies that use the P/E and P/B ratio to analyze the stock volatility; there is a link between P/E ratios and the volatility of stock prices (Shen 2000; Fama & French, 1992; Cheng et al., 1995). The articles that are available and examine the relationship between price multiples and stock prices support mixed results. In particular, the results that concern the P/E-ratio. Unlike the P/E-ratio, does the P/B-ratio receive lesser attention as a subject for research. The existing research on the P/B-ratio has not been able to present whether there is a direct link between the price multiple and the stock returns. As stated above, research regarding the P/S and P/C ratio, is virtually non-existent.

Our primary concern is towards the strength of the relationship between price multiples and the stock returns.

In this paper, we will investigate whether there is a relationship between the volatility of price multiples and the volatility of stock returns and thereby we will fill the research gap that exists within this topic. Additionally, we will examine the three largest Nordic markets, in the sample used in our thesis, these Nordic markets consist of Norway, Sweden, and Denmark. Additionally, we will also look at different industries, this allows us to be able to compare our results across industries and stock markets.

We identify the following research question:

What is the relationship between the volatility of price multiples and the volatility of stock returns in the Nordic markets (Norway, Sweden, and Denmark)?

Answering this question through conducting an empirical analysis will provide clarity on the relationship and how to interpret this link in volatility between stock returns and price multiples. By doing so, it will also be possible to assess whether the volatility of price multiples affects variation in stock returns. To measure the volatility of stock prices, we will use the standard deviation of stock returns as a proxy.

1.3 Research Purpose

There exists a noticeable lack of research regarding the link between the volatility of price multiples and stock return volatility. Nevertheless, it is not the lack of research that made us interested in this relation. It is the relation in general and the fact that valuation ratios are popular indicators frequently used by investors and traders daily. The existing literature examines either the relationship between stock prices and price multiples or the relationship between stock returns volatility and price multiples. However, no literature explicitly examines the relationship between the volatility of price multiples and the volatility of stock prices. Thus, the focus of this paper is to investigate the relationship between the volatility of the P/E, P/B, and P/C ratio and stock price volatility. This paper intends to look at the strength of this relationship, using a period of the last eleven years, from 01.01.2008 to 31.12.2018. The first step is to estimate and model the volatility of the mentioned price multiples and the stock price. The following step will be to compare the results on an aggregate and industry level for each market and lastly we will also compare across the results among the different markets. Hence we will understand whether there are any differences or similarities.

Also, we will apply a linear regression test where we will examine if the volatility of the individual price multiples can explain the variance in the volatility of stock prices. Similar to the first part of our analysis, we will divide and compare the results on an aggregate and industry level. Also, we will make a comparison of the different stock markets to investigate whether there are differences or similarities.

1.4 Research Limitation

We use the data from Norway, Sweden, and Denmark from 2008 to 2018 in our analysis. The Nordic countries are generally considered to be a region which consists of Denmark, Norway, Sweden, Finland, and Iceland. In our thesis, we will exclude Finland and Iceland, mainly since we consider the Danish-, Swedish-, and Norwegian stock market to be the largest and most important markets in northern Europe. Additionally, considering the amount of data and a period of eleven years that we examine in this thesis, we exclude Iceland and Finland due to time limitations. The extracted data used in this thesis does not include unlisted companies. Furthermore, it focuses on the Norwegian-, Swedish- and Danish stock market only. Hence, there are several biases in our thesis that can lead to a drawback. Since our data exclude unlisted companies and the Finnish and Icelandic stock market, there exists a sample selection bias.

The prices in the stock markets are shown at the point in time, but the fiscal price to book ratio could not be shown to the publicly available until the following fiscal period, resulting in a look-ahead bias. It is important to note that when researching price multiples, one should always consider the possibility of a look-ahead bias since financial metrics such as earnings or book value are not reported continuously. We take into consideration that both the sample selection- and look-ahead bias could have the chance to influence our results.

Not a limitation per se, but essential to consider is the fact that we look only at the number of changes in the volatility of stock returns that is explained by the volatility of price multiples. Hence, we ignore the fact that there could be more factors that are influencing these two. Moreover, linear regression is a simple model that can exclude external influences.

1.5 Outline

In this section, we will present the outline of this thesis. In the view of the scope of this paper, theoretical assumptions and understanding, we have chosen to divide our paper into the following six chapters:

Chapter 1, Introduction: In this chapter, we start with describing factors that can influence an investment decision and the role of price multiples. Then, we discuss previous research regarding the relationship between price multiples and stock prices and present our research question. Moreover, we present the research purpose and lastly the limitations in this thesis.

Chapter 2, Literature Review: The purpose of this chapter is to present the theoretical framework for our paper. First, we present literature regarding price multiples in general, and then we present theory regarding the relationship between price multiples and stock prices. We look into each price multiple separately. Next, we present the relationship between price multiples and the role of market efficiency, stock prices and volatility.

Chapter 3, Methodology: In this chapter, the research design will be highlighted, and we describe the applied methods used in the data processing. This will make it possible for the reader to understand step by step how we conducted our analysis and why we consider this approach to be the best suited for our study. We start by defining our sample data and time horizon. Further, we describe the stock price transformation and how Datastream calculates and aggregates the different price multiples. Next, we describe the GARCH model and Linear Regression. Lastly, we present our stated hypotheses.

Chapter 4, Empirical Analysis and Results: This chapter presents our results. These results will form the basis for answering our research question. First, we present the descriptive statistics for our data, and we then test if our data follows a normal distribution. Next, we divide the chapter into two parts. We start by presenting our results regarding the volatility in the three stock markets and make a comparison of these. In the second part, we deal with the linear regression results.

Chapter 5, Discussion of results: In this chapter, we will discuss our results described in chapter 4. By using our hypotheses, we will divide our discussion into three parts. First, we discuss the hypothesis which questions if the volatility of the price multiples explains the changes in the volatility of stock returns. Further, we discuss the coefficient of determination across industries and finally, across time.

Chapter 6, Conclusion and Recommendations: The objective of this chapter is to give a conclusion based on our findings. Furthermore, we show which contribution our paper provides, both theoretical and practical. Lastly, we will also give a recommendation regarding further research.

2.0 Literature Review

2.1 Price Multiples

The basic idea behind using multiples for valuation is that similar assets should sell for similar prices, whether they are houses or shares of stock (Koller, Goedhart & Wessels, 2015, p. 351). There are two main types of valuation multiples: enterprise value multiples and equity multiples. In this master thesis, we will use the latter.

To value non-traded companies or divisions of traded companies and to see how a listed company is valued relative to peers, one can use multiples (Koller et al., 2015, p. 351).

Although valuation multiples seem to be easy to adapt and to understand because of the simplicity in their structure, they also exhibit some disadvantages.

One drawback is the mentioned simplicity. The simplification can lead to misinterpretation since a single value is used to show complex information about a company. Additionally, multiples reflect short-term data instead of long-term data, hence the resulting values may only apply to the short-term and not in the longer future (CFI, 2019).

This thesis will investigate the relationship between the volatility of stock returns and the volatility of the subsequent price multiples:

Price-earnings ratio (P/E): stock price to earnings per share.

Price-to-book ratio (P/B): stock price to book value per share.

Price-cash flow (P/C): stock price to cash flow per share.

2.1.1 Price-Earnings Ratio

The price-earnings ratio (P/E) describes a firm's current share price relative to its per-share earnings (Investopedia, 2019). This ratio is a well-known price multiple in association with stock valuation. A high P/E ratio reflects that investors anticipate higher growth in the future, and a low P/E-ratio reflects that investors expect more moderate growth in the future.

Therefore, should an investor buy the stock when the price is low relative to its earnings and sell the stock when the price is high relative to its earnings (Shiller, 1993, p. 34).

Price-earnings ratio is one of the most widely used stock analysis tool used by both analysts and investors to determine whether a company's stock is overvalued or undervalued.

Moreover, the P/E ratio can be used to compare a stock's valuation to its industry or a benchmark index (Investopedia, 2019). There are two main types of P/E ratios, trailing P/E ratio, and forward P/E ratio. The difference is that the trailing P/E ratio uses the last 12 months of earnings per share (EPS) and the forward P/E ratio uses the future earnings guidance.

Several studies have investigated the relationship between price multiples and stock prices (Barbee, Jeong & Mukherji, 2008). Basu (1977) investigates the relationship between the performance of stocks and their price-earnings ratios. While the efficient market hypothesis states that all stock prices reflect all information and that it is impossible for investors to buy undervalued stocks, the P/E hypothesis states that the P/E-ratio may be an indicator of future stock performance. In the period from April 1957 to March 1972, Basu finds that low P/E portfolios earned a higher return than high P/E portfolios. Hence, the findings show that there is a relationship between price-to-earnings and stock returns. Lakonishok, Shleifer, and Vishny (1994) find the same relationship by showing evidence that value strategies yield a higher return. They argued that value strategies provide higher returns because they exploit the sub-optimal behavior of investors.

Many previous researchers have criticized the relationship between earning-based price multiples and forecasting of stock returns (Barbee et al. 1996). According to Reinganum (1981), has the price-to-earnings ratio no explanatory power for stock returns after controlling for firm's size. Furthermore, Fama and French (1992) also conclude in their study that there was no significant relationship between stock returns and price-to-earnings ratios after controlling for size and book-to-market.

As we can see previous researches show different arguments regarding the linkage between stock prices and the P/E ratio.

2.1.2 Price to Book Ratio

The price-to-book ratio (P/B) is used by investors to compare a firm's market to book value by dividing the price per share by book value per share (Investopedia, 2019). A stock's market value reflects the future cash flows of the company. The book value is an accounting-based measure that reflects the difference between the company's total assets and total liabilities. A high price-to-book ratio reflects that the stock is overvalued and that lower expected future gains are expected. A low price-to-book ratio reflects that the stock is undervalued and that more considerable expected future gains are expected. Generally speaking reflects a price-to-book ratio over 1 that the investors are willing to pay more than the equity per share, a book-to-market ratio below 1 reflects that the investors are willing to pay less the equity per share (Investopedia, 2019).

The price-to-book ratio is widely used in finance, and some studies show that there is a positive relationship between the price-to-book ratio and the company's returns (Fama and French, 1992). Rosenberg, Reid, and Lanstein (1985) investigate a trading strategy known as the "book-to-price" strategy. In their study, they find that companies with a low book-to-price ratio have a lower return than companies with a high book-to-price ratio. This shows that there is a relationship between a firm's book value and a firm's market value. In the study of Rosenberg et al. they investigate the book-to-price ratio. It is important to note that many investors are more familiar with the price-to-book ratio, which is simply the inverse of the book-to-price ratio (Investopedia, 2019). Hence, both ratios are identical.

Characteristics such as size, leverage, dividend yield, price-to-earnings ratio, and price-to-book have all shown evidence that they can explain cross-sectional patterns of stock returns (Daniel and Titman, 1997).

However, according to Fama and French (1992, 1996), only size and book-to-market explain the cross-sectional variation in expected stock returns. Other researchers have investigated the relationship between price-to-book ratios and stock returns across international markets (Carlo, Capaul, Rowley & Sharpe, 1993). They find that stocks with low price-to-book ratio earned excess returns over firms with a high price-to-book ratio in all the six countries they investigated. This relationship is also investigated in the Japanese market where they find that

the price-to-book ratio has an active role in explaining the cross-section of average returns in Japanese stocks (Chan, Hamao & Lakonishok, 1991).

The significant relationship between price-to-book ratio and stock returns described by Fama and French is called in to question by Kothari, Shanken, and Sloan (1995). In their research, they find that the relationship between B/MV-ratio and stock returns are far weaker than previous research findings. Kothari et al. criticize the result derived by Fama and French for being influenced by the period-specific performance of past winner and loser stocks as well as survivor bias in the Compustat data. These problems pose a serious problem to the B/MV model since a reasonable price multiple should be trusted to work under a wide variety of conditions. Another criticism of the B/MV model is that a firm's book value is affected by both the firm's age, depreciation, and inventory-accounting methods (Barbee et al. 1996).

2.1.3 Price to Cash Flow Ratio

The price-to-cash flow ratio (P/CF) or (C/P) describes the ratio between a company's stock price and its operating cash flow per share. It can be calculated by dividing the stock price by operating cash flow per share. The Price-to-cash flow ratio tells us how much a company generates in cash relative to its stock price. Many investors believe that the price-to-cash flow ratio is a more reliable valuation multiple than the price-to-earnings ratio. The reason for this is that a company's cash flow cannot be as easily manipulated as it is the case with earnings. Price-to-cash flow is especially useful when valuing companies that have positive cash flow but are not profitable because of significant non-cash charges (Investopedia, 2019). In the presented literature in this master thesis, several articles will refer to the price-to-cash flow ratio as the cash flow yield or price-to-free cash flow ratio. The price-to-free-cash-flow ratio is a more rigorous measure than the price-to-cash flow ratio, also the cash flow yield is the inverse of the price-to-free-cash-flow ratio (Investopedia, 2019).

Lakonishok, Shleifer, and Vishny (1994) take a closer examination into potential explanations on why value strategies work. A value strategy is an investment strategy which intends to select stocks, known as value stocks, with a low market value relative to its intrinsic value. The results from the study suggest that portfolios which are formed by sorting stocks on C/P produce more significant differences in returns than sorting on the inverse of the P/B ratio (Lakonishok J., Shleifer A. & Vishny W. R., 1994, p. 1549-1550). This

indicates that there is a positive relationship between a high C/P ratio and stock returns. A study conducted earlier by Chan, Hamao & Lakonishok (1991) on the Japanese stock market interestingly find similar results.

Similar to the article from Lakonishok, Shleifer and Vishny (1994) the results from the article of Chan, Hamao & Lakonishok (1991) imply that portfolios of stocks with the highest values for C/P yield higher returns. They conclude that the portfolio of stocks consisting of high C/P and B/M values earned 1,58 percent per month more than a portfolio with low C/P and B/M ratio values (Chan C.K. L., Hamao Y. & Lakonishok J., 1991, p. 21). Furthermore, they state that if more fundamental variables are included in the sample, such as the E/P ratio, results can change. Thus the finding should be interpreted with caution. Nevertheless, the study concludes also that the cash flow yield and book to market ratio seem to have the most significant impact on expected returns (Chan C.K. L., Hamao Y. & Lakonishok J., 1991, p. 20). Thus, this strengthens the evidence on the suggested positive relationship between the C/P ratio and stock returns.

It is worth noting that the C/P ratio is the ratio that has received notably the least amount of attention in the academic literature, despite its popularity in the financial community.

2.2 Price Multiples and the role of market efficiency

The fact that price multiples and stock returns depend on each other is well documented. Several researchers find that stock returns and price multiples have a significant relationship. However, the different price multiples vary in explanatory power, which indicates that some of the price multiples are more useful than others. “Market efficiency refers to the degree to which market prices reflect all available, relevant information” (Investopedia, 2018). When a market is efficient, the stock prices should reflect all available information. Hence, an investor should not be able to pick stocks that will gain excess returns.

Regarding the market efficiency theory, it should not be possible to predict future stock returns based on price multiples that depend on historical data. However, some researchers test the relationship between stock returns and price multiples, and find that the stock prices do not fully reflect the information in the price multiples.

Due to differences in the explanatory power of the price multiples, some of the information is better reflected in the stock returns. Since P/E and P/B ratio are more favorable by investors than P/CF, the information in these multiples is most likely more incorporated into stock returns (Barbee et al., 2008). Many researchers tested the efficient market theory, and they debate the ability of price multiples to predict future stock returns.

Nicholson (1960), Ball (1978), Basu (1983) and Fama and French (1993), all find a significant relationship between different price multiples and stock returns. These findings question the market efficiency theory. In the research of Campbell and Shiller (1998), they find that the P/E ratio explains as much as 40 percent of the variance in future stock prices. They conclude that stock prices have been predictable to a considerable extent.

Other researchers have questioned the ability of price multiples to prove market inefficiency. In the period 1993-1998, a mutual fund used the criteria of Fama and French (1993) to build a portfolio of value stocks. At the end of the period, the fund had gained a negative abnormal monthly return compared to the reference index, after controlling for risk (Schwert, 2002). In the study of Malkiel (2003), he points out that in 1987, the P/E ratio of the S&P 500 indicated low long-term stock returns. Over the next ten years, the S&P 500 had an average yield of 16,6%. These results question both the reliability of price multiples and their explanation power regarding an inefficient market.

While some researchers have proven the relationship between price multiples and stock returns, others have proven it wrong. Whether these studies can justify that price multiples are an indication of an inefficient market is far from clear.

2.3 Price Multiples and Stock Prices

We break the theoretical framework for our research into different parts. This part focuses on the general relationship between stock prices and price multiples, especially on the P/E-ratio and P/B-ratio, since these two are the ratios that have been subject to several research papers.

One of the first research papers that examines the relationship between stock price and the price to earnings ratio is the paper from Beidleman. Although the paper does not mention the P/E ratio directly, Beidleman (1973) argues that earnings variability is interpreted as an essential measure of the overall riskiness of the firm and has a direct effect on investors' capitalization rates, thus an unfavorable effect on the firm's shares. The objective of Beidleman's paper is to examine how earnings smoothing can affect the value of a firm and the role of management. Results from the paper strongly suggest that companies use specific devices over which they have the discretion to normalize reported earnings; in other words, companies, can manipulate earnings (Beidleman, 1973).

It should be noted that it is not mentioned in the paper. However, the results indicate that there is a link between share price and earnings.

Another paper that examines the linkage between stock prices and earnings is done by Ou & Penman (1989). Unlike the research paper from Beidleman, Ou & Penman has a bigger focus on the price-to-earnings ratio. Ou & Penman (1989) show that price changes predict earnings changes relatively poorly when accounting statements indicate a high transitory component to current earnings. They state that the reason for this is that prices not necessarily capture both transitory and long-run earnings components, while price changes reflect information about future earnings, they also reflect transitory elements of current earnings that are negatively correlated with future earnings changes (Ou & Penman 1989). Even if the main focus of the paper is to investigate earnings and its components, it shows evidence that there exists a relationship between stock prices and earnings as a part of the P/E-ratio.

In their research paper from (1998) Fama & French examine if there is a value premium in markets outside the United States and if it is possible to describe the value premium with a risk model that seems to describe U.S. returns. The findings from their paper are interesting for our thesis. The research paper does not examine the link between stock returns and price

multiples in a direct way, however the data used in the paper consists of a growth portfolio and a value portfolio, the latter includes firms whose book to market (B/M)-, earnings to price (E/P)-, cash flow to price (C/P)-ratio and dividend yield (D/P) (Fama & French, 1998, p.4). Unlike the papers from Ou & Penman (1989) and Beidleman (1973) Fama and French expand the research by examining other price multiples. Thus the P/E ratio receives less attention.

They conclude that if sorting on book-to-market equity, value stocks outperform growth stocks in twelve of thirteen important markets during the 1975-1995 period (Fama & French, 1997, 1998). Interestingly, they also conclude that they find similar value premiums when they sort on earnings/price, cash flow/price, and dividend price. The results from this study indicate that there is a link between stock returns and price multiples, in this case, the results also show that other multiples like the book to market and price to cash flow ratio can affect stock returns.

There is also evidence presented in the article from Davis (1994) that strengthens the suggested link between price multiples and stock returns. With the use of a new database along with fresh data, the article finds that the P/C ratio and the book-to-market equity, the inverse of the P/E ratio have significant explanatory power with respect to the cross-section of realized stock returns during the period from July 1940 through June 1963 (Davis L. J., 1994, p. 1579).

While some researchers have more or less proven that there exists a linkage between the P/E and P/B ratio and stock returns, the relationship between stock returns and the P/S and P/C ratio is a topic that has received the least attention. Nevertheless, some researchers suggested that other multiples like the price-sales ratio should receive more attention due to ambiguous results from research regarding the relationship between stock returns and the P/B-ratio. Furthermore, some research had evidence that earnings based variables, such as the price-earnings ratio had no explanatory power for stock returns. Motivated by this, Barbee et al. (1996) conducted a study where they investigated if sales-price and debt-equity explained stock returns better than book-market and firm size. The study's results are impressive as they provide evidence that the sales-price ratio could affect stock returns. During the 1979-1991 period, the sales-price ratio had a higher explanatory power for stock returns (Barbee et al., 1996, p. 56).

Another study conducted by Lakonishok, Shleifer & Vishny (1994) investigates if value strategies yield higher returns when using the cash flow to price ratio. The findings in their study suggest that the cash flow to price ratio can be associated with yielding more significant returns for stocks than the book to market ratio (Lakonishok J., Shleifer A. & Vishny W. R., 1994, p. 1549-1550). There is also evidence from the Japanese stock market that there is a significant relationship between fundamental variables such as cash flow yield and expected returns, particularly the book to market ratio and cash flow yield seem to have the most significant positive impact on expected returns (Chan, Hamao & Lakonishok, 1991, p. 20)

The various market multiples have different explanatory powers for stock returns, a reason for this can be the different influences of accounting methods on the different accounting numbers used to calculate the multiples. Inventory accounting methods, amortization, and depreciation, for instance, affect earnings and book values. However, cash flows or sales are unaffected. Moreover, due to historical popularity and noticeable evidence, analysts, investors, and researchers may tend to focus more on the P/E-, and P/B-ratio than on the P/S-, or P/C-ratio. A result of this can be that information contained in the first two multiples being more efficiently incorporated into stock returns than the information in the latter multiples. It can also be an explanation for why the research conducted on P/E and P/B multiples is abundant, while research on P/S and P/C is scarce.

2.4 Price Multiples and Volatility

The previous paragraph has a focus on previous literature regarding the relationship between price multiples and stock prices or returns. In this section, we will present research that has been done on the relationship between price multiples and volatility.

In the years (1992) and (1993) Fama & French published two research papers where they examined the joint roles of market risk, size, E/P, leverage, and book-to-market equity in the cross-section of average returns on NYSE, AMEX and NASDAQ stocks, the paper from 1993 can be considered as an extension of the first one. While the paper from '92 focused on stocks only, the paper from 93' extends the research by expanding the set of asset returns to be explained, and the set of variables used to explain returns, additionally, they use a different approach to test the asset-pricing models (Fama & French, 1993). While both papers cover a

broader topic, the results from the studies are interesting. Fama and French (1992) conclude that for the 1963-1990 period, size, and book-to-market equity capture the cross-sectional variation in average stock returns associated with size, E/P, book-to-market equity, and leverage. The results do not explicitly tell that there is a relationship between the B/M ratio and stock returns. However, it is reasonable to assume that the B/M-ratio could be a factor that affects the volatility of stock returns.

Moreover, the findings from the study that was published a year later show compelling indications regarding the price multiple volatility relationship as well. Stock returns have shared variation due to stock-market factors, and they are linked to bond returns through shared variation in the bond-market factors, the stock-market factors are an overall market factor and factors related to firm size and book-to-market equity (Fama & French, 1993). If we ignore the part of the findings that are related to bonds and the bond market, the results indicate that the book-to-market ratio can affect the variation (volatility) in stock returns. Furthermore, Fama & French (1993) also argue that the five factors seem to explain average returns on stocks and bonds.

The article from David and Veronesi (2013) shows that variation in the beliefs of market participants about economic and inflation regimes is what generates and interconnects stochastic changes in the relation between stock and bond prices, volatilities and cross-covariance. The results from their paper provide interesting implications and contributions to the research regarding the relationship between fundamentals and stock return volatility. The model used in their study shows that the volatility of stock returns is nonlinearly related to both the log P/E ratio and long-term yield. This also implies that return volatility at times may be positively related to the log P/E ratio (David & Veronesi, 2013, p. 737).

While the previously presented literature shows evidence that price multiples may affect the volatility of stock prices and returns, some articles examine how volatility affects multiples. Kane, Marcus & Noh (1996) investigate how the predicted volatility of future market returns affect the price-earnings ratio. In their paper, the results suggest a negative coefficient between the price-earnings ratio and market volatility. Current low values of inflation and volatility are mainly responsible for the high values of price-earnings ratio (Kane et al., 1996, p. 23). However, it is important to note that the mentioned volatility relates to changes in the market risk premium, which affects the discount rate.

Hence a higher discount rate reduces the equilibrium prices corresponding to any earnings stream. Furthermore, the empirical results also imply that the price-earnings ratio is highly sensitive to changes in market volatility (Kane et al., 1996, p. 16). The article from Kane et al. (1996) makes two interesting contributions to the literature on price multiples and volatility.

First, it suggests that variation (volatility) in stock returns may affect the variation in multiples; second, it suggests that the price-earnings ratio is more volatile relative to changes in market volatility.

The volatility of price multiples can also be affected by more factors than just the stock price component. As the measure of value per share is a factor that can be affected by a company's business policy or a country's accounting policy, resulting in differences across industries and countries. Existing academic literature shows interesting results regarding the cross-sectional variability of selected price multiples across developed markets.

Differences in the financial structure were one of the causes that motivated Bildersee, Cheh & Lee (1990) to examine the P/E ratio concerning differences in policies between the U.S. and Japanese market. In their article, they investigate the P/E ratio on an international level and investigate how the different business and ownership policies of companies in the two countries affect the variability of the price-earnings ratios. The study provides different results with interesting implications. For the Japanese market, the P/E ratio appears to be more volatile than in the U.S. market on an average level, whereas the P/B ratio shows the converse situation (Bildersee et al., 1990, p. 269). The contribution from the paper is important as it shows that the variability of price multiples varies across international markets, such as the Japanese and U.S. market provided that no adjustments have been made for accounting and financial policy differences. Although, the results indicate that the differences between the markets are narrowing and that the trends in the data point towards a relative internationalization, over time, it appears that the price multiples show increased similarity in the two markets (Bildersee et al., 1990, p. 280).

Reexamining the differences in the level of P/E ratios across U.S. and Japanese markets with a different variability measure leads to different results as documented by Cheng, Hsu & Noland (1995) in their research paper. Unlike the findings from the paper from Bildersee et al. (1990), Cheng et al. (1995) find that the volatility of the P/E ratio is consistently lower in

the Japanese market than that of the P.B. ratio and the converse seems to be true for the U.S. market. Interestingly they repeat the analysis done by Bildersee et al. (1990) and obtain the same results. However, they only apply to the sample for the U.S. market. The results for the Japanese sample is consistent with their initial analysis. Despite the inconsistency between the results presented in this study and the previous study, the provided evidence indicates that the P.B. ratio is less volatile in the U.S. market while the P.E. ratio is more stable in the Japanese market (Cheng et al., 1995, p. 32).

3.0 Methodology

The main objective in this thesis is to study the volatility of stock returns in relation with the volatility of the P/E, P/B, and P/C ratio in the Norwegian, Danish and Swedish stock market. Our research deals with the description of the volatility of stock returns and the volatility of price multiples. However, presenting the data and stating the facts is not our main objective, we also want to examine and discuss the relationship between our chosen variables. Thus, our study has the characteristics of an explanatory and descriptive research design. We divide our data by both stock market, period, and industry, in order to get a possible explanation to the results we get.

3.1 Sample data

In our thesis, the selected populations are the Norwegian, Swedish, and Danish stock markets, the selected samples are the Datastream Indices for Norway, Sweden, and Denmark with its listed companies from 2008 to 2018. In order to obtain an answer to our research question, we plan to take data from the Norwegian, Swedish, and Danish stock market during the past 11 years. The selection of the right index was an obstacle for us since the stock markets in the northern countries are relatively small by comparison with other stock markets in Europe, e.g. Germany or France. Also, not all indices contain available or valid data for regarding the price multiples. Thus, we need to find indices which satisfy our requirements for the sample data for our thesis, they need to be representative and the requirements for construction of the indices should be equal for all countries. It is important to note that the number of companies was not a criterion for our sample selection. However, we felt that the sample for each country should come from a common source since it provides consistency.

Inspired by the master thesis conducted by Gonta and Yang (2013) where the students used the companies listed on the Sweden Datastream Index as their sample, we chose also to use the Datastream Index however we expand the sample with the companies listed on the Datastream Index for Norway and Denmark.

Thomson Reuters provides trusted and innovative indices and index-related services to the investment community. The Thomson Reuters Datastream database covers 53 countries, 32 regions and 170 sectors worldwide, and daily history is available from January 1965.

Datastream Global Equity Indices provide; a standard for equity analysis and comparison that draws on the breadth and depth of the Thomson Reuters Datastream database. Also, it provides several data types for each index such as total returns, price-earnings ratio, dividend yield and more, they form an independent and comprehensive standard for equity research and benchmarking (Thomson Reuters Datastream, 2017, p. 3). A reason for why we chose the Datastream Indices as a source for our sample is due to its availability for several data types such as price multiples. The indices' composition and maintenance are governed by a set of rules, and we also consider the latter as reasonable reasons for choosing the Datastream Indices for Norway, Sweden, and Denmark as our sample.

The following presented rules are considered to be the most adequate for our choice: the size of the market determines the number of stocks for each market, and the sample covers a minimum of 75% - 80% of the total market capitalization (Thomson Reuters Datastream, 2017, p. 9). Within each market, stocks are allocated to industrial sectors using the Industry Classification Benchmark (ICB) jointly created by FTSE and Dow Jones (Thomson Reuters Datastream, 2017, p. 3). Suitability for the inclusion of stocks is determined by market value and availability of data, the largest stocks for each market are included (Thomson Reuters Datastream, 2017, p. 9).

We download the data from Thomson Reuters Datastream, which is available at Oslo Metropolitan University. The Norwegian and Danish datastream indices consist of 50 companies, while the Swedish index consists of 69 companies. We extract the data for the daily observations of the stock price, price earnings ratio, price to book ratio, price to cash flow ratio for each stock market individually. Afterward, we extract the data for each industry individually. To get a better understanding of this, we explain the process through an example for the Norwegian stock market. The main index for the Norwegian stock market is called Norway Datastream Index and contains aggregated data from the 50 constituents included in

the index. There are nine industries included in the main index. Table 3. presents the industries for the Norwegian stock market. To obtain the data for one particular industry, e.g. the Oil & Gas industry, we download the data from the Norway Datastream Oil & Gas Index, which contains aggregated data from the ten constituents included in that index. The Datastream industry-specific indices follow the exact same structure as the Datastream Global Equity Indices. We apply this procedure to all the other stock markets and industries as well.

Since we examine three different markets we expect an unequal concentration of industries across the countries, e.g. the oil industry missing in the Danish stock market. We expect that the different industry concentrations across the countries will have a bigger emphasis on the part of our analysis where we examine the relationship of the volatility of price multiples and the volatility of stock returns across industries.

In the data extracting process, we were able to obtain different data types for the price and price-earnings ratio, these data types were available in both fixed and recalculated form. We chose to download the recalculated index data types since they are recalculated historically to show the long term performance of current constituents. Moreover, this enables to avoid distortions by stocks entering or leaving a sector (Thomson Reuters Datastream, 2017, p. 10). We examine a rather long period, and the frequency of companies entering/leaving sectors is relatively high. Hence, the use of the recalculated data types is more convenient in our case. However, data types such as price to cash flow ratio and price to book ratio are only available in fixed form. Changes in these data types are based on analysis of annual reports and are recalculated historically using the current list of constituents (Thomson Reuters Datastream, 2017, p. 10). Nevertheless, even with the recalculated datatypes, we could not avoid the issue regarding industries that entered the index at a later point of time. Some companies that are representative for a specific industry were established at a later point of time in the period we examine. This results in a limited amount of available data for that specific industry.

It is important to note that we do not aggregate the data ourselves, all datatypes are downloaded in aggregated form, this means that Datastream has done the entire aggregation. This applies to all three markets we examine in this thesis, as well as the industries.

We were not able to obtain all data in the extracting process, and this forms a limitation for our thesis in terms of potential bias in the results and a weaker comparison basis. The tables 1., 2., and 3. present the summarized industries, missing data in percent and number of companies in each industry for the Danish, Swedish, and Norwegian data.

Denmark					
Industry	Number of companies	Missing data in %			
		Stock price	P/E ratio	P/B ratio	P/C ratio
Financials	9	0	8	0	0
Industrials	14	10	27	10	10
Alternativ energy	1	0	20	0	0
Basic Materials	1	0	18	0	0
Utilitites	1	77	83	77	77
Consumer Goods	7	14	29	14	14
Consumer Services	1	0	0	0	0
Technology	3	53	53	53	53
Healthcare	13	4	31	4	4
Total	50	11	26	11	11

Table 1. The industries with number of companies included and missing data in % for the Danish data.

The numbers present the missing data for each industry and also show the total amount of missing data for each variable in the entire data sample. The interpretation is as follows; e.g. in table 1. the eight percent for P/E ratio in financials means that across the nine companies in the financial industry eight percent of daily observations of the P/E ratio between the period 2008-2018 are missing. The last row named “Total” shows the missing data of the entire sample for the given market, e.g. in table 1 this means that eleven percent of the daily stock price observations across the 50 companies are missing in the period 2008-2018. This interpretation also applies for the two following tables presenting the Swedish and Norwegian data.

Sweden					
Industry	Number of companies	Missing data in %			
		Stock price	P/E ratio	P/B ratio	P/C ratio
Financials	19	3	14	3	3
Industrials	21	12	15	10	10
Telecommunication services	2	0	11	0	0
Basic Materials	6	1	9	1	1
Oil&Gas	1	0	36	0	0
Consumer Goods	7	32	34	32	32
Consumer Services	6	11	18	11	11
Technology	3	0	15	0	0
Healthcare	4	0	10	0	0
Total	69	9	16	8	8

Table 2. The industries with number of companies included and missing data in % for the Swedish data.

Norway					
Industry	Number of companies	Missing data in %			
		Stock price	P/E ratio	P/B ratio	P/C ratio
Financials	12	27	40	29	29
Industrials	8	11	28	15	11
Telecommunication services	1	0	2	0	0
Basic Materials	4	34	42	15	15
Oil&Gas	10	20	40	23	23
Consumer Goods	8	6	17	6	6
Consumer Services	4	17	58	17	17
Technology	2	43	46	43	43
Utilities	1	0	6	0	9
Total	50	19	35	19	19

Table 3. The industries with number of companies included and missing data in % for the Norwegian data.

The companies included in the respective indices for the stock markets are presented in Appendix 4, 5, and 6.

3.2 Time horizon

The time horizon in our paper is from 2008 to 2018. Since we want to investigate volatility, the choice of a period is an important issue. A more extended period provides more data both in terms of availability and number of observations. Conversely, it also increases the probability that the amount of data that is not available. From a financial perspective this makes sense, some data types, e.g. the P/E ratio will not be reported, because when a company reports a loss for a period, it will report negative earnings as “not applicable” (Investopedia, 2019). We consider a period of the last eleven years since it includes both the financial crisis and the oil price shock. Furthermore, the period contains also smaller events that affected the economy, such as the presidential election, Brexit, and also the fall in the Chinese stock market. We assume that all of the events that occurred in the past 11 years had to some degree an impact on the Nordic markets, particularly in regards to volatility. In addition to the events, we also assume that a period of 11 years provides enough data for this thesis, hence we think that the choice of our period adequate.

In our thesis, we build three periods:

The first period covers the entire interval (2008-2018), the second period covers the financial crisis and its aftermath (2008-2012) lastly, we build a third period which covers the oil price shock, its aftermath and lasts until the most recent available whole year (2013-2018).

Since we will investigate both the differences between industries at a certain point in time and the changes of the volatility of price multiples and the volatility of stock prices over several years, we will use both cross-sectional and longitudinal studies. We will use daily observations for each year of both stock prices and price multiples for each company.

We collect raw data from 31.12.2007 until 31.12.2018.

3.3 Stock Price Transformation

We study the volatility of stock prices and apply the use of the returns to calculate it. In the empirical analysis we use the DS Global Equity Index for the Danish, Swedish and Norwegian market to define daily returns. The calculations are conducted on the stock-market level. We download the default datatype for stock price from Thomson Reuters Datastream. Our raw data consists of the daily stock price for the index. To calculate the volatility of the stock prices we apply the use of continuously compounded returns.

The entire calculation of the returns was conducted in Excel using the following formula:

$$r_t = \ln\left(\frac{P_{t+1}}{P_t}\right) = \ln(P_{t+1}) - \ln(P_t) \quad (1.0)$$

Where:

P_t = the index price at the day t ;

P_{t+1} = the index price at the next day ($t+1$).

This calculation is applied to the prices for the Danish, Swedish and Norwegian market indices. Throughout the thesis we will refer to the log-returns simply as stock returns.

After we calculate the continuously compounded return (r_t), we find the daily standard deviation (σ_{daily}). To calculate the annual volatility we first calculate the standard deviation, noted as the greek letter sigma. Standard deviation measures the dispersion of a dataset relative to its mean and are calculated by the following formula:

$$\sigma_{daily} = \sqrt{\frac{1}{m-1} \sum_{i=1}^m (r_{t-1} - \bar{r})^2} \quad (1.1)$$

where:

m = number of observations

r = return

\bar{r} = mean of returns

To calculate the annual volatility we will apply the square root of time rule. The rule argues that the relationship between time and volatility, as measured by standard deviation, increases with the square root of time (Breakingdownfinance, 2019).

We calculate the annual volatility by using the following formula:

$$\sigma_{annual} = \sigma_{daily} * \sqrt{T} \quad (1.2)$$

Where:

$$T = 252$$

According to the formula stated above, volatility is measured by the return provided by the variable, in our case, the index price. One could argue that there are better ways to calculate annual volatility. Regarding the formula above, in principle, the mentioned square root of time rule only applies to the case when returns follow a normal distribution. In a later section of this paper, we show that this is not the case for our data, we provide evidence that our data follows a t-student distribution. Hence it is not quite adequate to apply the square root of time rule in our case. However, the object in our thesis is not to provide an in-depth analysis of risk in the given markets. We want to examine and gain a better insight in the behavior and development of volatility in the Nordic markets in the last eleven years. Moreover, we want to investigate if the volatility of price multiples can explain the changes in the volatility of stock returns. Therefore for our paper, the simple concept such as the square root of time rule is sufficient for calculating the annual volatility.

3.4 Price Multiples

We download the default data types for the price-earnings ratio, price-to-book ratio, and price-to-cash flow ratio. The raw data consists of the daily observations of the price multiples on the stock market level. Since we use aggregated data calculated by Datastream we need to clarify these calculations.

In Datastream the P/E ratio is defined as follow, “derived by dividing market value by the total earnings, thus providing an earnings weighted average of the P/E ratio of the constituents” (Thomson Reuters Datastream, 2017, p. 24).

Where the earnings per share for Sweden and Denmark is extracted from a local source, and the earnings per share for Norway is obtained from a Worldscope database. The formula used is illustrated below:

$$\frac{P}{E} = \frac{\sum_1^n (P_t * N_t)}{\sum_1^n (E_t * N_t)} \quad (1.3)$$

Where:

$\frac{P}{E}$ = price earnings ratio on day t

P_t = price on day t

N_t = number of shares in issue on day t

E_t = earnings per share on day t (negative earnings per share are treated as zero)

n = number of constituents in index

In Datastream, the aggregated P/B ratio is calculated as follows:

$$\frac{P}{B} = \frac{\sum (P \times NOSH)}{\sum (X (1380) \times NOSH)} \quad (1.4)$$

Where:

$\frac{P}{B}$ = price to book ratio

P = latest daily price

$NOSH$ = latest number of shares

1308 = book value per share

1308 refers to the proportioned common equity divided by outstanding shares at the company's fiscal year end (Thomson Reuters Datastream, 2017, p. 26).

The P/C ratio is derived by dividing market value by the latest total cash earnings amount (Thomson Reuters Datastream, 2017, p. 23).

In Datastream, the aggregated P/C ratio is calculated according to the following formula:

$$PCE_t = \frac{\sum_1^n (P_t * N_t)}{\sum_1^n (CE_t * N_t)} \quad (1.5)$$

Where:

PCE_t = price/cash earnings ratio on day t

P_t = price on day t

N_t = number of shares in issue on day t

CE_t = cash earnings per share on day t

N_t = number of constituents in index

In order to make the results comparable we conduct the transformation applied to stock prices to the price multiples as well. Therefore, we use the logarithmic values of the price multiples to calculate volatility.

The entire calculation of the logarithmic values of the price multiples was conducted in Excel using the following formula:

$$\log X_t = \ln\left(\frac{X_{t+1}}{X_t}\right) = \ln(X_{t+1}) - \ln(X_t) \quad (1.6)$$

Where:

X_t = the given price multiple ($\frac{P}{E}$, $\frac{P}{B}$ or $\frac{P}{C}$) at the day t ;

X_{t+1} = the given price multiple ($\frac{P}{E}$, $\frac{P}{B}$ or $\frac{P}{C}$) at the next day ($t+1$).

As we mentioned above we apply the same calculation as for the returns to calculate volatility and annual volatility:

$$\sigma_{daily} = \sqrt{\frac{1}{m-1} \sum_{i=m}^m (\log X_{t-i} - \overline{\log X})^2} \quad (1.7)$$

Where:

m = number of observations

$\log X$ = log return of a given price multiple

$\overline{\log X}$ = mean of log returns of a given price multiple

$$\sigma_{annual} = \sigma_{daily} * \sqrt{T} \quad (1.8)$$

This calculation is applied to the price multiples for the Danish, Swedish and Norwegian data. Throughout the thesis we will refer to the logarithmic values of the price multiples by using $\log(\text{given Price multiple}) + \text{given stock market}$, e.g $\log PE$ Sweden.

3.5 GARCH Model

The development of stochastic models such as GARCH models is intended to model particular phenomena. One of the phenomena that applies to volatility is the so-called volatility clustering. Financial assets with time series often exhibit the volatility clustering property, meaning that significant changes in price tend to cluster together, resulting in persistence of the amplitudes of price changes (Cont, 2007, p. 1).

In order to model the volatility, we employ to use the GARCH (Generalized Autoregressive Conditional Heteroskedasticity). The GARCH model is a natural generalization of the ARCH model, which was first introduced by Engle (1982). In the light of the limitations of the ARCH class of models, Bollerslev (1986) argues that it seems to be of practical use to extend the model to allow for both a longer memory and a more flexible lag structure. Thus he introduced the GARCH model. As the above-mentioned volatility clustering is a property that usually applies to time series in financial assets, they display a form for heteroskedasticity. The presence of heteroskedasticity can affect the standard errors and confidence intervals estimated by conventional procedures (Engle, 2001, p. 157). In statistical analyses, this can be viewed as a problem. However, GARCH models treat heteroskedasticity as a variance that can be modeled, this results not only in a correction of the shortcomings of the ordinary least squares but also in the calculation of a prediction for the variance of each error term (Engle, 2001, p. 157).

The GARCH (p,q) process is written as follows:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^p \alpha_i a_{t-1}^2 + \sum_{j=1}^q \beta_j \sigma_{t-1}^2 \quad (1.9)$$

Where:

p = number of autoregressive lags

q = number of moving average lags

α, β = GARCH parameters

a^2 = the squared residuals

GARCH (1, 1) is the the simplest model. In the study of Hansen and Lunde (2001) they question whether the evolution of volatility models has led to better forecast of volatility when compared to the first group of volatility models. They conclude that none of the new models can provide a significantly better forecast than the GARCH (1, 1) model.

We provided tests to determine the appropriate model for the stock returns and logged price multiples and consider to use a MA(1) model.

The model for the stock returns and logged price multiples is:

$$y_t = \mu + \theta a_{t-1} + a_t, a_t \sim N(0, \sigma_t^2) \quad (2.0)$$

The GARCH (1, 1) process is written as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 a_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (2.1)$$

Where:

μ = mean

θ = MA parameter

α, β = GARCH parameters

a^2 = the squared residuals

This model is widely used by researchers, especially to measure volatility in financial time series. One of the prerequisites for the GARCH model to work is that the data used is following a normal distribution. However, several researchers find that financial time series usually display both leptokurtosis and negative skewness (e. g. Mandelbrot, 1963 and Glosten et al., 1993). To solve this problem, researchers traditionally use the student-t distribution or the general error distribution (GED) (Feng and Shi, 2017). Research regarding which distribution that fit financial data best is scarce.

However, Egan (2007) investigates the fit of three different statistical distributions to the returns of the S&P 500 index and concludes that the student-t distribution is the most accurate. Hence, we will in this thesis use GARCH (1, 1) with a student-t distribution.

3.6 Linear Regression

Since the main object of our thesis is the relationship between the volatility of stock returns and the volatility of price multiples, we plan to analyze how the variation in the volatility of stock returns is affected by the volatility of price multiples. Unlike the correlation coefficient which only describes the strength and direction of a relationship between any two variables, regression describes a relationship between an explanatory variable (x) and a dependent variable (y) (Moore et al., 2011, p. 100). Hence, a linear regression provides a suitable model where an explanatory variable predicts the dependent variable.

A common method for fitting a regression line to data is least squares and an important indicator that describes the strength of a straight-line regression is R-squared (Moore et al., 2011, p. 106). The simple linear regression model is formulated as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i \quad (2.2)$$

Where:

Y_i = the dependent variable

β_0 = population y intercept

β_1 = population slope coefficient

X_i = the independent variable

ϵ_i = random error term

R-squared is defined as a statistical measure that represents the proportion of the variance for a dependent variable that is explained by an independent variable in a regression model (Investopedia, 2019). The formula used to calculate the R-squared is as follows:

$$R^2 = \frac{SSR}{SST} = \frac{\sum (\hat{y}_i - \bar{y})^2}{\sum (y_i - \bar{y})^2} \quad (2.3)$$

Where:

$SSR = \text{sum squared regression}$

$SST = \text{sum squared total error}$

$\hat{y} = \text{predicted values}$

$\bar{y} = \text{mean of } y$

We will use the program “R” to perform the regression analysis and to calculate the value of R-squared. We will use the volatility of the price multiples as the explanatory variable and the volatility of stock returns as the dependent variable.

3.7 Hypothesis Testing

In our literature review, we presented several papers that examined the relationship between the stock prices and the price multiples or their volatility. However, only the master thesis conducted by Gonta and Yang (2013) analyzed the direct relationship between the volatility of stock returns and the volatility of price multiples on the Swedish market for the period 2003-2012. We intend to extend this analysis by expanding the sample with the Norwegian and Danish stock market. Also, we will repeat the tests on the Swedish stock market with a different sample. Furthermore, we will examine the period 2008-2018. In addition to that, we also follow the suggestions made by Gonta and Yang (2013) and expand the examined variables by the price-to-cash flow ratio.

However, unlike Gonta and Yang, we do not intend to apply correlations tests, since we are already testing how the volatility of the stock returns is affected by the volatility of the price multiples by performing linear regression, testing for correlations is redundant.

The coefficient of determination (R-squared) is the coefficient of correlation squared, hence performing correlation tests is not necessary. Furthermore, it is reasonable to assume that the

coefficient of determination contains a more considerable relevance from an investors perspective than just a simple correlation in terms of the potential prediction of stock returns.

When we form our hypotheses, we will formulate simple hypotheses since we are not able to test any of the hypothesis statistically. We will either accept or discard the hypotheses by inspecting the results we get from our analysis.

To test the relationship between the volatility of stock returns and the volatility of price multiples, we have formulated the following hypothesis:

Hypothesis 1:

We want to test if for a given market, the volatility of the P/E ratio explains the changes in the volatility of stock returns or not.

In the master thesis of Gonta and Yang (2013) they conclude that the volatility of the P/E ratio explains the changes in the volatility of stock returns in the Swedish stock market for the period from 2003 to 2012. We want to test if this also applies for the period from 2008 to 2018 for all of the three markets. Further, we question whether the coefficient of determination will vary across industries and time.

Hypothesis 2:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/E ratio varies across industries or not.

Hypothesis 3:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/E ratio is constant in time or not.

For the Swedish stock market, Gonta and Yang (2013) find that the coefficient of determination between the volatility of stock returns and the volatility of the P/E ratio varies

across industries. They also conclude that the correlation between the volatility of stock returns and the volatility of the P/E ratio is non-constant in time.

The following hypotheses question the same as stated above, only they refer to the P/B ratio and P/C ratio. First, we examine whether the volatility of the P/B ratio explains the changes in the volatility of stock returns. Additionally, we also consider both the industry and the time aspect.

Hypothesis 4:

We want to test if for a given market, the volatility of the P/B ratio explains the changes in the volatility of stock returns or not.

Hypothesis 5:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/B ratio varies across industries or not.

Hypothesis 6:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/B ratio is constant in time or not.

For the Swedish stock market, Gonta and Yang (2013) find that the volatility of the P/B ratio explains the changes in the volatility of stock returns. They also conclude that the coefficient of determination between the volatility of stock returns and the volatility of the P/B ratio varies across industries and are non-constant in time.

The last hypotheses consider the relation between the volatility of the P/C ratio and the volatility of stock returns. The first hypothesis examines whether the volatility of the P/C ratio explains changes in the volatility of stock returns. The last two hypotheses examine the industry and the time aspect.

Hypothesis 7:

We want to test if for a given market, the volatility of the P/C ratio explains the changes in the volatility of stock returns or not.

Hypothesis 8:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/C ratio varies across industries or not.

Hypothesis 9:

We want to test if for a given market, the coefficient of determination between the volatility of the stock returns and the volatility of the P/C ratio is constant in time or not.

4.0 Empirical Analysis and Results

4.1 Descriptive statistics and Normality Tests

Before starting with the analysis, we will present descriptive statistics for the data on an aggregate level we intend to use in our analysis. Since we work with financial data, it is important to evaluate statistics such as skewness and kurtosis are The latter is essential as it describes what type of distribution the data follows.

We will use stock returns and the log return for the P/E, P/B, and P/C ratio.

Denmark				
Statistic	Stock returns	logPC	logPB	logPE
Mean	0,00022	0,00003	0,00002	-0,00004
Standard Deviation	0,01280	0,01509	0,01357	0,02183
Sample Variance	0,00016	0,00023	0,00018	0,00048
Kurtosis	7,33673	29,74733	8,51136	215,35889
Skewness	-0,28951	-1,37895	-0,57574	-3,01431

Table 4. The descriptive statistics for the logged values for the Danish market

Sweden				
Statistic	Stock returns	logPC	logPB	logPE
Mean	0,00017	0,00006	-0,00002	0,00006
Standard Deviation	0,01355	0,01557	0,01456	0,01773
Sample Variance	0,00018	0,00024	0,00021	0,00031
Kurtosis	5,39122	19,22576	9,76197	19,90760
Skewness	-0,07721	-1,06791	-0,66953	0,13136

Table 5. The descriptive statistics for the logged values for the Swedish market

Norway				
Statistic	Stock returns	logPC	logPB	logPE
Mean	0,00007	0,00000	-0,00012	0,00012
Standard Deviation	0,01496	0,02012	0,01590	0,02295
Sample Variance	0,00022	0,00040	0,00025	0,00053
Kurtosis	7,40888	92,77369	6,96420	49,77800
Skewness	-0,53574	-3,00886	-0,63189	1,50742

Table 6. The descriptive statistics for the logged values for the Norwegian market

Table 4., 5. and 6. show the descriptive statistics for the logged values from each market. The two statistics that are interesting for our analysis are kurtosis and skewness; the latter is negative for the data for stock returns for each market. Moreover, the statistics show excess kurtosis for the data for all variables in every market, this indicates that our data does not follow a normal distribution. In the paper from DeCarlo (1997), he describes a normal distribution with the value of 3 for kurtosis. Hence every value above or under will be a reference for another type of distribution. In our case the values show excess kurtosis, also named leptokurtic. If the value for kurtosis is above 3, the data follows a t-distribution (DeCarlo, 1997, p. 292).

Furthermore, we observe that the statistics for kurtosis for the variables logPC for Norway (92,77) and logPE for Denmark (215,35) are much higher compared to the other statistics for kurtosis across the different markets. T-distributed data has heavier tails and higher peak than the normal distribution (DeCarlo, 1997, p. 293). Moreover, we observe that all statistics except logPE for Norway (1,50) and logPE for Sweden (0,13) display negative skewness.

In addition to the descriptive statistics, we test if our data follows a normal distribution by performing the Shapiro-Wilk test. Moreover, we plot the aggregate data for returns, logPC, logPB, and logPE for each market to visualize the distribution. Appendix 1,2 and 3 presents the normality plots and histograms. Table 7. shows the results from the Shapiro-Wilk test.

Indicator	Denmark		Sweden		Norway	
	Shapiro-Wilk		Shapiro-Wilk		Shapiro-Wilk	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
returns	0,92851	2,20E-16	0,93381	2,20E-16	0,90847	2,20E-16
logPC	0,82894	2,20E-16	0,85743	2,20E-16	0,71298	2,20E-16
logPB	0,91059	2,20E-16	0,90367	2,20E-16	0,89957	2,20E-16
logPE	0,5675	2,20E-16	0,83102	2,20E-16	0,7137	2,20E-16

Table 7. Shapiro-Wilk Test for Normality

The null hypothesis in the Shapiro-Wilk states that the data follows a normal distribution, and the alternative hypothesis states that the data does not follow a normal distribution. The results presented in the table show that the results are significant on a 1% level. Therefore, we can reject the null hypothesis and conclude that our data does not follow a normal distribution, this allows us to use the GARCH model with the t-student distribution.

4.2 Volatility Results

In this paragraph we will present the estimated volatility values for the Danish-, Swedish- and Norwegian stock market individually. We start with the presentation of the volatility of the P/E ratio in the Danish stock market. Then we present the volatility of the P/B and P/C ratio. Moreover, we also present the results for the Swedish and Norwegian stock market.

The volatility presented in the graphs for each market is estimated by the use of the GARCH model, which we described in chapter 3, the yearly volatility values are presented in table 9, 10 and 11. To get the yearly values we applied formula 1.2 stated in chapter 3. Subsequently, we compare the results across the countries at the end of this paragraph.

4.2.1 Volatility in the Danish Stock Market

Figure 1. presents the volatility movements of the P/E ratio. The figure shows eight big spikes. These occurred at the end of 2008, at the start of 2009, 2010, 2011, 2012 and 2016 and the end of 2014. It seems that at the turn of the year except for 2013 to 2014, the volatility takes on a very high value, hence the big spikes. Throughout the entire period, we can observe this pattern. A reason for the high volatility values can be jumps in stock prices. Thus it is likely that stock returns are the factor that forces the volatility of the price multiple to change abruptly. Also, it is not easy to observe, but the volatility seems to flatten out fast right after the big spikes occur.

On a general basis, it can be said that the spikes for the P/E ratio are more vastly and appear more frequently. However, it is also worth mentioning that the duration of the spikes is relatively short, and periods where high volatility persists for a while, are rarely.

In comparison to the volatility of the other multiples, the P/E ratio comprises taller spikes. The highest volatility value is in February 2011 (4.854), and the lowest is in August 2013 (0.182).

The oil price shock, which occurred about at the end of 2014, appears to have stronger fluctuations in the volatility. Hence, the two big spikes at the end of the year 2014 can be an indication for the shock. The presidential elections in 2016, or the OPEC cut or the crash in the Chinese stock market could be a reason for the big spike at the beginning of 2016.

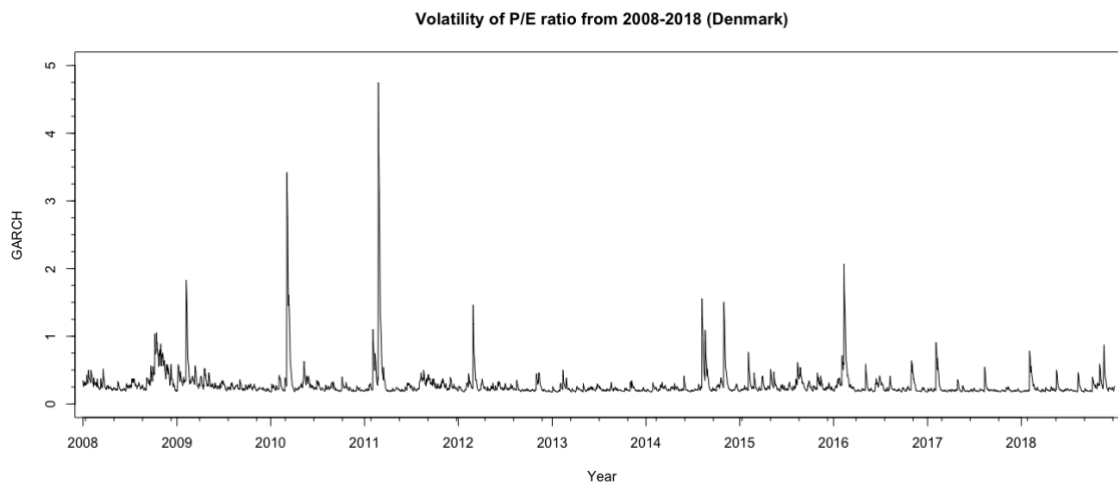


Figure 1. Volatility of P/E ratio for the Danish stock market

Figure 2. presents the volatility of the P/B ratio. Unlike the volatility of the P/E ratio, the volatility of the P/B ratio shows fewer big spikes. We can see a significant spike at the beginning of 2010, as well as at the start of 2014 and also at the start of 2018, however the highest value for the volatility is in the last quarter of the year 2008 in October (0.878), while the lowest value is in October 2017 (0.091). Also, the highest values that are recorded for the volatility of the P/B ratio are much smaller than the highest values recorded for the volatility of the P/E ratio. This can imply that the volatility of the P/B ratio is less sensitive.

On the other hand, it can also imply that the book value per share is a variable that comprises higher stability. Moreover, as for the P/E ratio, it seems that the volatility of the P/B ratio increases particularly during the turn of the year, nevertheless this is only the case for the

years 2010, 2014, 2016 and 2018. We can also observe that the periods of high volatility last longer than it was the case for the volatility of the P/E ratio and that the spikes flatten out more evenly and less abrupt.

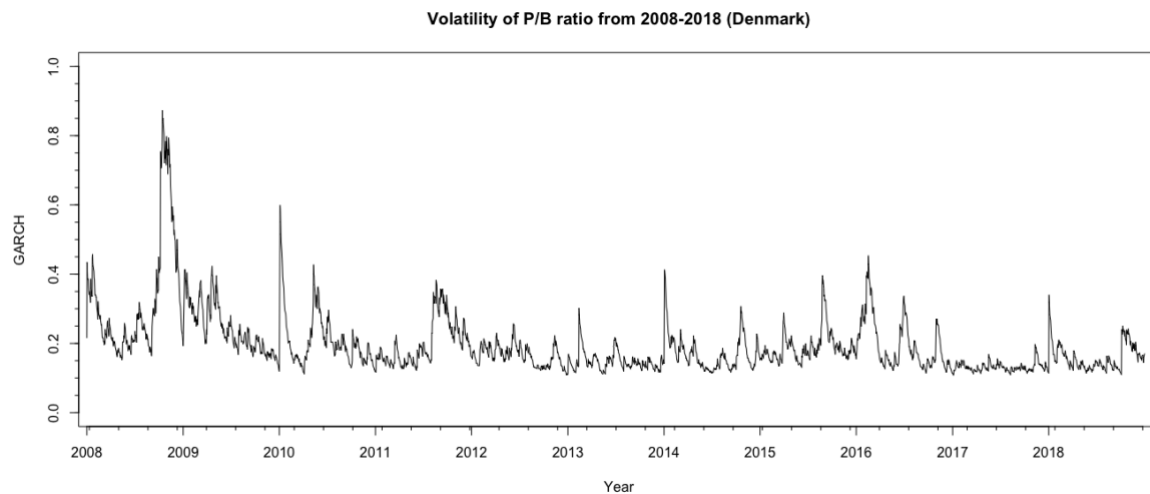


Figure 2. Volatility of P/B ratio for the Danish stock market

Lastly, the volatility of the P/C ratio is presented in figure 3. The volatility of the P/C ratio seems to follow a similar pattern as the volatility of the P/E ratio in regards to the fact that during the turns of the years, especially right at the beginning of the following year, the volatility makes sharp jumps, with some exceptions. There are big spikes at the beginning of each year except for 2015. The highest value for the volatility of the P/C is recorded in January 2014 (1.148). Similar to the P/B ratio, the lowest value for the volatility of the P/C ratio is in October 2017 (0.096). Although it is not evident at first glance, the periods where the volatility of the P/C ratio is high last a bit longer compared to the volatility of the P/B ratio.

Nevertheless, the P/E ratio shows the highest volatility values when we compare the plots. Furthermore, it seems that the volatility comprises lesser sharp fluctuations in the ending of the eleven-year period and periods where volatility is calm are more persistent, this applies to the other two price multiples as well. It is important to note that the scale of the y-axis in the plot for the volatility of the P/E ratio is larger compared to the other two. However, we are forced to use a bigger scale to be able to present the entire graph.

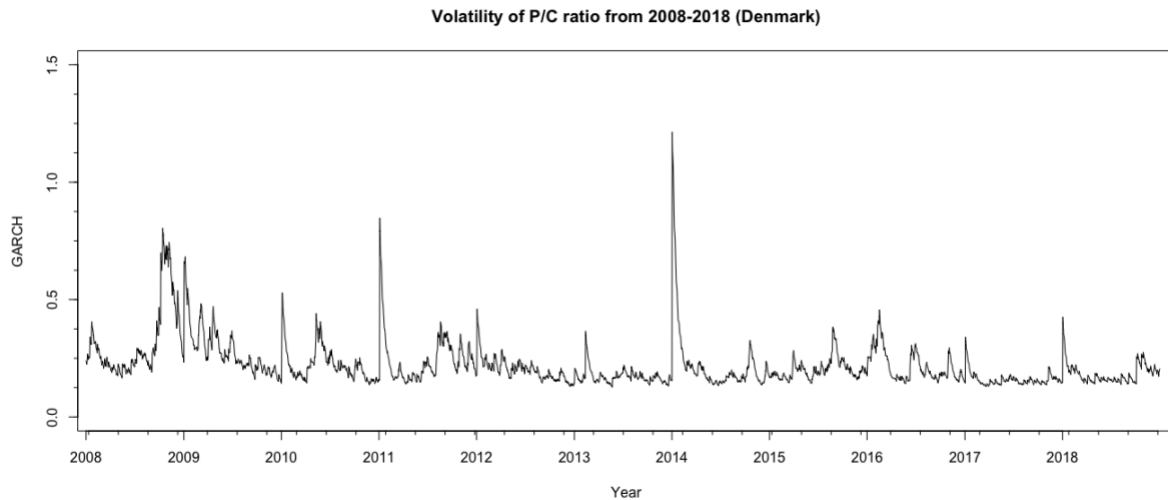


Figure 3. Volatility of P/C ratio for the Danish stock market

Table 9. shows the yearly values for the volatility. The yearly values were calculated by applying formula 1.2. The same formula has been applied for the Swedish and Norwegian stock market. From the table, we can see that the highest volatility values are in 2008 for the stock returns, P/B- and P/C ratio (0.372, 0.399 and 0.376 respectively) on the aggregated level. However, the highest yearly value for the P/E ratio is in 2011 (0.617).

Furthermore, for the stock returns, the highest values across the industries are all in 2008 expect within the basic materials industry, which records its highest volatility value the following year. On the contrary, the highest values for the volatility of the price multiples in the different industries occur in different years. To get a better understanding of the values presented in table 9., we also downloaded the daily observations of the stock prices for the S&P 500, logged the stock prices to get the stock returns and applied the same formula we used to get the values in table 9. Since the focus of our thesis is on the Danish, Swedish and Norwegian stock markets we will limit the data for the S&P 500 only to the volatility of the stock returns for the period from 2008 to 2018. When we compare the yearly values of the volatility of stock returns for the S&P 500 against the Danish counterpart, we can see that the values are relatively similar. However, it seems that the S&P 500 was more volatile right at the start and the end of the period, while the Danish stock market appears to be more volatile in the period from 2012 until 2017.

Volatility of Stock Returns (S&P500)											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aggregate	0,410	0,273	0,181	0,234	0,128	0,111	0,114	0,155	0,131	0,067	0,171

Table 8. Yearly values for the volatility of stock returns for the S&P 500

Volatility of Stock Returns											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,424	0,332	0,251	0,301	0,219	0,168	0,156	0,189	0,226	0,127	0,180
Industrials	0,487	0,412	0,284	0,281	0,238	0,169	0,194	0,224	0,265	0,160	0,199
Alternative Energy	0,838	0,515	0,487	0,575	0,736	0,526	0,450	0,331	0,350	0,362	0,289
Basic Materials	0,430	0,822	0,653	0,472	0,308	0,258	0,278	0,264	0,310	0,299	0,320
Consumer Goods	0,556	0,415	0,253	0,335	0,227	0,171	0,189	0,221	0,209	0,155	0,162
Consumer Services	0,379	0,280	0,205	0,191	0,142	0,079	0,100	0,183	0,224	0,200	0,162
Technology	0,519	0,317	0,282	0,302	0,233	0,220	0,250	0,260	0,273	0,206	0,255
Healthcare	0,292	0,238	0,179	0,204	0,174	0,173	0,171	0,229	0,255	0,149	0,192
Aggregate	0,372	0,253	0,190	0,207	0,152	0,131	0,148	0,189	0,205	0,105	0,142
Volatility of P/C ratio											
Financials	0,482	0,826	0,669	0,336	0,251	0,301	0,301	0,195	0,246	0,195	0,184
Industrials	0,502	0,699	0,844	0,458	0,300	0,180	0,331	0,246	0,432	0,185	0,383
Alternative Energy	0,868	0,612	0,920	1,620	1,077	0,796	0,843	0,410	0,616	0,438	0,357
Basic Materials	0,430	1,276	1,577	0,423	0,456	0,231	0,269	0,668	0,316	0,464	0,320
Consumer Goods	0,681	0,638	0,303	0,342	0,271	0,201	0,214	0,221	0,361	0,172	0,167
Consumer Services	0,378	0,603	0,205	0,380	0,192	0,082	0,155	0,206	0,227	0,212	0,162
Technology	0,551	0,363	0,284	0,356	0,270	0,239	0,274	0,339	0,300	0,234	0,323
Healthcare	0,297	0,260	0,257	0,231	0,192	0,250	0,202	0,282	0,348	0,168	0,211
Aggregate	0,376	0,305	0,228	0,272	0,194	0,148	0,281	0,193	0,218	0,130	0,171
Volatility of P/B ratio											
Financials	0,432	0,352	0,274	0,319	0,239	0,200	0,174	0,208	0,241	0,145	0,193
Industrials	0,520	0,419	0,326	0,276	0,236	0,176	0,229	0,230	0,277	0,197	0,225
Alternative Energy	0,873	0,678	0,525	0,591	0,911	0,534	0,564	0,392	0,369	0,360	0,292
Basic Materials	0,380	0,668	0,573	0,428	0,329	0,247	0,274	0,378	0,328	0,365	0,321
Consumer Goods	0,780	0,415	0,408	0,345	0,246	0,186	0,273	0,278	0,252	0,175	0,163
Consumer Services	0,380	0,283	0,208	0,193	0,148	0,096	0,115	0,189	0,236	0,209	0,162
Technology	0,536	0,364	0,285	0,331	0,242	0,265	0,256	0,506	0,274	0,348	0,406
Healthcare	0,298	0,230	0,243	0,213	0,164	0,163	0,402	0,234	0,262	0,165	0,206
Aggregate	0,399	0,259	0,228	0,212	0,155	0,135	0,169	0,190	0,208	0,106	0,153
Volatility of P/E ratio											
Financials	0,428	1,064	0,389	0,578	0,616	0,228	0,239	0,552	0,418	0,234	0,219
Industrials	0,517	0,413	1,231	1,953	0,505	0,257	0,321	0,347	0,975	0,177	0,745
Alternative Energy	1,334	0,754	0,500	0,852	1,013	N/A	1,538	0,364	0,409	0,328	0,332
Basic Materials	1,339	0,590	N/A	0,471	0,278	0,306	0,265	0,266	0,373	0,285	0,327
Consumer Goods	0,581	0,450	0,408	0,578	0,314	0,251	0,518	0,699	0,296	0,489	0,369
Consumer Services	0,695	1,050	1,275	0,953	1,420	0,169	0,194	0,320	0,466	0,425	0,339
Technology	0,527	0,343	0,306	0,323	0,426	2,932	0,395	0,335	0,275	0,283	0,331
Healthcare	0,379	0,240	0,265	0,337	0,220	0,209	1,100	0,276	0,298	0,156	0,198
Aggregate	0,385	0,333	0,469	0,617	0,253	0,156	0,328	0,249	0,340	0,176	0,222

Table 9. Yearly values for the volatility for the Danish stock market

When we calculated the yearly values, we were not able to get results for the Utility industry for the Danish stock market. We stated in chapter 3. that there is not sufficient data available for that industry; therefore, we removed it from the table.

Although the values are not necessarily comparable, we also observe that the volatility values of the price multiples exceed the values for the volatility of the stock returns for the S&P 500. Hence, it is reasonable to assume that the volatility of the price multiples in the S&P 500 can potentially be higher or lower.

We notice that the volatility values of the price multiples are higher than the volatility values of the stock returns on the aggregate level in the entire period. While on the industry level there are some exceptions where volatility values are actually lower, for the P/C ratio this is within Basic Materials in the years 2011, 2013 and 2014 and in Consumer Services in 2009 and 2018. For the P/B ratio the volatility values are lower in Industrials in 2011 and 2012, Alternative Energy in 2017, Basic Materials in 2008, 2009, 2010, 2011, 2013 and 2014, Consumer Goods in 2009 and Healthcare in 2009, 2012 and 2013. For the P/E ratio, the values are lower in Alternative Energy in 2017 and Basic Materials in 2009, 2011, 2012, 2014 and 2017. It seems that Basic Materials distinguishes itself from the other industries by having the most values that are lower.

4.2.2 Volatility in the Swedish Stock Market

Figure 4. displays the volatility movements of the P/E ratio. The volatility features spikes that occur frequently. We see that the period around the turn of the year 2008/2009 is the longest period with persistent high volatility, implying that the financial crisis had a significant effect on the Swedish market. Moreover, we also see that the periods where volatility recorded high values had a longer duration until the end of 2012, for the remaining years the periods with high volatility were briefer, and big spikes flattened out more abruptly. Also in the Swedish stock market, we can observe a trend where in the period around the turn of the year the volatility records sharp spikes with the exception of 2014/2015, however the period just before the turn of the year registers sharp spikes as well, particularly in the years from 2012 to 2018. The highest level in the volatility of the P/E ratio is recorded in November 2015 (1.466), and the lowest level of volatility is in March 2013 (0.107).

Compared to the other price multiples, the P/E ratio in the Swedish stock market is the most volatile.

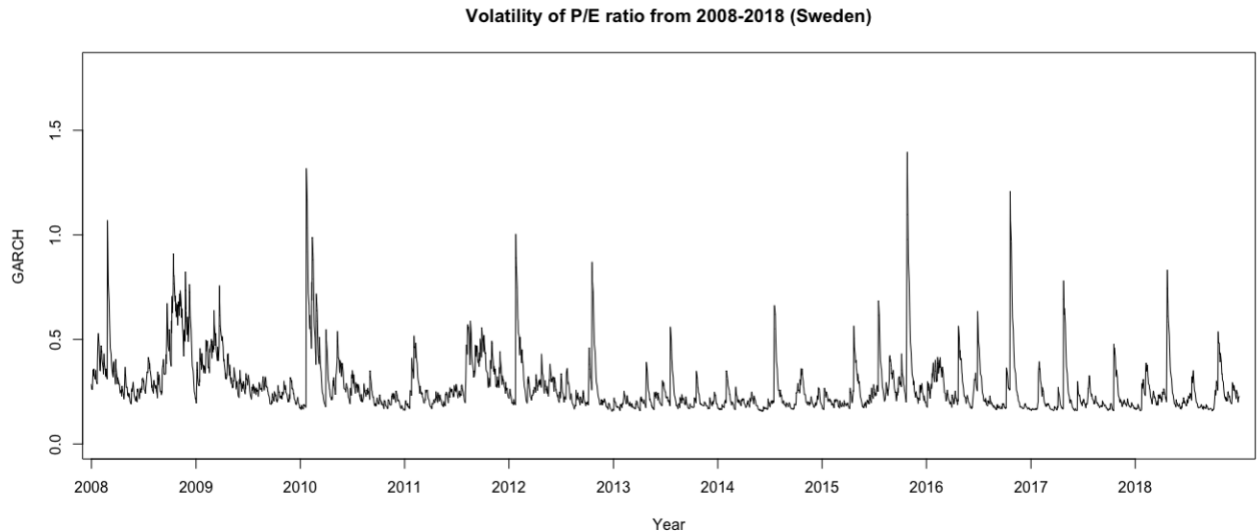


Figure 4. Volatility of P/E ratio for the Swedish stock market

The next figure shows the volatility of the P/B ratio. At the first glance the volatility movements seem to be more calm compared to the P/E ratio, also out of all the three multiples the P/B ratio is the one with the least big spikes, implying that the volatility of the P/B ratio is more steady and less sensitive than the other two. It seems that volatility increases significantly around the turn of the year throughout the period, it is worth noticing that this pattern is less prominent in the volatility of the P/B ratio. Furthermore, we can see that the overall volatility decreased over the last years, in particular, the last year has been very calm. In 2013 we recorded the highest value for the volatility in January (0.771). In the following year in May, we record the lowest value (0.074).

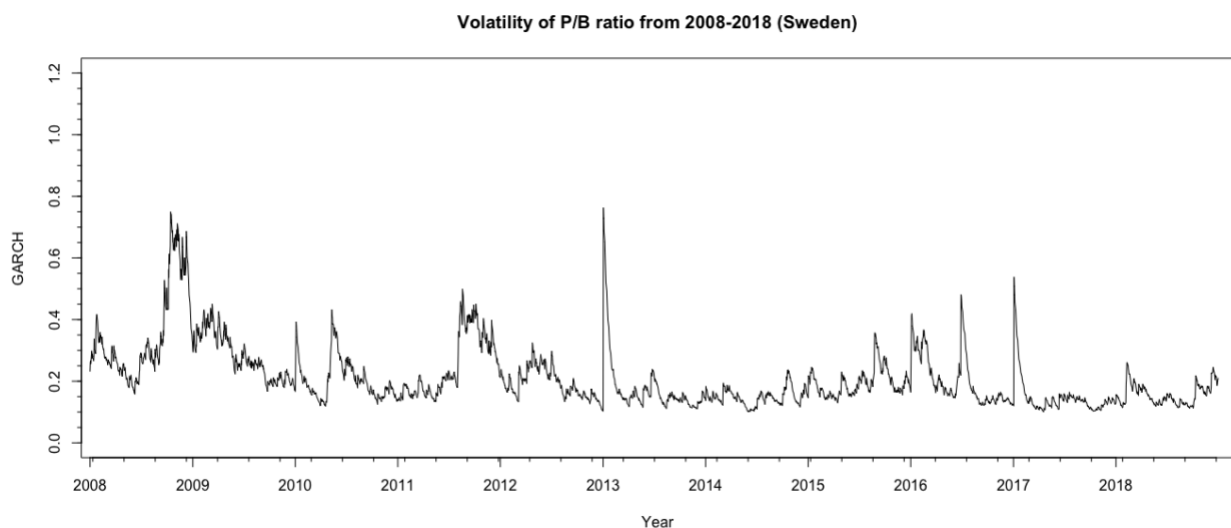


Figure 5. Volatility of the P/B ratio for the Swedish stock market

Finally, figure 6. presents the volatility of the P/C ratio. We can observe seven big spikes that occurred between 2008 and 2018, four of them occurred in the last three years, starting in the beginning of 2015, where the highest value of volatility is recorded in February (0.922). Interestingly the year before, the volatility value was at its lowest, where the lowest value was recorded in June 2014 (0.092). The movements in the volatility of the P/C ratio resemble more closely the volatility of the P/B ratio with the exception that the P/C ratio records taller spikes in the period from 2015 to 2017, whereas the period from 2013 to 2015 appears to be calm. Out of the three multiples the P/C can be placed between the volatility of the P/E and P/B ratio, while the volatility of the P/C ratio has fewer and smaller spikes than the P/E ratio, it has taller spikes than the P/B ratio. Moreover, we also notice that the pattern with tall spikes around the turn of the year can be observed in the volatility of the P/C ratio as well. However, like for the P/B ratio, this pattern is less prominent.

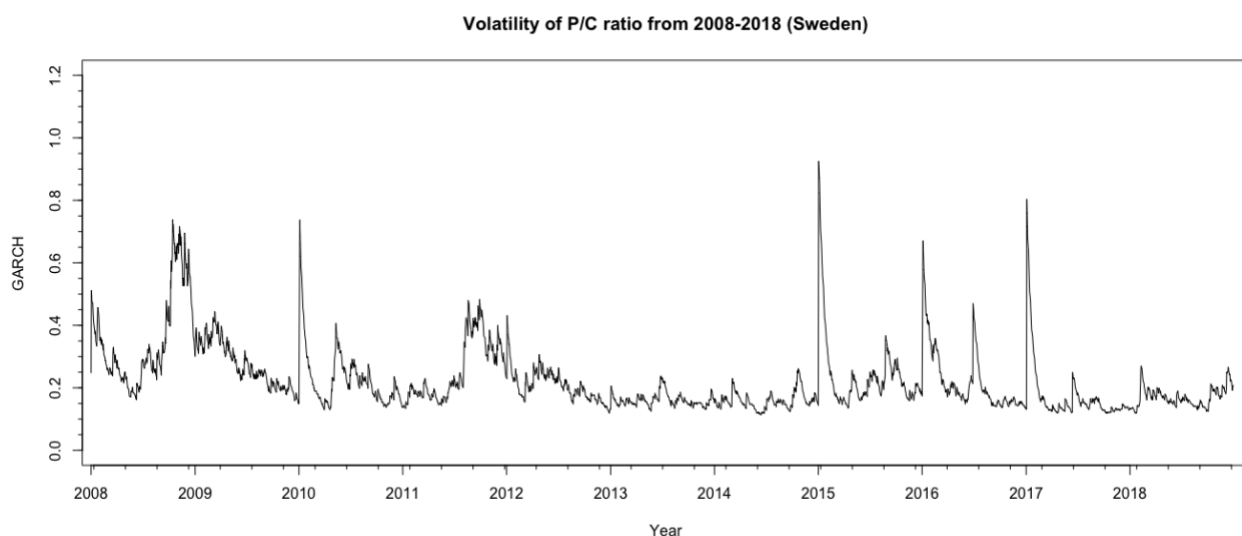


Figure 6. Volatility of the P/C ratio for the Swedish stock market

From table 10. we can see the yearly values of the volatility on an aggregate level. We register the highest values in 2008 for the volatility of stock returns, P/C, P/B, and also the P/E ratio (0.387, 0.410, 0.401 and 0.424 respectively). Moreover, on the industry level, the highest values for the stock returns across the industries are all in 2008. While for the P/C, P/B, and P/E ratios, the highest values for the volatility in the different industries occur in different years. Especially the year 2014 shows a very high volatility value for the P/E ratio in the Oil & Gas industry (4.379), it is also the highest value in the entire period across all price multiples and stock returns.

Comparing the volatility values of the stock returns for the Swedish market against the S&P 500 we see that from the year 2012 to 2017 the Swedish market comprises higher volatility, however, the deviations between the volatility values of the stock returns of the two markets are not significant. We also notice that on an aggregate level, the volatility values of the multiples are higher than the volatility values of the stock returns for the entire period with fewer exceptions. The values of the volatility of the P/E ratio are lower than the volatility values of stock returns in Oil & Gas in 2008, 2010 and 2015, for the P/B ratio they were lower in Healthcare in 2018 and for the P/C ratio they were lower in Oil & Gas in 2013, Consumer Goods in 2018 and Healthcare in 2011. We are not able to see if there is a relationship, however we notice that the Oil & Gas industry seems to comprise very high volatility values of the P/E ratio, particularly in the period 2013 to 2014, these values exceed the other volatility values significantly. This could imply that the P/E ratio is more sensitive in the Swedish market during events that are strongly correlated with oil price changes.

Volatility of Stock Returns											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,471	0,377	0,214	0,286	0,189	0,157	0,147	0,199	0,212	0,105	0,149
Industrials	0,462	0,383	0,241	0,349	0,243	0,156	0,154	0,236	0,232	0,137	0,188
Telecom	0,405	0,285	0,179	0,243	0,182	0,151	0,162	0,213	0,231	0,127	0,198
Basic Materials	0,430	0,324	0,225	0,296	0,208	0,166	0,154	0,232	0,208	0,133	0,216
Oil & Gas	0,756	0,482	0,373	0,541	0,341	0,227	0,263	0,343	0,360	0,229	0,319
Consumer Goods	0,365	0,293	0,207	0,239	0,186	0,151	0,167	0,212	0,181	0,119	0,146
Consumer Services	0,388	0,234	0,222	0,272	0,196	0,153	0,159	0,193	0,224	0,181	0,217
Technology	0,525	0,363	0,265	0,347	0,263	0,190	0,189	0,254	0,303	0,201	0,238
Healthcare	0,322	0,293	0,226	0,261	0,178	0,167	0,220	0,236	0,236	0,167	0,219
Aggregate	0,387	0,277	0,189	0,273	0,183	0,123	0,131	0,190	0,200	0,099	0,146
Volatility of P/C ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,516	0,498	0,383	0,301	0,532	0,164	0,188	0,369	0,437	0,367	0,244
Industrials	0,471	0,766	0,848	0,357	0,279	0,159	0,163	0,316	0,235	0,248	0,227
Telecom	0,420	0,302	0,182	0,246	0,317	0,388	0,168	0,265	0,365	0,177	0,223
Basic Materials	0,498	0,389	0,296	0,321	0,244	0,167	0,315	0,289	0,225	0,558	0,242
Oil & Gas	0,814	0,486	0,470	0,578	0,376	0,226	0,385	0,374	0,779	0,384	0,403
Consumer Goods	0,496	0,551	0,215	0,466	0,252	0,163	0,217	0,236	0,324	0,168	0,146
Consumer Services	0,397	0,289	0,279	0,272	0,266	0,169	0,171	0,193	0,273	0,182	0,218
Technology	0,537	0,424	0,297	0,355	0,340	0,231	0,194	0,278	0,743	0,701	0,297
Healthcare	0,365	0,411	0,242	0,260	0,209	0,170	0,240	0,261	0,291	0,260	0,219
Aggregate	0,410	0,284	0,249	0,284	0,204	0,143	0,141	0,274	0,243	0,198	0,159
Volatility of P/B ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,535	0,416	0,269	0,302	0,205	0,213	0,202	0,210	0,230	0,155	0,157
Industrials	0,472	0,392	0,255	0,353	0,247	0,375	0,299	0,256	0,266	0,167	0,199
Telecom	0,423	0,290	0,194	0,255	0,199	0,158	0,163	0,258	0,243	0,149	0,208
Basic Materials	0,437	0,334	0,237	0,299	0,210	0,181	0,183	0,247	0,240	0,603	0,225
Oil & Gas	0,774	0,588	0,374	0,547	0,354	0,227	0,864	0,344	0,830	0,397	0,360
Consumer Goods	0,375	0,316	0,208	0,245	0,196	0,210	0,245	0,288	0,216	0,127	0,157
Consumer Services	0,407	0,246	0,223	0,277	0,199	0,247	0,180	0,204	0,248	0,185	0,220
Technology	0,528	0,363	0,274	0,352	0,266	0,196	0,207	0,258	0,305	0,317	0,259
Healthcare	0,481	0,341	0,229	0,267	0,221	0,175	0,222	0,242	0,248	0,184	0,219
Aggregate	0,401	0,290	0,210	0,277	0,188	0,199	0,135	0,194	0,216	0,149	0,150
Volatility of P/E ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,614	0,493	0,695	0,325	0,728	0,204	0,228	0,503	0,488	0,317	0,320
Industrials	0,486	0,451	0,342	0,435	0,297	0,220	0,189	0,267	0,252	0,200	0,253
Telecom	0,423	0,301	0,219	0,264	0,228	0,498	0,614	0,245	0,629	1,615	1,919
Basic Materials	0,462	0,460	0,345	0,522	0,678	0,517	0,212	0,276	0,336	0,527	0,293
Oil & Gas	0,751	0,704	0,269	0,560	0,349	3,913	4,379	0,337	N/A	N/A	0,736
Consumer Goods	0,394	0,544	0,430	0,323	0,340	0,194	0,293	0,397	0,328	0,235	0,166
Consumer Services	0,417	0,259	0,349	0,302	0,262	0,261	0,316	0,207	0,249	0,183	0,230
Technology	0,546	0,701	0,981	0,941	0,449	1,315	1,572	0,274	0,363	0,819	0,253
Healthcare	0,327	0,333	0,254	0,275	0,212	0,210	0,279	0,369	0,351	0,239	0,355
Aggregate	0,424	0,305	0,334	0,297	0,287	0,169	0,181	0,298	0,281	0,195	0,225

Table 10. Yearly values for the volatility for the Swedish stock market

4.2.3 Volatility in the Norwegian Stock Market

Figure 7. presents the volatility of the P/E ratio and shows eight big pointed spikes. The highest volatility value is in August 2009 (2.696). For the P/E ratio we notice sharp jumps in volatility that occur at the periods around the turn of the year and particularly in the first quarter of each year except 2012 and 2014, this also holds partly for the last quarter of each year. The lowest volatility value records in February 2012 (0.213). Despite the big spikes, the last two years appear to be relatively calm in contrast to the start of the period and the period from 2014 to 2017.

Compared to the other two multiples, the volatility of the P/E ratio has the tallest spikes.

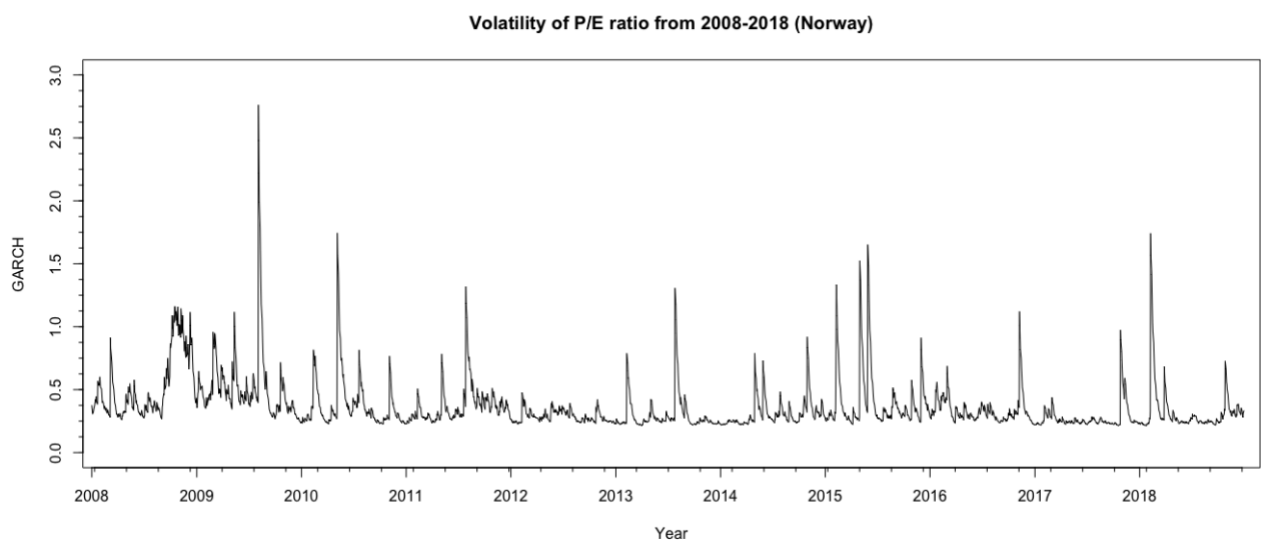


Figure 7. Volatility of the P/E ratio for the Norwegian stock market

Figure 8. presents the volatility levels for the P/B ratio. Here the highest spike is in October 2008 (0.897). Furthermore, the period around the financial crisis in 2008 is also the most volatile period for the P/B ratio. Out of the three multiples, the P/B ratio shows the smallest spikes. In general, it appears that the periods with high volatility are more even in comparison to the P/E ratio. However, the volatility of the P/B ratio shows similarity to the volatility of the P/E in terms of having volatility jumps around the turn of the year, yet the jumps are less significant and decline less abrupt. The lowest volatility value is recorded in September 2017 (0.112).

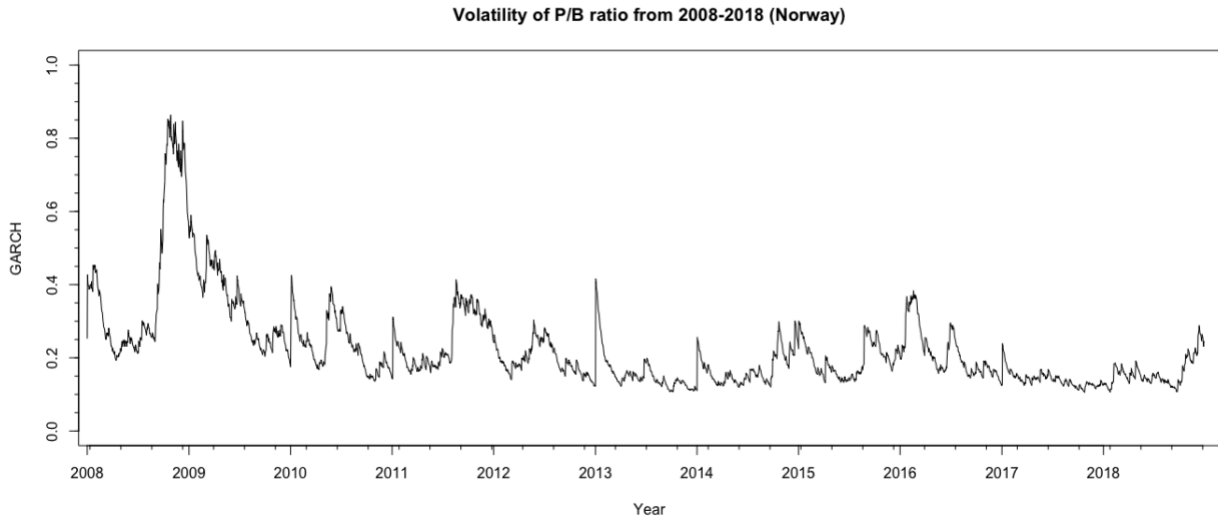


Figure 8. Volatility of the P/B ratio for the Norwegian stock market

Finally, figure 9. presents the volatility of the P/C ratio. The figure shows five big spikes, and the volatility does not record the highest values during the financial crisis, unlike the other price multiples. The highest value is in January 2014 (3.147). In that period, the values in the volatility of the P/E are almost at their lowest. Almost a year before the highest recorded volatility value, the volatility is at its lowest, the lowest volatility value is in May 2013 (0.128). The volatility jumps around the turn of the years are less prominent for the P/C ratio, also we notice that the two years from 2012-2014 and the last two years are periods with the least fluctuations.

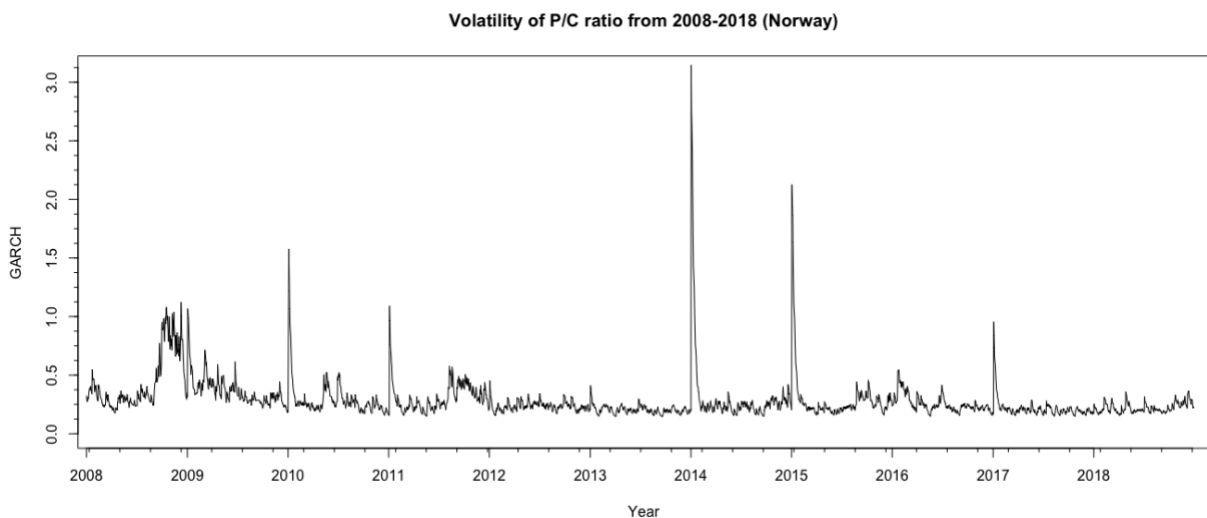


Figure 9. Volatility of the P/C ratio for the Norwegian stock market

Volatility of Stock Returns											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,576	0,514	0,269	0,310	0,224	0,174	0,161	0,192	0,222	0,128	0,154
Industrials	0,403	0,321	0,205	0,258	0,184	0,129	0,131	0,146	0,188	0,107	0,184
Telecom	0,582	0,429	0,265	0,247	0,215	0,167	0,216	0,231	0,256	0,176	0,195
Basic Materials	0,691	0,490	0,321	0,351	0,248	0,159	0,178	0,232	0,256	0,202	0,217
Oil&Gas	0,544	0,353	0,235	0,276	0,189	0,126	0,222	0,318	0,336	0,168	0,235
Consumer Goods	0,509	0,333	0,225	0,266	0,183	0,148	0,185	0,191	0,200	0,173	0,214
Consumer Services	0,551	0,533	0,356	0,352	0,249	0,220	0,352	0,254	0,268	0,207	0,235
Technology	0,589	0,499	0,345	0,348	0,330	0,257	0,235	0,334	0,290	0,232	0,216
Utilities	0,390	0,384	0,217	0,297	0,220	0,234	0,320	0,255	0,346	0,332	0,320
Aggregate	0,479	0,333	0,214	0,248	0,169	0,106	0,150	0,183	0,206	0,106	0,150
Volatility of P/C ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	2,151	1,326	0,545	0,375	0,325	0,246	1,759	1,585	0,223	0,216	0,213
Industrials	0,604	0,706	0,268	0,375	0,206	0,204	0,197	0,372	0,245	0,164	0,193
Telecom	0,580	0,463	0,342	0,248	0,219	0,415	0,262	0,258	0,284	0,180	0,195
Basic Materials	0,774	1,868	1,436	0,564	0,349	0,288	0,511	0,328	0,364	0,235	0,227
Oil&Gas	0,565	0,420	0,321	0,371	0,193	0,196	0,262	0,338	0,382	0,297	0,254
Consumer Goods	0,525	0,488	0,537	0,412	0,679	0,881	0,207	0,232	0,680	0,174	0,214
Consumer Services	N/A	0,611	1,295	0,530	0,250	0,310	0,590	0,487	0,517	0,420	0,237
Technology	0,562	0,412	0,514	0,391	0,315	0,252	0,295	0,310	0,301	0,276	0,244
Utilities	N/A	0,385	0,288	0,350	0,245	0,429	0,325	0,429	0,357	0,405	0,370
Aggregate	0,500	0,370	0,318	0,320	0,203	0,157	0,463	0,353	0,233	0,192	0,184
Volatility of P/B ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,587	0,526	0,302	0,320	0,251	0,210	0,189	0,251	0,257	0,153	0,166
Industrials	0,423	0,465	0,223	0,465	0,509	0,418	0,201	0,381	0,245	0,189	0,214
Telecom	0,606	0,432	0,306	0,252	0,241	0,170	0,253	0,247	0,290	0,200	0,196
Basic Materials	0,700	0,499	0,334	0,383	0,267	0,183	0,213	0,259	0,272	0,207	0,233
Oil&Gas	0,571	0,362	0,280	0,345	0,244	0,179	0,255	0,321	0,360	0,185	0,247
Consumer Goods	0,572	0,395	0,248	0,388	0,233	0,202	0,209	0,218	0,218	0,188	0,216
Consumer Services	0,581	0,559	0,447	0,356	0,265	0,363	0,404	0,483	0,303	0,241	0,235
Technology	0,649	0,420	0,329	0,349	0,300	0,245	0,222	0,311	0,291	0,237	0,202
Utilities	0,535	0,432	0,365	0,335	0,236	0,226	0,366	0,351	0,352	0,666	0,320
Aggregate	0,488	0,344	0,241	0,265	0,186	0,154	0,172	0,191	0,217	0,127	0,160
Volatility of P/E ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Financials	0,640	0,652	0,343	0,363	0,274	0,221	0,217	0,227	0,408	0,156	0,312
Industrials	0,542	0,730	0,342	0,406	0,329	0,309	0,388	0,491	0,846	1,147	0,357
Telecom	0,586	0,684	0,707	0,479	0,992	0,959	0,522	0,622	1,538	2,258	0,326
Basic Materials	0,812	2,584	2,148	0,512	0,430	0,262	0,355	0,422	0,444	0,293	0,390
Oil&Gas	0,645	0,951	0,686	0,478	0,273	0,412	0,446	1,825	1,920	1,234	1,489
Consumer Goods	0,992	1,953	0,719	0,795	1,107	0,526	0,350	0,281	0,324	0,302	0,325
Consumer Services	1,507	6,404	1,251	0,922	2,240	0,874	1,401	0,952	1,082	1,246	1,096
Technology	0,616	0,487	0,313	0,387	0,305	0,263	0,331	0,336	0,292	0,644	0,625
Utilities	0,948	N/A	1,247	0,754	1,460	0,559	1,751	0,670	0,640	0,672	0,542
Aggregate	0,540	0,563	0,379	0,338	0,203	0,257	0,258	0,430	0,287	0,205	0,318

Table 11. Yearly values for the volatility for the Norwegian stock market

From the table above we can see that on an aggregate level the highest level of yearly values of the volatility was in 2008 for the stock returns, the P/C ratio and the P/B ratio (0.479, 0.500 and 0.488 respectively). The following year the P/E ratio records the highest yearly value (0.563). Across industries, the highest yearly values are in the year 2008 for stock returns, while for the price multiples, the highest yearly volatility values in the different industries occur in different years. We notice that as for the other two markets, on the aggregate level the volatility values of the price multiples generally exceed the volatility values of the stock returns, however, as for the two other markets this holds only partly for the industry level. The exceptions are within Technology, which records lower values in 2009, 2010 and 2012 for the volatility of the P/E ratio, also in 2009, 2010, 2012 to 2015 and

2018 for the volatility of the P/B ratio and lastly in 2008 and 2018 for the volatility of the P/C ratio. For the volatility of the P/B ratio, we see also lower values in Utilities in 2013 and 2018 and for the P/C ratio in Telecommunications in 2008 and 2018. Technology records the most volatility values of price multiples that are lower than the volatility values of stock returns. Also worth mentioning is the Financials, which records several high volatility values throughout the period for the volatility of the P/C ratio. Regarding the volatility of the P/E ratio, we notice very high values for the Oil & Gas industry in the last four years in our eleven-year period, on the other hand, the Consumer Services industry registers the highest value in 2009 across all industries, all variables, and all markets. Furthermore, we also can see that the volatility values of the stock returns on an aggregate level are higher than the values of stock returns for the S&P 500 except for 2013 and 2018, implying that the Norwegian market is more volatile than the S&P 500.

4.2.4 Comparison of Volatility levels across the different markets

As stated in the beginning of paragraph 4.2, we will compare the volatilities of the stock returns and price multiples across the three stock markets. The figures in the following paragraph present the volatility graphs for the given variable and stock market.

4.2.4.1 Stock returns Volatility

Figure 10. shows the volatility levels for the stock returns from all three stock markets. The period from 2008 until 2011 appears to be the most volatile, particularly the period during and after the financial crisis in late 2008. When observing figure 10. we notice that the Norwegian stock market seems to be the most volatile market out of the three. The Norwegian stock market records the highest spikes during the financial crisis and until 2011, comparing the volatility values for stock returns on an aggregate level of the respective country in the tables in the previous paragraph confirms this. Furthermore, if comparing the values, we can see that in the first three years of the entire period the values of the Norwegian stock market deviate stronger from the other two markets, implying that the Norwegian stock market was more affected by the financial crisis.

However, from 2011 and until the end of our chosen period, the values of the Norwegian stock market resembles more the other two markets, this holds for the remaining years.

Especially in the period from 2015 to 2018, the volatility values of the three markets deviate

the least from each other. This indicates that the volatility of the three markets increased strongly in similarity in the last three years.

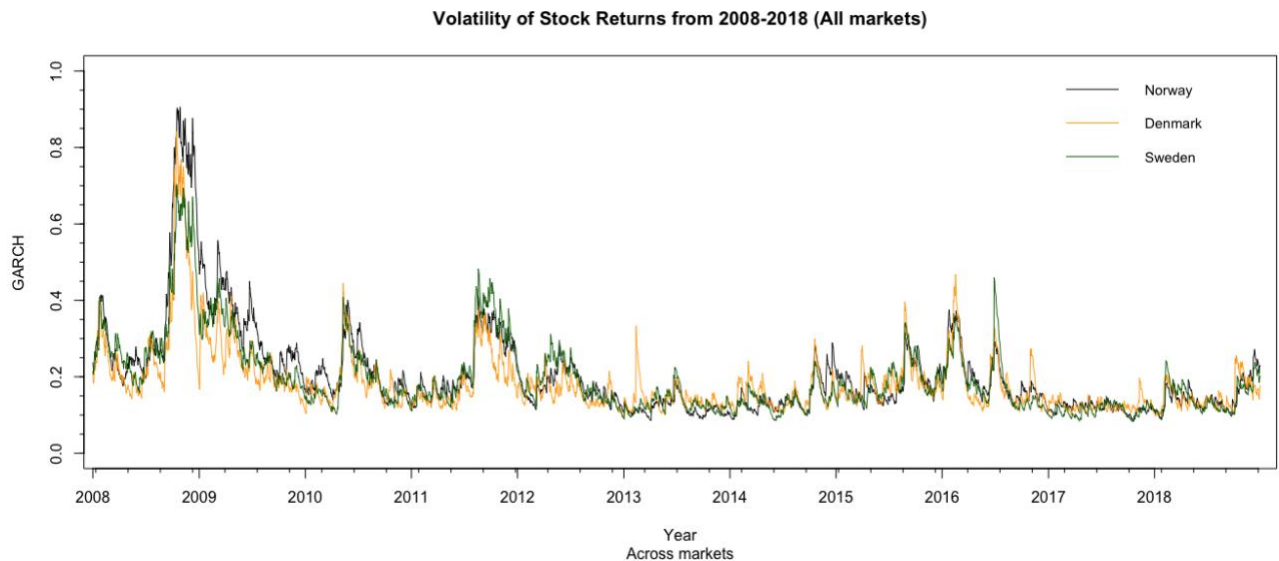


Figure 10. Volatility of stock returns for the Danish, Swedish and Norwegian stock market.

With the exception of the year 2015 and 2016, we can see that the volatility of the stock returns decreased after 2012. The period from 2017 in particular, seems to be the calmest for the three markets. Interestingly, we can also see that none of the three markets is distinguishably more volatile than the other.

It is reasonable to assume that the three markets share a similar economy to a certain degree, hence the similar volatility values. However, in some periods increases the deviation between the volatility values more, clarifying that the industry weighting in the three markets varies and affects the overall volatility values.

Comparing the three stock markets against the S&P 500, we can observe that the S&P 500 is on an overall basis less volatile than the Nordic markets, this holds especially from 2012 to 2018. Although the S&P 500 records high values during the financial crisis and the following two years, the Norwegian and Swedish stock market comprise higher values in the same period, the Norwegian stock market in particular. On the other hand, we can also see as for the Nordic markets, that the volatility decreased in the S&P 500 as well, indicating that the four markets follow a similar volatility trend.

Additionally, it is worth mentioning that the volatility values in the S&P 500 seem to be more steady compared to the Nordic markets, this can indicate that the Nordic markets are more sensitive.

4.2.4.2 Price Earnings Volatility

At first glance, it seems that the graphs of the respective markets in figure 11. deviate strongly from each other. Unlike the volatility of the stock returns and the other two multiples, the graphs are less aligned with each other, this can be observed throughout the entire period. Furthermore, the volatility of the P/E ratio is the variable that contains the tallest spikes compared to the stock returns and other price multiples, regardless of which market we examine. In figure 11. we can see that the jumps in the volatility do not last long, and the periods of high volatility are rather brief. When we examined the results for each market individually, we observe that the tallest spikes are around the period at the turn of the year in the volatility of the P/E ratio. The figure below confirms that this observation holds for all of the three markets. Despite several very high volatility values, the graphs of the volatility of the P/E ratio in the three markets appear to align with each other, though this holds only in some periods.

The Danish stock market clearly distinguishes itself by comprising the tallest spikes of the three Nordic markets. Especially the volatility of the P/E ratio distinguishes itself. Thus, this can imply that earnings is the variable that fluctuates the most in the Danish stock market compared to the other two markets. Moreover, we can also see that this is the case for the Norwegian stock market as well. Hence it can be assumed that the volatility of earnings is more sensitive in the Danish and Norwegian stock market. On the contrary, does the Swedish stock market comprise the smallest and least spikes and seems to be more stable.

If we compare the yearly volatility values on an aggregate level in the three markets, we can see that our observations that we made by comparing the graphs are confirmed. By comparing the values in table 12. we can see that the Swedish stock market has on average the lowest values throughout the entire period, while the Norwegian records the highest value for the entire period and the period 2013-2018. In 2008-2012 the Danish stock market was on average the most volatile, this is likely due to the high value recorded in 2011 (0.617).

However, despite observing that the volatility has decreased in the second period, it is not obvious if there is a trend in the volatility values in the period from 2008 to 2018.

When we compared the stock returns volatilities, we stated that the three markets share a similar economy. Hence, we get similar volatility values, however we also mentioned that in different periods the deviation between the volatility values increases more, and the reason for that could be the industry weighting in the three markets, it appears that this effect is more distinct in the volatility of the P/E ratio as the deviations between the volatility values are bigger.

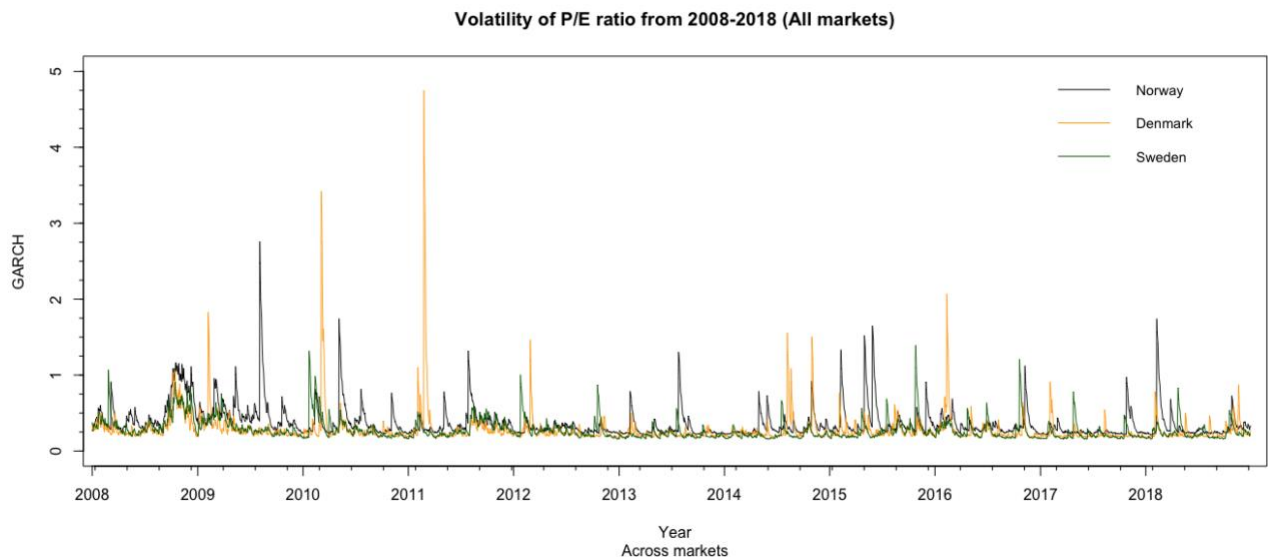


Figure 11. Volatility of P/E ratio for the Danish, Swedish and Norwegian stock market.

4.2.4.3 Price Book Volatility

Unlike the volatility of the P/E ratio, the pattern of the volatility of the P/B ratio shows different behavior. The three markets share a very similar volatility trend regarding the P/B ratio. Out of all of the three multiples, the volatility of the P/B ratio comprises the smallest and least spikes, indicating that it is the least sensitive in all of the three markets. When we compare the yearly values on an aggregate level across the three markets, this is also confirmed. Compared to the P/E ratio, the yearly volatility values of the P/B ratio comprise the smallest deviations across the markets. Similar to the stock returns, the volatility records the highest values in the year of the financial crisis, the Norwegian stock market records the highest. Hence, this affects also the average values for the period 2008-2018 and in particular, the period 2008-2012.

The Swedish stock market comprises the most peaked and tallest spikes in the volatility of the P/B ratio, and this is also reflected in the yearly values, as the Swedish stock market records several high values in different years, despite not being the most volatile stock market compared on an average level.

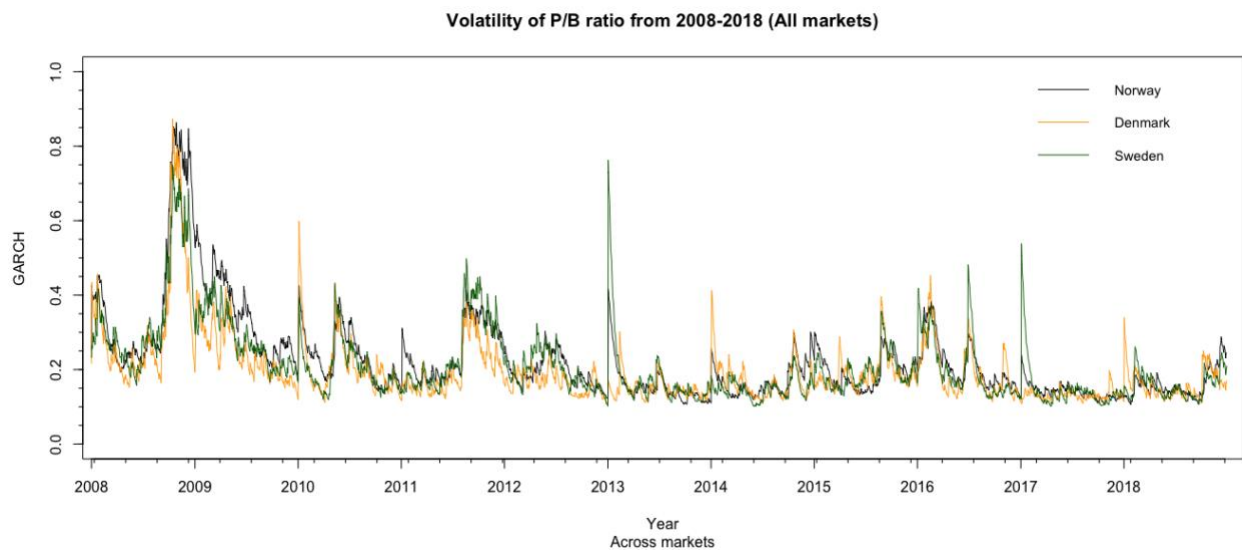


Figure 12. Volatility of P/B ratio for the Danish, Swedish and Norwegian stock market.

From table 12. we can see that the volatility of the P/B ratio decreased in the second period of the ten years.

Furthermore, we can observe that the trend where the volatility of the price multiple increased rapidly at the turn of the year also holds for the volatility of the P/B ratio. However, this is not consistent for all three markets and not for every year.

On an overall level, it appears that the book to the market variable, when considered isolated, is much more stable than earnings. Thus, the price to book ratio is less sensitive. Moreover, the stability in the volatility values of the P/B ratio across the markets also implies that the industry weighting affects the volatility of the P/B ratio in a smaller degree compared to the P/E ratio.

4.2.4.4 Price Cash Flow Volatility

At first glance, one can see that the pattern of the volatility of the P/C ratio is similar to the volatility of the P/E ratio since we can see some significant spikes with high values. Although it is not apparent, the pattern resembles the volatility of the P/B ratio as well. Therefore, one can say that the volatility of the P/C ratio can be considered to be a mixture of the other two multiples in the sense that the lines of the P/C ratio are closely aligned with the P/B ratio, while also comprising big spikes like the P/E ratio.

Out of the three markets, the Norwegian market comprises the tallest spikes. Hence, the Norwegian market records also the highest values. This is also confirmed by comparing the yearly volatility values across the three markets where the Norwegian stock market records the most values with high volatility. Additionally, when comparing the results on the average level in table 12. we observe that the Norwegian market was the most volatile in the first half as well as the second half of the period. A distinct feature of the graph for the Norwegian stock market is that it is less aligned with the graphs for the other markets.

Furthermore, the volatility of the P/C ratio is the second variable after the P/B ratio that is very closely aligned with the volatility of the stock returns, and this applies for all stock markets. This similarity is also reflected in the average values in the period 2008-2018, the deviations from the values of the stock returns can be placed between the P/E ratio and the P/B ratio where the volatility values of the P/B ratio deviate the least from the volatility values of the stock returns.

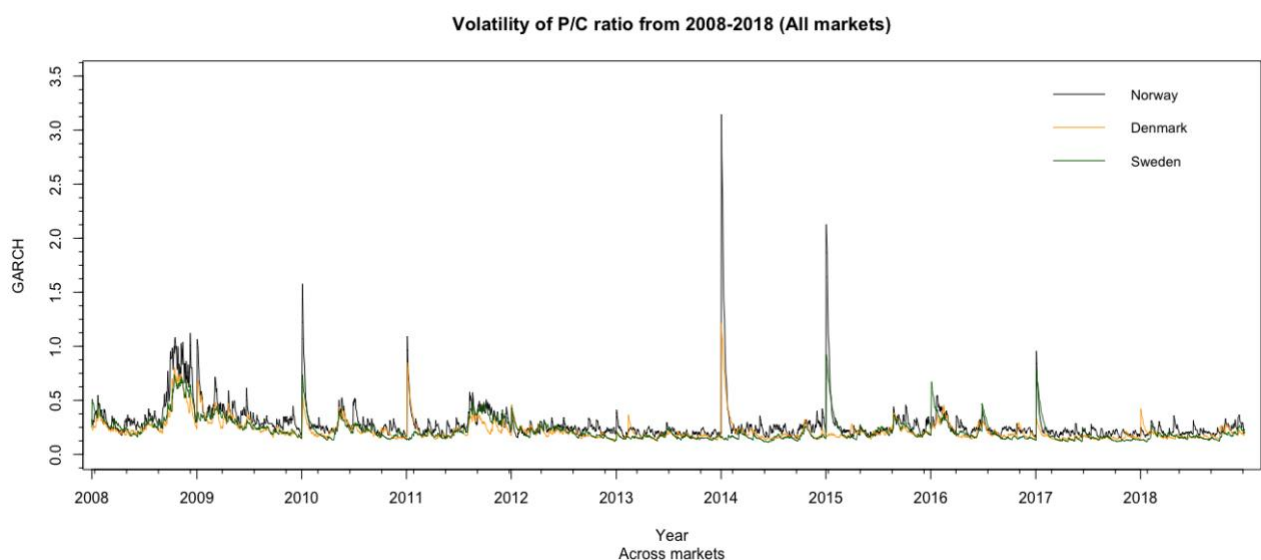


Figure 13. Yearly values for the volatility of P/C ratio for all three stock markets.

As for the P/E and P/B ratio we can observe that the pattern where the most significant spikes occur at the turn of the year and first quarter of each year also applies for the P/C ratio, confirming that this trend is present in the volatility of all of the price multiples.

Table 12. shows that on an average level, the Norwegian stock market is the most volatile for the period (2008-2018), this is valid for both the stock returns and the price multiples.

Moreover, this is also the case for the period (2008-2012) for the stock returns, P/E, and P/C ratio, for the period (2013-2018) this only applies to the P/E and P/C ratio.

Denmark has only one highest value for the period (2008-2012) for the P/E ratio, and for the stock returns in the period (2013-2018). Sweden, on the other hand, has only one single value that is the highest for the period (2013-2018) for the P/B ratio, in the period (2008-2012) the Swedish market does not record any volatility value that is the highest for any of the price multiples or the stock returns. Moreover, in regards to the average volatility values of stock returns in the examined period, all of the Nordic markets record higher values than the S&P 500 for the entire period of 10 years, the first half (2008-2012) except for Denmark and the second half (2013-2018).

As we stated earlier, we calculated the volatility values only for the stock returns of the S&P 500. We did not estimate the values for the price multiples, because our thesis aims to examine the Norwegian, Danish and Swedish stock market.

However, the inclusion of the volatility values of the S&P 500 returns gives a better understanding of how the values of the three Nordic markets behave in terms of size compared to other markets.

Market	Average Volatility Values											
	Stock returns			P/E Ratio			P/B Ratio			P/C Ratio		
	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018
Denmark	0,190	0,235	0,153	0,321	0,412	0,245	0,201	0,251	0,160	0,229	0,275	0,190
Sweden	0,200	0,261	0,148	0,272	0,329	0,225	0,219	0,273	0,174	0,235	0,286	0,193
Norway	0,213	0,288	0,150	0,344	0,405	0,293	0,231	0,305	0,170	0,299	0,342	0,264
S&P 500	0,180	0,245	0,125	N/A								

Table 12. Average values for the volatility of the stock returns and price multiples for different time periods.

4.3 Regression results

In the previous paragraph, we presented the volatility values of the stock returns and price multiples through graphs where we presented the estimated GARCH and tables where we presented the yearly standard deviation values across the industries and on an aggregated level. We were able to identify several similarities between the volatility of the stock returns and the volatility of the different price multiples. Furthermore, we also saw that the volatility of the price multiples shared similarities across the different markets as well.

Since our master thesis aims to examine if there is a relationship between the volatility of stock returns and the volatility of price multiples we want to test if there is linearly dependence between the volatility of stock returns and price multiples. To check this, we look at the coefficient of determination, known as R^2 . The volatility of stock returns is the endogenous variable, while the volatility of the individual price multiples is the exogenous variable. As our hypothesis states, we look at both the P/C ratio, P/B ratio, and P/E ratio for each market separately. First, we look at the coefficient of determination over our defined periods and then yearly.

4.3.1 Regression results over time periods

4.3.1.1 Results for the Danish Stock Market

In this paragraph, we present the results regarding the coefficient of determination for the three periods we defined in chapter 3. The first period is from 2008 to 2018, the second period is from 2008 to 2012 and the third period is from 2013 to 2018. As for the previous paragraphs, we will present the results for all the three markets, starting with the Danish stock market.

In table 13. we present the values of the coefficient of determination for each industry and on an aggregate level over the different periods. We can observe that all values differ extensively. Hence, the explanatory power varies both between industries and periods. We find that in the first period, the highest value registered is for the P/B ratio, followed by the P/C ratio and the P/E ratio. This also holds for the second and third period. Additionally, we see that the explanatory power of the P/C ratio decreases in the third period. This is not the case for the P/B and the P/E ratio, where the explanatory power increases in the third period.

When we look at the industries individually, in the first and second period, we find that the highest value registered regarding the P/C ratio is in Technology (0.854). In the third period, the highest value registered is in Consumer Services (0.839).

When looking at the P/B ratio, the highest value recorded is in Consumer Services, this holds for all three periods. Using the volatility of the P/E ratio as the independent variable, the highest value registered in the first period is in Consumer Goods (0.419), in the second period in Technology (0.752), and the third period in Finance (0.250).

When observing the changes from period two to three on the industry level, we observe that out of the three multiples, the P/B ratio features the smallest changes in explanatory power from one period to the other. This implies that the volatility of the P/B ratio is more stable than the other multiples, the P/C ratio shows relatively more moderate changes in the explanatory power. In contrast to the two mentioned multiples, the P/E ratio displays the most radical changes when looking on period two and three. Furthermore, comparing the results across the different multiples across the entire period from 2008-2018 we can see that the P/B ratio comprises the highest values in the different industries, while the P/C ratio comprises relative moderate values across the industries. However, the values tend to vary strongly. We should interpret the results in regards to the P/E ratio with caution as there was no data available for three industries. Hence, this results in a smaller comparison basis. However, from the available results, we can observe that the P/E ratio comprises the lowest values across the available industries. On an aggregated level, the P/B ratio also records the highest value for the entire period, while the P/E ratio records the lowest.

Also, on an aggregate level, we observe that the explanatory power increased marginally from period two to three when using the volatility of the P/B ratio as the exogenous variable. On the other hand, when using the volatility of the P/C ratio, the explanatory power decreased, and in the case of the P/E ratio it increased, however the changes are not significant. This implies that it is hard to determine whether the second period, which is characterized by the financial crisis and the third period which is characterized by the oil price shock and several other small events have had a significant impact on the explanatory power.

Nevertheless, on the industry level it appears that the events that took place in period two and three have a much bigger impact on the explanatory power, hence the strong variations in terms of direction and magnitude of the changes in the values across the different industries.

It is worth mentioning that some industries like Technology and Healthcare, but also Consumer Services show drastic changes in explanatory power from period two to three. This implies that some industries are highly sensitive during periods of economic instability, this holds especially for the P/E and P/C ratio where the changes are significant in the respective industries. The variation in regards to the P/B ratio is smaller but still worth mentioning.

There was no data available for the utility industry; this applied to all three multiples. Hence, we removed it from our table.

DENMARK									
Industries	The coefficient of determination								
	P/C Ratio			P/B Ratio			P/E Ratio		
	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018
Finance	0,364	0,323	0,544	0,911	0,935	0,853	0,235	0,231	0,250
Industrials	0,383	0,365	0,436	0,866	0,878	0,840	0,106	0,088	0,171
Alternative Energy	0,372	0,352	0,426	0,814	0,804	0,834	N/A	N/A	N/A
Basic Materials	0,209	0,162	0,459	0,627	0,599	0,729	N/A	N/A	N/A
Consumer Goods	0,608	0,600	0,638	0,661	0,654	0,686	0,419	0,667	0,196
Consumer Services	0,513	0,425	0,839	0,951	0,988	0,887	0,069	0,049	0,246
Technology	0,793	0,854	0,706	0,666	0,903	0,455	0,093	0,752	0,036
Healthcare	0,715	0,810	0,637	0,672	0,757	0,613	0,227	0,581	0,124
Aggregate	0,713	0,752	0,645	0,904	0,902	0,908	0,350	0,314	0,440

Table 13. The coefficient of determination for each period for the Danish stock market

4.3.1.2 Results for the Swedish Stock Market

In table 14., we present the coefficient of determination for the Swedish stock market. On an aggregate level, the P/B ratio records the highest values in all three periods, followed by the P/C ratio and the P/E ratio, respectively. When comparing period two and three, we find that the explanatory power decreases in the third period, this applies to all three multiples. Hence, this could imply that all three multiples seem to have had higher explanatory power during the period where the financial crisis took place. In regards to the magnitude of the changes in the explanatory power, we observe that unlike the Danish stock market where the changes were relatively moderate, the changes in the Swedish stock market are more significant.

When looking at the industry level, in the first period, the highest value registered for the P/B ratio is in Technology (0.914), this also holds for the second period. However, in the third period, the highest value recorded is in Healthcare (0.924). Regarding the explanatory power when using the volatility of the P/C ratio as the independent variable the highest value registered in the first and third period is in Consumer Services (0.826) and (0.858). In the

second period Technology (0.8346) registers the highest value. Setting the P/E ratio as the independent variable we find the highest value recorded in Industrials (0.745), this applies to period one and three. However, in the second period, Telecom is registered with the highest value (0,829). Moreover, we observe that the explanatory power differs broadly both within each industry and between years.

When comparing the direction of the explanatory power between the industries for period two and three, there is no clear direction when looking at the P/C ratio. Moreover, for the P/E ratio, all values decrease in the third period, this applies for the P/B ratio as well with the exception of the Healthcare industry. Also, we notice that the values registered regarding the P/B ratio are more steady across the different industries than the P/E and P/C ratio, this holds for both the second and third period. However, the values are less steady in the third period, implying that the explanatory power was much higher in the first half of the eleven-year period. As for the aggregated level, this could imply that the Financial crisis has an impact on the magnitude of the explanatory power in the sense that it is higher during an economic crisis.

In regards to the P/C and P/E ratio, we notice that the values across the different industries are less steady and exhibit a much higher variety than the P/B ratio. While the variation is relatively moderate regarding the explanatory power values using the volatility of the P/C ratio as the exogenous variable, the P/E ratio, on the other hand, shows much higher variety.

SWEDEN									
Industries	The coefficient of determination								
	P/C Ratio			P/B Ratio			P/E Ratio		
	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018
Finance	0,414	0,495	0,272	0,816	0,858	0,698	0,281	0,312	0,210
Industrials	0,393	0,345	0,651	0,750	0,939	0,473	0,745	0,775	0,668
Technology	0,479	0,836	0,259	0,914	0,976	0,811	0,126	0,235	0,066
Telecom	0,612	0,793	0,433	0,882	0,921	0,819	N/A	0,829	N/A
Basic Materials	0,529	0,748	0,305	0,635	0,948	0,375	0,309	0,386	0,198
Consumer Goods	0,460	0,422	0,577	0,788	0,931	0,588	0,326	0,381	0,231
Consumer Services	0,826	0,809	0,858	0,888	0,964	0,781	0,641	0,701	0,554
Healthcare	0,715	0,705	0,730	0,760	0,673	0,924	0,577	0,803	0,415
Oil & Gas	0,645	0,826	0,414	0,547	0,888	0,274	N/A	N/A	N/A
Aggregate	0,755	0,850	0,584	0,888	0,962	0,730	0,593	0,679	0,443

Table 14. The coefficient of determination for each period for the Swedish stock market

4.3.1.3 Results for the Norwegian Stock Market

Next, we present the results for the Norwegian stock market. On an aggregate level, the P/B ratio registers the highest values, followed by the P/C and P/E ratio, respectively. This holds for all three periods.

When looking at the different periods, the second period comprises the highest values for the explanatory power, this holds for all price multiples. In comparison to the values in period three, the decrease in the explanatory power when using the volatility of the P/B as the independent variable is moderate. However, it seems that the decrease is more significant for the P/C and P/E ratio.

When we look at the industries individually, we see that the highest value registered in the first period regarding the P/B ratio is in the Telecom (0.898). In the second period, Finance is registered with the highest value (0.946), closely followed by Basic Materials (0.940). In the third period, the highest value recorded is in Basic Materials (0.837). Similar to the P/B ratio, Telecom is registered with the highest value when the volatility of the P/C ratio is used as the independent variable. This holds for both the first and the second period.

In the third period, Oil & Gas registers the highest value (0.757). When looking at the P/E ratio, the Financial industry holds the highest value across all three periods.

On the industry level, comparing the direction of the values between the second and third period, we notice that the values regarding the P/C ratio have no clear direction, they either increase or decrease in period three. Moreover, for the P/B ratio, the explanatory power decreases in all industries except in the Technology industry. Regarding the P/E ratio, we miss data from both Telecom, Consumer Services, and Utilities. Based on the remaining sectors, we find that the explanatory power increases in two out of six industries. Hence, the information is too limited to make a clear conclusion about the direction. Looking at the consistency between the values in the different industries, in the second and third period, we find that the P/B ratio has the most steady values in both periods. In regards to the P/C and P/E ratio, the values are more inconsistent between the industries, this holds for both the second and third period.

Interestingly, we notice that some industries were registered with a more significant drop than others. For the P/E ratio, both Industrials and Oil & Gas severe a significant decrease in the third period. It is reasonable to assume that the reason for the severe drop in explanatory power is due to the oil price shock event, which occurred in 2015.

Norway									
Industries	The coefficient of determinaton								
	P/C Ratio			P/B Ratio			P/E Ratio		
	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018	2008-2018	2008-2012	2013-2018
Finance	0,078	0,120	0,028	0,890	0,946	0,700	0,630	0,708	0,423
Industrials	0,379	0,365	0,427	0,400	0,477	0,259	0,157	0,355	0,066
Technology	0,605	0,574	0,677	0,682	0,627	0,820	0,400	0,619	0,221
Telecom	0,764	0,880	0,565	0,898	0,895	0,804	N/A	0,323	N/A
Basic Materials	0,174	0,153	0,379	0,916	0,940	0,837	0,098	0,089	0,248
Consumer Goods	0,260	0,371	0,148	0,814	0,821	0,800	0,092	0,076	0,243
Consumer Services	N/A	N/A	N/A	0,733	0,865	0,544	N/A	0,020	N/A
Utilities	N/A	N/A	0,608	0,598	0,630	0,573	N/A	N/A	0,102
Oil & Gas	0,756	0,756	0,757	0,828	0,823	0,836	0,056	0,321	0,011
Aggregate	0,553	0,755	0,290	0,898	0,928	0,809	0,457	0,591	0,235

Table 15. The coefficient of determination for each period for the Norwegian stock market

4.3.2 Comparison of the the Explanatory Power across the different markets divided by time periods.

Regarding the similarities and differences across the three Nordic markets, we find that on an aggregate level the volatility of the P/B describes the volatility of the stock returns best, followed by the volatility of the P/C ratio, this applies to all three markets and all three periods. The volatility of the P/E ratio performs poorly at explaining the variance in the volatility of the stock returns, this observation also holds for all of the three markets and periods.

Furthermore, if we look isolated at the values on an aggregate level for the entire eleven-year period. In period one, we find that the explanatory power is highest when using the volatility of the P/C and P/E ratio as the explaining variable in the Swedish stock market. However, when using the volatility of the P/B ratio, it is the lowest compared to the other two markets. When using the volatility of the P/B ratio, the explanatory power is highest in the Danish stock market, whereas using the volatility of the P/E ratio results in the lowest explanatory power compared to the other two markets.

The Norwegian stock market does not comprise any highest values when using the volatility of any of the three multiples compared to the other two markets. However, it comprises the lowest value when using the volatility of the P/C ratio as the exogenous variable.

Comparing period two and three, we observe that the explanatory power decreases when using the volatility of any of the three price multiples in period three both in the Swedish and the Norwegian stock market on an aggregate level. Hence, this implies that the financial crisis which occurred in period two could have affected the explanatory power positively. Another explanation could be that the price multiples lose relevance in periods which are not characterized by events that affect the global economy in the degree as the financial crisis did. This is not the case in the Danish stock market, where the explanatory power increases in period three using the volatility of the P/B and P/E ratio, thus, this could imply that the financial crisis could have affected the explanatory power negatively. However, we note that the changes are not significant.

On the industry level, we notice that the explanatory power when using the volatility of the P/B and P/E ratio as the exogenous variable differs extensively both within periods and between the different stock markets. On the contrary, we find some similarities between the two markets when looking at the P/C ratio. In the Danish and the Swedish stock market, the highest values registered in the second period are registered within the Technology industry, and Consumer Services in period three. Unlike the Norwegian stock market where the highest value is registered in Telecom in period two, and the Oil & Gas industry in period three. However, we do not have available data for the Consumer Services industry in the Norwegian stock market, thus the comparison basis is weaker, and one should interpret the results with caution, especially on the industry level.

When looking at the direction of the explanatory power from period two to three, we find that the P/B ratio decreases in almost every industry, this holds for both the Swedish and Norwegian stock market. In the Danish stock market, the explanatory power regarding the P/B ratio either increases or decreases and gives no clear direction. As with the P/B ratio, we notice that the P/C ratio shows the same tendency in both the Swedish and Norwegian stock market, but instead of decreasing we find that the values either increases or decreases. For the Danish stock market, all values increase in period three, except in Technology and Healthcare.

Regarding the P/E ratio, the direction of the explanatory power differs among all three markets. In the Danish stock market, the values either increase or decrease. In the Swedish stock market the values mostly decrease, and in the Norwegian stock market, the direction is not clear because of missing data, but the tendency seems to be decreasing. On an overall level, it appears that within the different industries, the amount of values with a decreasing tendency is higher than the amount where the values increase in period three. Hence, this could imply that over the last five years, the volatility of the price multiples became worse at explaining the variance in the volatility of stock returns.

4.4.3 The coefficient of determination on a yearly basis

4.4.3.1 Yearly Values for the Danish Stock market

In this section, we present the coefficient of determination for each industry on a yearly basis. First, we present the values registered for the Danish stock market.

On an aggregate level, when the volatility of the P/B ratio was set as the independent variable, the highest value records in 2015 (0.977) and the lowest value in 2010 (0.706). When using the volatility of the P/C and P/E the highest values are recorded in 2008 when the financial crisis broke out, (0.949) and (0.933) respectively, while the lowest values for both multiples are registered in 2014, interestingly in the year when we start seeing the first indications of the oil price shock. Regarding the P/C ratio, the lowest recorded value is (0.290), and for the P/E ratio, the lowest value is (0.080). For the remaining years, R^2 varies more between the multiples, also when comparing R^2 from year to year, the P/B ratio features the least deviations, while the values regarding the P/C ratio appear to be relatively steady, the P/E ratio features the least steady values.

When we look at the industries individually, the explanatory power differs a lot across and within industries and we notice that nearly all industries register relatively high values in 2008, this applies to all multiples. Interestingly we also notice that nearly all industries register relatively high values at the end of the eleven-year period in 2018. However, this only holds for the values related to the P/C and P/B ratio.

It is important to mention that R^2 when using the volatility of the P/B ratio is relatively high in several years across all industries, especially noticeable within Consumer Services.

Regarding R^2 when using the volatility of the P/C ratio as the explanatory variable, we notice that both Technology and Healthcare register relatively high and constant values across all years. When looking at the P/E ratio, the values within each industry vary broadly from year to year, and the values for R^2 are the least steady.

Coefficient of determination											
Volatility of the P/C ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Finance	0,781	0,166	0,140	0,865	0,667	0,302	0,270	0,937	0,838	0,534	0,968
Industrials	0,946	0,346	0,115	0,485	0,551	0,879	0,349	0,737	0,368	0,862	0,266
Alternative Energy	0,928	0,681	0,282	0,201	0,304	0,431	0,288	0,680	0,321	0,760	0,642
Basic Materials	0,660	0,154	0,090	0,801	0,152	0,762	0,870	0,151	0,974	0,403	0,997
Consumer Goods	0,589	0,433	0,752	0,976	0,819	0,725	0,786	0,989	0,336	0,754	0,932
Consumer Services	1,000	0,215	1,000	0,192	0,533	0,949	0,415	0,792	0,973	0,849	1,000
Technology	0,886	0,752	0,981	0,845	0,793	0,841	0,839	0,537	0,830	0,696	0,619
Healthcare	0,982	0,854	0,500	0,818	0,861	0,481	0,733	0,671	0,538	0,861	0,825
Aggregate	0,944	0,711	0,643	0,620	0,540	0,773	0,290	0,921	0,892	0,799	0,696
Volatility of the P/B ratio											
Finance	0,969	0,939	0,890	0,932	0,870	0,792	0,845	0,876	0,902	0,677	0,924
Industrials	0,918	0,937	0,679	0,892	0,866	0,850	0,698	0,897	0,939	0,794	0,808
Alternative Energy	0,919	0,582	0,861	0,981	0,733	0,970	0,631	0,755	0,901	0,994	0,987
Basic Materials	0,817	0,524	0,610	0,775	0,368	0,641	0,857	0,460	0,909	0,656	0,995
Consumer Goods	0,532	0,961	0,473	0,963	0,845	0,934	0,534	0,631	0,603	0,843	0,978
Consumer Services	0,998	0,995	0,993	0,970	0,911	0,639	0,819	0,919	0,893	0,863	0,993
Technology	0,942	0,748	0,973	0,920	0,938	0,669	0,968	0,218	0,998	0,278	0,418
Healthcare	0,873	0,788	0,441	0,817	0,912	0,913	0,215	0,959	0,963	0,709	0,877
Aggregate	0,949	0,935	0,706	0,921	0,899	0,905	0,787	0,977	0,971	0,931	0,825
Volatility of the P/E ratio											
Finance	0,941	0,044	0,331	0,444	0,287	0,419	0,206	0,191	0,257	0,148	0,756
Industrials	0,870	0,900	0,016	0,022	0,150	0,528	0,244	0,551	0,106	0,613	0,130
Alternative Energy	0,388	0,460	0,986	0,398	N/A	N/A	N/A	0,526	0,528	0,776	0,881
Basic Materials	0,072	N/A	N/A	N/A	0,534	0,247	0,863	0,603	0,611	0,532	0,973
Consumer Goods	0,925	0,882	0,359	0,506	0,433	0,470	0,147	0,181	0,481	0,160	0,137
Consumer Services	0,266	0,102	0,024	0,019	0,008	0,100	0,197	0,381	0,285	0,150	0,285
Technology	0,964	0,840	0,721	0,906	0,298	0,003	0,436	0,545	0,975	0,729	0,432
Healthcare	0,580	0,972	0,585	0,401	0,538	0,783	0,005	0,793	0,928	0,896	0,952
Aggregate	0,933	0,461	0,125	0,145	0,262	0,746	0,080	0,678	0,590	0,491	0,515

Table 16. R^2 across industries for each year (Danish stock market)

4.4.3.2 Yearly Values for the Swedish Stock market

From table 17. we see that on an aggregated level, in 2008, we register the highest level of R^2 using the volatility of the P/B ratio as the exogenous variable (0.984). In the same year, we also record the highest values of R^2 using the volatility of the other two multiples as the independent variable, for P/C (0.960) and P/E (0.870). On the other hand, 2017 was the year where we record the lowest values for R^2 using the volatility of the three multiples as explaining variable, P/B registers (0.347), P/C registers (0.204) and the lowest value for the P/E ratio registers (0.153). When comparing the three multiples across the eleven-year period, we notice that all three register particularly high values for explanatory power at the start of the period. Regarding the P/B ratio, the explanatory power is relatively high in all years except in 2013 and 2017. We observe that the best explanation regarding the variance in the volatility of stock returns is by the volatility of the P/B ratio, this holds for the entire period except for 2013 where the P/C registers higher explanatory power. In contrast to the P/B ratio, we observe the least explanatory power when using the volatility of the P/E ratio as the explaining variable throughout the whole period. When using the volatility of the P/C ratio, we observe that the explanatory power is also relatively high similar to the P/B ratio. However, the values are less steady throughout the period.

On the industry level, we notice that almost all industries record a high coefficient of determination in 2008 for all three multiples. When looking at the different industries throughout our eleven-year period, we observe that within Consumer Services and Technology, the explanatory power records the highest levels using the volatility of the P/B ratio as the exogenous variable. This also applies partly to the P/C ratio; however, we observe that the values express stronger fluctuations. Regarding the P/E ratio, we cannot find an industry that clearly distinguishes itself by having the highest values for R^2 for a longer period. However, we observe that the P/E ratio records the lowest values in our eleven-year time frame, in particular within industries such as Oil & Gas, Technology, and Telecom R^2 drops significantly. Thus, this implies that the volatility of the P/E ratio is the worst explaining variable compared the volatility of the P/C and P/B ratio which provide high R^2 when being used to explain variance in the volatility of stock returns.

Coefficient of determination											
Volatility of the P/C ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Finance	0,838	0,584	0,310	0,938	0,060	0,951	0,616	0,284	0,232	0,050	0,372
Industrials	0,966	0,246	0,085	0,914	0,797	0,964	0,824	0,572	0,975	0,264	0,675
Telecom	0,923	0,878	0,951	0,978	0,320	0,136	0,925	0,632	0,403	0,409	0,873
Basic Materials	0,752	0,708	0,585	0,908	0,800	0,989	0,228	0,650	0,855	0,011	0,795
Oil & Gas	0,861	0,988	0,546	0,828	0,837	0,999	0,465	0,839	0,217	0,336	0,631
Consumer Goods	0,550	0,297	0,901	0,349	0,473	0,861	0,597	0,820	0,313	0,467	0,997
Consumer Services	0,982	0,655	0,674	0,996	0,561	0,827	0,869	0,991	0,647	0,998	0,996
Technology	0,961	0,728	0,797	0,930	0,327	0,677	0,954	0,843	0,169	0,106	0,644
Healthcare	0,777	0,516	0,778	0,966	0,710	0,953	0,845	0,811	0,657	0,356	1,000
Aggregate	0,960	0,888	0,585	0,969	0,711	0,763	0,817	0,505	0,672	0,204	0,878
Volatility of the P/B ratio											
Finance	0,834	0,935	0,736	0,939	0,753	0,579	0,542	0,874	0,815	0,412	0,888
Industrials	0,941	0,945	0,900	0,939	0,962	0,164	0,233	0,871	0,749	0,638	0,860
Telecom	0,936	0,950	0,860	0,905	0,872	0,894	0,921	0,666	0,871	0,677	0,953
Basic Materials	0,953	0,947	0,923	0,996	0,926	0,904	0,767	0,928	0,768	0,061	0,915
Oil & Gas	0,952	0,667	0,986	0,959	0,910	0,993	0,094	1,000	0,184	0,319	0,789
Consumer Goods	0,959	0,866	0,964	0,962	0,914	0,529	0,484	0,488	0,720	0,894	0,854
Consumer Services	0,962	0,917	0,996	0,982	0,974	0,371	0,793	0,884	0,853	0,956	0,991
Technology	0,981	0,988	0,934	0,990	0,957	0,957	0,887	0,972	0,983	0,428	0,852
Healthcare	0,498	0,802	0,924	0,873	0,634	0,898	0,912	0,966	0,925	0,796	0,994
Aggregate	0,984	0,969	0,854	0,982	0,932	0,404	0,903	0,939	0,855	0,347	0,935
Volatility of the P/E ratio											
Finance	0,637	0,612	0,099	0,756	0,051	0,492	0,432	0,216	0,178	0,034	0,260
Industrials	0,921	0,831	0,551	0,732	0,646	0,635	0,775	0,734	0,754	0,488	0,608
Telecom	0,975	0,843	0,644	0,745	0,598	0,073	0,078	0,792	N/A	N/A	0,217
Basic Materials	0,818	0,529	0,469	0,298	0,150	0,017	0,376	0,730	0,352	0,035	0,634
Oil & Gas	0,993	0,436	N/A	N/A	0,949	0,037	0,009	N/A	N/A	N/A	N/A
Consumer Goods	0,877	0,168	0,194	0,701	0,299	0,640	0,150	0,113	0,226	0,313	0,631
Consumer Services	0,812	0,865	0,533	0,754	0,509	0,248	0,282	0,882	0,809	0,713	0,824
Technology	0,881	0,297	0,098	0,092	0,432	0,162	0,001	0,672	0,486	0,110	0,702
Healthcare	0,978	0,767	0,693	0,774	0,677	0,546	0,547	0,463	0,422	0,321	0,288
Aggregate	0,871	0,831	0,346	0,863	0,351	0,528	0,586	0,465	0,459	0,153	0,481

Table 17. R^2 across industries for each year (Swedish stock market)

4.4.3.3 Yearly Values for the Norwegian Stock market

Table 18. presents our results from the Norwegian stock market. On an aggregated level, when we set the volatility of the P/C or P/E ratio as the independent variable, the highest R^2 records in 2008 (0.955) and (0.869) respectively. Unlike the P/C and P/E ratio, the highest level of R^2 registers in 2009 (0.970) using the volatility of the P/B ratio as the explaining variable. Although the R^2 are not recorded in the same year for all multiples, we observe that the highest values are recorded during and after the year of the financial crisis.

In 2013 we registered the lowest levels of R^2 regarding the P/B ratio (0,519), a year later we record (0,081) regarding the P/E ratio, and in 2017 we register (0,249) in regards to the P/C ratio. It seems that the explanatory power shows a declining trend prior and during the year

when the oil price shock occurred in regards to using the volatility of one of the three multiples as the explaining variable, however, as stated above the lowest value regarding the P/C ratio was registered in 2017. In the eleven-year period, only the P/E ratio shows indications of a trend in the sense that R^2 is decreasing throughout the years. When it comes to R^2 and the P/B-, and P/C ratio we observe no clear direction as the values vary broadly.

On the industry level, we notice that R^2 records high values in 2008, 2009 and 2018 when comparing the industries within the same year. However, this applies only to using the volatility of the P/B ratio as the exogenous variable. Using the volatility of the P/C ratio as the explaining variable, we observe that the values for R^2 are moderate throughout the period. Also, we cannot see any clear direction in which the values move. Moreover, the magnitude of changes differs extensively, and we record values that are close to 1 in one year and 0,01 in another year, this also applies partly to the other two multiples.

Regarding the P/E ratio, we notice that the values for R^2 are at their lowest compared to the other two multiples. Also, we observe that halfway through the eleven-year period, several industries record noticeable low values such as Consumer Goods, Telecom and Oil&Gas.

As for the aggregate level, we notice that the volatility of the P/B ratio explains the variance in the volatility of the stock returns best. While the volatility of the P/C and P/E ratio is an inferior explaining variable, especially the volatility of the P/E ratio is the worst performer.

Coefficient of determination											
Volatility of the P/C ratio											
Industry	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Finance	0,075	0,156	0,249	0,702	0,512	0,488	0,002	0,015	0,976	0,422	0,548
Industrials	0,437	0,208	0,593	0,480	0,823	0,457	0,463	0,190	0,616	0,452	0,916
Telecom	0,995	0,824	0,582	0,949	0,956	0,166	0,662	0,811	0,814	0,873	0,980
Basic Materials	0,789	0,066	0,049	0,382	0,585	0,299	0,127	0,502	0,492	0,726	0,880
Utilities	N/A	N/A	0,571	0,766	0,809	0,295	0,971	0,357	0,950	0,638	0,731
Consumer Goods	0,940	0,470	0,178	0,428	0,079	0,031	0,797	0,657	0,089	0,975	0,991
Consumer Services	N/A	0,209	0,042	0,411	1,000	0,497	0,353	0,262	0,270	0,336	0,992
Technology	0,784	0,568	0,234	0,621	0,768	0,631	0,450	0,915	0,741	0,702	0,572
Oil & Gas	0,929	0,709	0,536	0,520	0,968	0,419	0,760	0,973	0,886	0,283	0,931
Aggregate	0,955	0,741	0,446	0,625	0,658	0,512	0,296	0,262	0,816	0,249	0,786
Volatility of the P/B ratio											
Finance	0,984	0,963	0,827	0,939	0,837	0,692	0,749	0,604	0,716	0,640	0,883
Industrials	0,967	0,487	0,861	0,391	0,131	0,099	0,333	0,181	0,503	0,275	0,736
Telecom	0,914	0,950	0,713	0,954	0,813	0,962	0,716	0,876	0,770	0,625	0,988
Basic Materials	0,977	0,947	0,922	0,823	0,924	0,731	0,711	0,867	0,889	0,910	0,842
Utilities	0,539	0,779	0,346	0,839	0,879	0,982	0,775	0,555	0,994	0,256	0,995
Consumer Goods	0,884	0,899	0,904	0,562	0,843	0,575	0,703	0,823	0,846	0,837	0,991
Consumer Services	0,889	0,915	0,642	0,988	0,932	0,371	0,757	0,281	0,758	0,633	0,992
Technology	0,590	0,546	0,645	0,769	0,815	0,675	0,785	0,904	0,800	0,831	0,925
Oil & Gas	0,894	0,950	0,643	0,679	0,683	0,498	0,741	0,917	0,866	0,839	0,913
Aggregate	0,962	0,970	0,773	0,885	0,897	0,519	0,736	0,855	0,949	0,678	0,930
Volatility of the P/E ratio											
Finance	0,828	0,613	0,673	0,721	0,621	0,589	0,589	0,744	0,274	0,698	0,280
Industrials	0,600	0,207	0,413	0,422	0,266	0,234	0,061	0,059	0,028	0,122	0,269
Telecom	0,895	0,492	0,145	0,378	0,140	0,001	0,178	0,048	N/A	N/A	0,570
Basic Materials	0,730	0,041	0,036	0,418	0,326	0,433	0,213	0,218	0,188	0,231	0,344
Utilities	0,170	N/A	0,022	0,186	0,025	0,215	0,036	0,177	0,196	0,224	0,250
Consumer Goods	0,384	0,008	0,089	0,129	0,049	0,001	0,378	0,410	0,394	0,418	0,484
Consumer Services	0,114	0,002	0,098	0,205	0,145	0,062	0,003	N/A	0,260	0,050	0,042
Technology	0,710	0,453	0,624	0,593	0,771	0,579	0,321	0,837	0,717	0,040	0,049
Oil & Gas	0,715	0,178	0,197	0,412	0,438	0,020	0,202	0,043	0,002	0,005	N/A
Aggregate	0,869	0,414	0,421	0,615	0,599	0,122	0,081	0,237	0,397	0,242	0,154

Table 18. R^2 across industries for each year (Norwegian stock market)

5.0 Discussion of results

By using our hypotheses, we will in this section discuss our results presented in the chapter above. We divide our discussion into three parts. First, we discuss the hypothesis which questions if the volatility of the price multiples explains the changes in the volatility of stock returns. Further, we discuss the coefficient of determination across industries and finally across time.

5.1 Linear Regression

In this part, we look at the coefficient of determination to test the explanatory power of the volatility of the price multiples to predict the volatility of stock returns. We look at both the Danish, Swedish and Norwegian stock market and our three chosen variables. Hence, the first hypotheses in this section are as follows:

Hypothesis 1: *For a given market, the volatility of the P/E ratio explains the changes in the volatility of stock returns.*

Hypothesis 4: *For a given market, the volatility of the P/B ratio explains the changes in the volatility of stock returns.*

Hypothesis 7: *For a given market, the volatility of the P/C ratio explains the changes in the volatility of stock returns.*

From table 13., 14., and 15. we can observe that the value of the coefficient of determination is larger than zero in all the three periods, besides the industries in the three stock markets that contain no available data this provides evidence for accepting the hypotheses stated above. We expect that the volatility of the P/E, P/B, and P/C ratio can explain the variance in the volatility of the stock returns. Also, we can infer that this holds for each of the three markets.

Moreover our results strengthen the results of the papers done by (Fama and French, 1992, 1993; Chan, Namao & Lakonishok, 1991; Campbell and Shiller, 1998; Davis, 1994; David and Veronesi, 2013) and the master thesis of Gonta and Yang (2013), where they conclude that the volatility of price multiples can be used to create a prediction model for the volatility of stock prices in the Swedish stock market. Our results show that this also applies to both the Danish and Norwegian stock market. Hence, based on our findings, the conclusion in the research of Gonta and Yang is strengthened.

5.2 Linear Regression across industries

This section is concerned with the coefficient of determination across industries. The following hypotheses are answered:

Hypothesis 2: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/E ratio varies across industries.

Hypothesis 5: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/B ratio varies across industries.

Hypothesis 8: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/C ratio varies across industries.

We accept the hypotheses stated above based on the results presented in table 16., 17., and 18. we can observe that the explanatory power takes on different values across industries, with the exception of the industries in the three stock markets that contain no available data. Our findings show that the coefficient of determination varies across industries in all three markets for both the P/B, P/C, and P/E ratio. Moreover, we find that the volatility of the price multiples explains the variance in the volatility of stock returns best within one industry. We find evidence that the volatility of the stock returns is best explained by the volatility of the P/B ratio within Consumer Services, P/C within Technology, regarding the P/E no industry clearly distinguishes itself, this applies to the Danish and Swedish stock market. In regards to the Norwegian stock market, we find that the highest R^2 is registered within Telecom when the volatility of the P/B ratio or P/C is used as the exogenous variable, when using P/E the highest R^2 is within Finance.

5.3 Linear Regression across time

Last part of linear regression is related to the explanatory power across time. In this section, we are interested in how the coefficient of determination varies between years and between our given periods. Hence, the following hypotheses are answered:

Hypothesis 3: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/E ratio is non constant in time.

Hypothesis 6: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/B ratio is non constant in time.

Hypothesis 9: For a given market, the coefficient of determination between the volatility of stock returns and the volatility of the P/C ratio is non constant in time.

The results from table 13., 14., 15., 16., 17., and 18. provide evidence that the coefficient of determination varies yearly and across the different time periods defined in our thesis, hence we accept the hypotheses stated above. The evidence provided by the results holds for all of the three markets. In periods that are characterized by economic instability the volatility of each of the price multiples explains the variance in the volatility of the stock returns better. However, this holds only for the Norwegian and Swedish stock market as the highest levels of R^2 were measured in the first five years, with the peak in 2008 and 2009. In the Danish stock market, only the volatility of the P/C ratio explains the changes in the volatility of the stock returns better during the periods with market instability. The results from table 13. show that the volatility of stock returns is more dependent on the volatility of the P/E and P/B ratio during periods which are not characterized by financial crises, since the highest values of R^2 were measured in the last five years, with peaks in 2013 and 2015.

5.4 Discussion

In this paragraph, we will summarize our main empirical findings and try to relate them with the existing theory.

In the first part of our analysis, we examine the results regarding the volatility values of the price multiples. We notice differences and similarities between the volatility of the three multiples, as well as between the markets. Regarding the volatility of the price multiples, our results suggest that the P/B ratio is the least volatile ratio, while the P/C and P/E ratio exhibit stronger fluctuations. The P/E ratio, in particular, features the highest volatility movements among the three ratios. Also, during the eleven-year period, our results suggest that the volatility of the price multiples exceeds the volatility of the stock returns to a great extent, indicating that the underlying valuation factor is more sensitive to changes in market conditions.

We find evidence that for the entire eleven-year period, the Norwegian stock market is on average the most volatile market in regards to the volatility of the price multiples and stock returns. We are comparing the results to the findings from the article of Kane et al. (1996), which suggest that variation in price multiples is affected by the variation in stock returns. This can be an explanation for why the volatility of the price multiples record the highest values in the Norwegian stock market because the volatility of the stock returns is also the highest. Another explanation for why the Norwegian stock market is the most volatile stock market among the three Nordic markets could lie in the movements of the oil price. In the master thesis from Anfinnsen & Johansen (2017), the students examine different variables which could affect the volatility of the Norwegian stock market. They investigate how prices of commodities could affect the volatility, one of the findings is that oil price does characterize the volatility in the Norwegian stock market. Since the Norwegian stock market is characterized by having a significant weighting in the oil industry, it is reasonable to assume that the volatility of stock returns fluctuates with oil price movements.

It is also reasonable to assume that financial metrics also will fluctuate with changes in the oil price.

Companies with main activities related to oil are especially sensitive, since their revenues are highly dependent on the oil price. This can be an explanation for why the volatility of the price multiples is also the highest in Norway.

During the eleven years, we took into account. We find that in the three markets, the average values for the volatility of stock returns and price multiples decreased. This suggests that the volatility of price multiples is high when stock returns volatility is high. Furthermore, it also suggests that the variation in the volatility of the price multiples decreases when market volatility decreases. An explanation for why the price multiple volatility increases when stock returns volatility increases can be that when stock returns fluctuate more the financial metric in the multiple becomes less significant in regards to being the component in the price multiple responsible for changes in volatility. Hence, this implies that price is the component in the price multiple that has the most significant effect on the volatility of the given price multiple.

In the paper of Bildersee et al. (1990), the findings suggest that the variability of price multiples varies across international markets, the findings also suggest that the differences between the markets are narrowing over time. Our findings support both findings from the paper of Bildersee et al. (1990), we find evidence that the volatility of the price multiples varies across the Nordic markets. Moreover, our results suggest that the differences between the Norwegian, Danish, and Swedish stock market narrow, the volatility of the price multiples show increased similarity over time. Bildersee et al. (1990) do not discuss the “narrowing” effect in their paper explicitly. However, they mention that nationalization can be a reason. We think that increased nationalization or rather globalization is one reason for why the price multiple volatility shows increased similarity in the Nordic markets. In addition to globalization, we also think that due to the higher market correlation, the similarity has increased over time.

In the article from Glaser (2012), market correlation is examined, and although the results vary and are strongly influenced by choice of the time interval as mentioned by the author, the results imply that market correlation has increased in the past 15 years. Now, when we look at the Nordic countries, it is reasonable to assume that Denmark, Sweden, and Norway trade extensively with each other because these countries share a mutual history and border to each other. Hence, an increased market correlation will have a stronger effect on the three

markets. However, when we look at the period 2013-2018, our results suggest that the “narrowing” effect differs across the price multiples.

Regarding the volatility of the P/B ratio, we observe that the Norwegian and Swedish stock market show increased similarity, while the volatility of P/C show increased similarity in Denmark and Sweden. On the other hand, despite the differences having decreased throughout the period, the volatility of the P/E ratio shows the least similarity across the three markets. This indicates that an increased market correlation has a stronger effect on stock returns, while financial metrics are less affected.

When we compare the graphs of the volatility of price multiples we notice that all three markets share a similar trend, in the sense that the volatility increases significantly during the period around the turn of the year. This is a trend that we often notice throughout the eleven-year period. The trend applies to all of the three multiples and is most prominent in the volatility of the P/E and P/C ratio, while it is less significant in the volatility of the P/B ratio. Thus the trend seems not to be consistent in the volatility of the price multiples. We think that a possible explanation for the jumps can be attributed to tax deduction reasons. Investors have a tendency to sell off stocks at the year’s end to cash in gains and sell losing stocks to offset their gains for tax purposes, thus the stock prices drop, once the new year begins they rush back to the market and the stock prices increase sharply (Investopedia, 2009). This particular seasonal increase is often referred to as the “January effect”, this effect is supposed to be an anomaly. To what extent there exist an anomaly in our examined stock markets is questionable since our results do not provide sufficient evidence to be able to debate this subject. However, our results do indicate that price multiples are affected by a seasonal increase in stock prices. We notice that the P/E ratio volatility, particularly in the Danish stock market is significantly exposed to the seasonal increase.

When looking at the sensitivity of the price multiples in the entire period, our results suggest that from a time aspect the P/B ratio is the least sensitive price multiple in the three markets, this applies both to the aggregated level and industry level. In contrast to the P/B ratio, our results suggest that the sensitivity of the P/E ratio is the highest among the ratios, this also holds for all three markets on the aggregate level and industry level. On the contrary, it is hard to determine the sensitivity of the P/C ratio as the results vary across the markets, but it seems that the sensitivity resembles more the sensitivity of the P/E ratio considering the time aspect.

Speaking of the time aspect, in the eleven-year period we took into account we were not able to find a pattern in regards to the different industries. Besides higher volatility values in conditions of high market instability (e.g. financial crisis and oil price shock) and the fact the general volatility level decreased over the past 11 years.

In the second part of our analysis, we intend to test the ability of the price multiples volatility to explain the variance in the volatility of stock returns. Our results show that there exists an explanatory power when using the price multiples volatility as the explaining variable. Hence, we find evidence that there is a significant relationship between the volatility of price multiples and stock returns. This holds for all price multiples in all three stock markets.

We find evidence that the volatility of the price multiples can explain the variance in the volatility of the stock returns in the Nordic markets. The results are not surprising since the price is an underlying part of the price ratio. However, our results suggest that the explanatory power differs both across the different price multiples and stock markets.

During the eleven-year period, we find that the volatility of the P/B ratio performs best at explaining the variance in the volatility of stock returns, this applies to all the three stock markets. We notice that the variance is best explained in the Danish stock market, while the results for the Swedish and Norwegian stock market show a weaker but similar explanatory in both markets.

In contrast to the P/B ratio, the P/C ratio volatility seems to perform on a moderate level when explaining the variance in the volatility of the stock returns. The results for the Danish and Swedish stock market are similar, while the explanatory power is significantly lower in the Norwegian stock market.

Regarding the volatility of the P/E ratio, we find evidence that the P/E ratio volatility performs worst at explaining the variance in the volatility of stock returns in the Nordic stock markets. The results for the Swedish stock market indicate a relative moderate explanatory power. However, the Norwegian and Danish stock market features the values with the lowest explanatory power, in particular, the Danish stock market having the lowest values. The finding in regards of the weak explanatory power of the P/E ratio volatility may not be surprising in respect of the finding from the paper of David & Veronesi (2013). They

investigated the relationship between stock return volatility and log P/E ratio and find that they are nonlinearly related. This could explain why the volatility of the P/E ratio performs worst at explaining the variance in stock returns volatility in the Nordic markets.

However, Barbee et al. (2008) state in their research paper that the P/E and P/B ratio are more favorable by investors than the P/CF ratio since the information in these multiples is most likely to be incorporated into stock prices. Our results confirm that the explanatory power is high when using the P/B ratio volatility as the explanatory variable, when using the P/C ratio volatility it is moderate, and the P/E ratio volatility performs worst at explaining the variance in the volatility of stock returns. Hence, our results suggest that the information in the P/C and P/B ratio is more likely to be incorporated into stock prices in the Nordic markets, but this seems not to be the case for the P/E ratio.

When analyzing the regression results, we divided our eleven year period into two sub-periods, which we defined as period two (2008-2012) and period three (2013-2018). The intention was to check how the explanatory power would develop from one sub-period to another. Additionally, we wanted to investigate how the explanatory power behaves during conditions of economic instability. Period two includes the financial crisis, and period three includes the oil price shock.

Our results show that the explanatory power decreased in period three in the Norwegian and Swedish stock market, this applies to the volatility of all price multiples. We notice that when using the volatility of the P/C and P/E ratio, the explanatory power drops significantly in period three, while the drop regarding the P/B ratio is less significant in both markets.

The results for the Danish stock market are different, the explanatory power decreases when using the P/C ratio volatility as the explanatory variable in period three, just as in the two other stock markets. However, when using the P/B and P/E ratio volatility as the explanatory variable, the explanatory power actually increases in period three. It is hard to find a plausible explanation for why the results differ in the Danish stock market regarding the direction of the P/E and P/B ratio volatility, especially since most of the results on the industry level actually follow the opposite direction.

The findings suggest that the volatility of the P/C ratio is better at explaining the variance in the volatility of stock returns in periods characterized by economic instability. This also holds

for the volatility of the P/B and P/E ratio, however only for the Norwegian and Swedish stock market.

In regards to the explanatory power in the different industries in the three stock markets, we could not find a pattern. The evidence from our results suggests that the explanatory power varies extensively both within and between industries. Also, we find that the explanatory power is high in the years 2008 and 2009, this applies to a great extent to all industries and holds for all multiples and stock markets. Interestingly we find that the explanatory power increases in 2018, this applies mostly to all multiples in the Danish and Swedish stock market, regarding the Norwegian stock market this holds only for the P/C and P/B ratio.

6.0 Conclusion and recommendations

6.1 Conclusions

The main objective of this paper was to look at the relationship between the stock returns volatility and price multiples volatility. In order to achieve the objective, we used volatility modeling and linear regression analysis. The first part of our test concerns with the estimation and graphical illustration of the volatility of the price multiples in the three stock markets. Thus, we examined the behavior of the volatility of the price multiples and compared the behavior across the different markets. Furthermore, we estimated yearly values for the industries and compared them as well. The second part of our test is concerned with whether the volatility of the price multiples can explain the variance in the volatility of stock returns. Moreover, we compared the results across the different industries and stock markets. The coefficient of determination helps us to observe the magnitude in the explanatory power when using the volatility of each price ratio as the exogenous variable. The sample in our thesis consists of companies that are listed on the Norwegian, Sweden, and Denmark Datastream Index. The examined period is 2008-2018.

The existing literature did not study the relationship between the volatility of price multiples and the volatility of stock returns explicitly. One master thesis conducted by Gonta & Yong (2013) examined the relationship between the volatility of the P/E and P/B ratio and the volatility of stock returns and contributed to the research field with their findings, the literature on this particular subject is still scarce.

They find that there exists a correlation between the volatility of price multiples and the volatility of stock prices in Sweden. Our thesis builds on their findings. Furthermore, we follow Gonta & Yong's recommendation and extend the examined variables with the P/C ratio. Additionally, we extend the dataset with data from the Norwegian and Danish stock market. Thus, our paper broadens and contributes to filling the research gap created by the lack of literature. Moreover, we contribute not only to the research field, but we provide investors with more detailed information about the relationship between the movements of the price multiples in relation to the stock returns in the three Nordic countries; Norway, Sweden, and Denmark.

Our research question can be answered as follows: *the volatility of price multiples can explain the variation in the volatility of stock returns in Norway, Sweden, and Denmark, hence there exists a relationship.*

First, our findings show that the volatility of the P/E, P/B, and P/C ratio explains the variation in the volatility of stock returns in the three examined stock markets.

Secondly, the volatility of the P/B ratio performs best at explaining the variance in the volatility of stock returns in Norway, Sweden, and Denmark. The volatility of the P/C ratio performs in the range between good and mediocre and that the volatility of the P/E ratio performs worst at explaining the variance in stock returns volatility in Norway, Sweden, and Denmark.

Thirdly, we find that for the period 2008-2012 the explanatory power was higher than in the period 2013-2018, this applies to all price multiples and holds for Sweden and Norway. In Denmark, only the volatility of the P/C ratio was better in the period 2008-2012 at explaining the movements in the volatility of stock returns. The volatility of the P/B and P/E ratio was better at explaining the variance in stock returns in the period 2013-2018.

Fourthly, on the industry level, the explanatory power differs both within and between the industries each year. Our findings show that there is no clear direction or trend in Norway, Sweden, and Denmark.

Lastly, the results of the explanatory power lead us to conclude that the volatility of the price multiples performs best at explaining the variance in the volatility of stock returns in periods of high market uncertainty (e.g. crises). However, it is essential to mention that this seems only to apply to crises of considerable extent since our results suggest that the explanatory power in bad economic situations or shocks (e.g. oil price shock) seems not to increase significantly.

6.3 Contribution

We divide our contribution into two aspects, a theoretical aspect, and a practical aspect. The theoretical aspect of our contribution applies to the lack in the existing literature on this particular subject. As we mentioned and pointed towards earlier in our literature review, most of the existing literature investigates the link between stock returns or stock prices and price multiples or the relationship between price multiples and volatility. Thus, our master thesis fills the gap in the literature. Moreover, our thesis shows that there exists a linkage between the volatility of price multiples and stock returns volatility. Our results show the behavior of the volatility of the price multiples in the past eleven years in Norway, Sweden, and Denmark. Additionally, they show that the volatility of the price multiples can explain the variance in the volatility of stock returns and that the direction and strength of the explanatory power differ when the time, industry and stock market aspect is taken into account.

Regarding the practical aspect, we think that our thesis provides better insight for investors and analysts. This study investigated the Norwegian, Swedish and Danish stock market, and took into consideration a period of eleven years which includes the financial crisis, the oil price shock, Brexit and several other events, where the financial crisis is the event that affected investors greatly. Our study contains recent data which gives investors an updated picture of the market conditions in Norway, Sweden, and Denmark. The results in our study give investors a better understanding of the characteristics of the volatility of the individual price multiple. Moreover, our study shows how much information the price multiple volatility conveys in relation to the movements in stock returns volatility in the three different markets. This enables investors to make better investment decisions, both in their home country and across the three markets.

6.4 Suggestions for further research

Our results led us to propose the following suggestions for future researchers. Firstly, we suggest that further research could be done on the same research questions as ours but in different markets. We suggest that one could investigate American, Asian, or other European stock markets. Perhaps it would also be useful to combine the different markets in the same data sample, as this gives the researchers a basis for comparison. Moreover, researchers could extend the period or investigate a different period in regards to different market conditions. We also suggest the use of another model to calculate volatility, the GARCH model is known to have limitations. Future researchers can use a different model or an extension of the GARCH, such as the E-GARCH, and check if the relationship between the volatility of stock returns and the volatility of price multiples still holds.

Secondly, researchers can use the results from the regression part in our thesis to investigate the different values for the explanatory power with respect to the behavior of investors, when they prefer to buy the stock and when they prefer to sell the stocks. Because the values are different across the industries, it means that the investors' behavior is different across each industry and across time. The financial behavior theory or efficient market hypothesis can be used as a basis for this type of research.

Thirdly, since the literature about the volatility of the price multiples is scarce, we recommend future researchers look into the factors that affect the volatility of price multiples. Additionally, researchers could extend the price multiples that could be used, such as the price-sales ratio, this would help broaden the knowledge regarding the behavior of this ratio.

Lastly, we propose that future researchers could also investigate to what extent the price multiples are cointegrated with stock returns. Researchers could also investigate how investors perceive volatility in the price multiples: if this is considered to be positive or negative.

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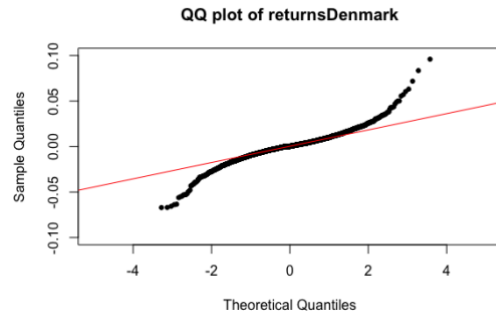
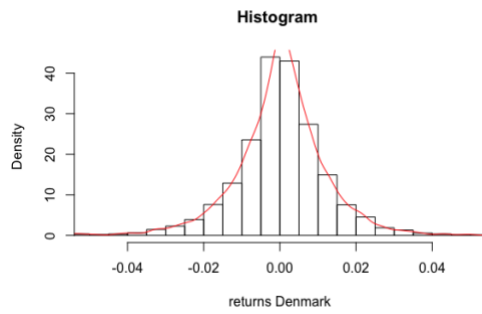
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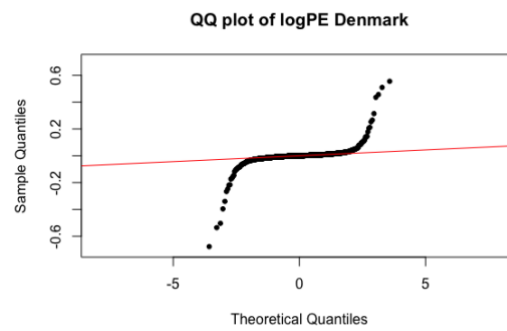
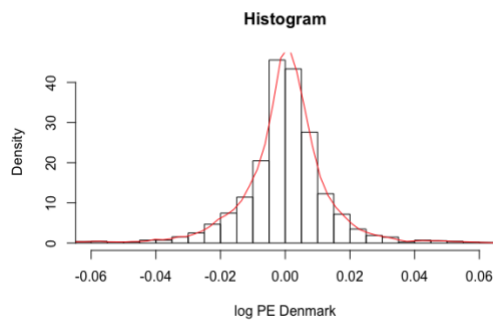
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Appendix 1: Normality plots (Aggregated data) Denmark

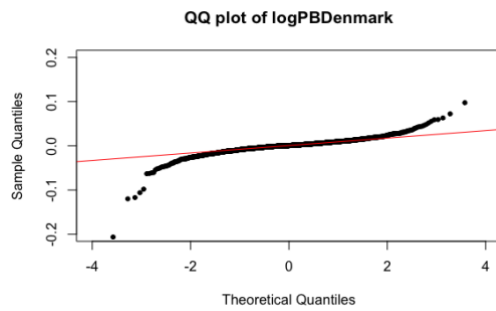
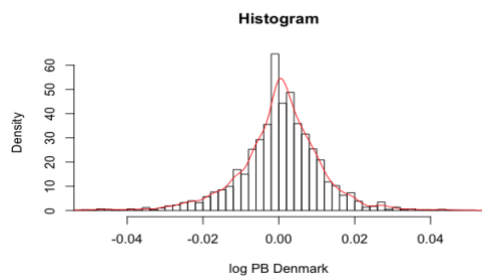
- Stock Returns



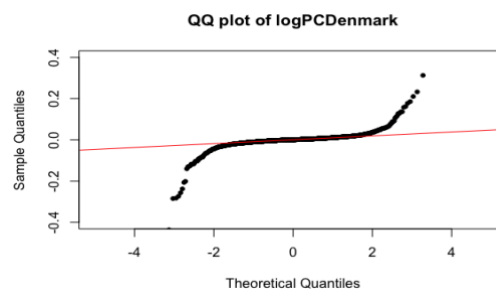
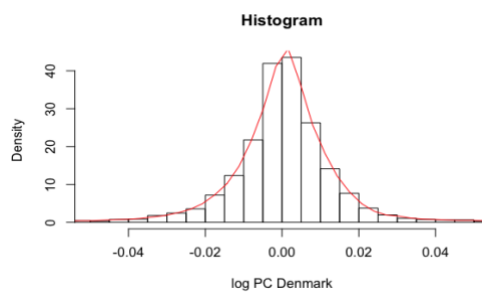
- P/E Ratio



- P/B Ratio

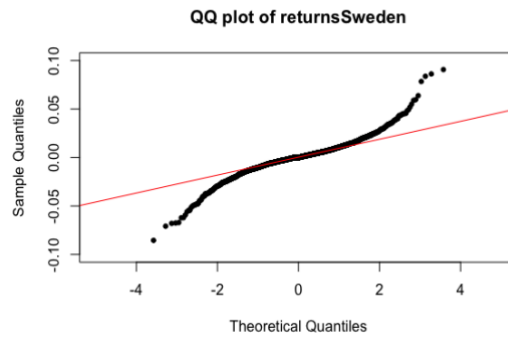
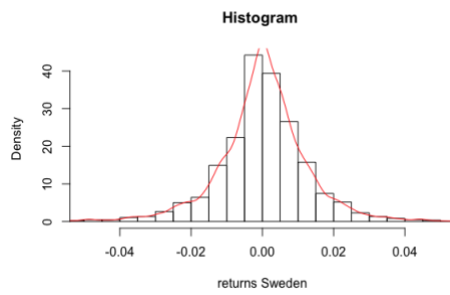


- P/C Ratio

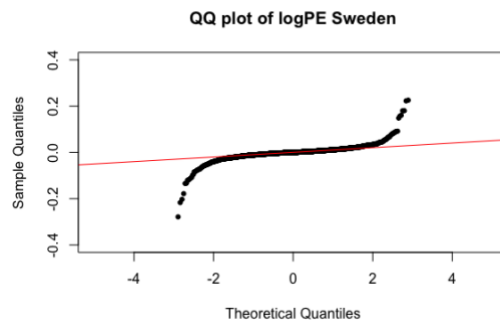


Appendix 2: Normality plots (Aggregate data) Sweden

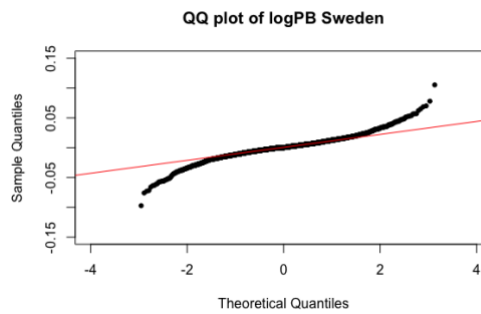
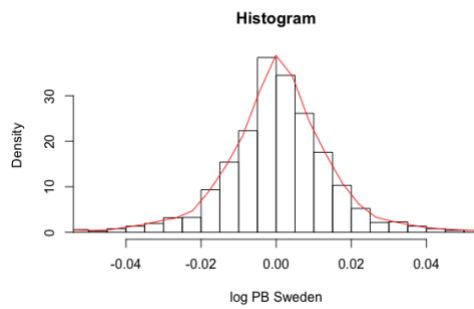
- Stock Returns



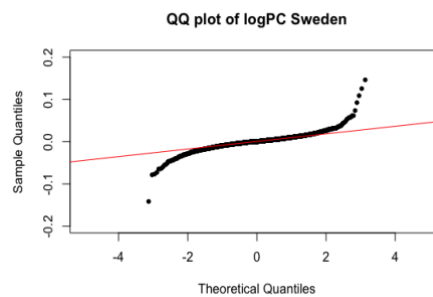
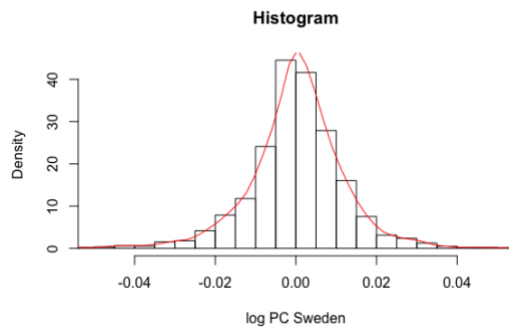
- P/E Ratio



- P/B Ratio

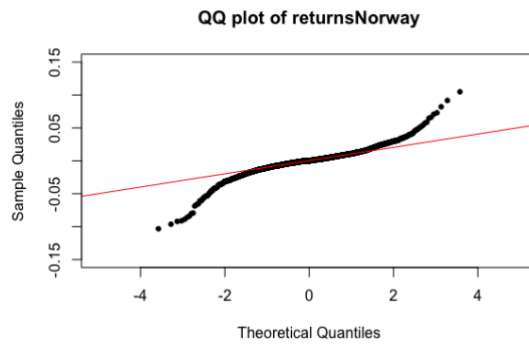
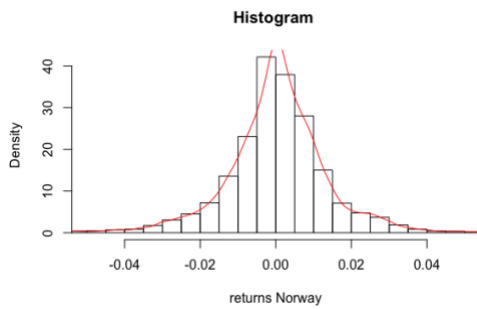


- P/C Ratio

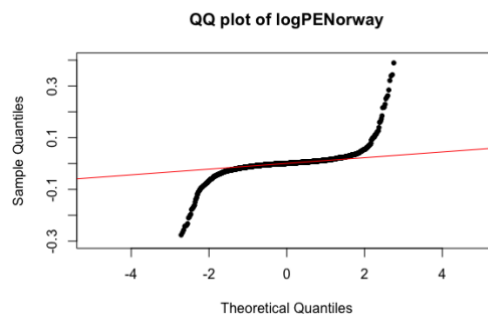
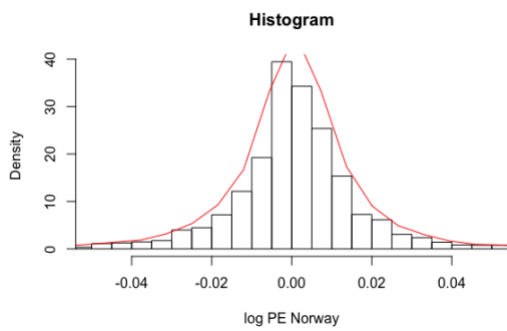


Appendix 3: Normality plots (Aggregate data) Norway

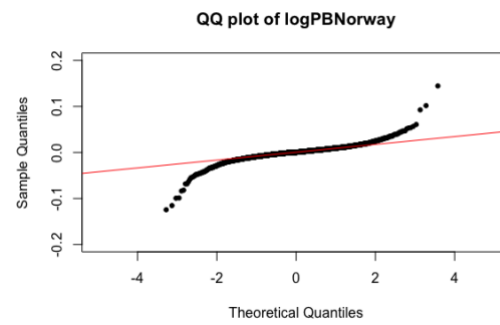
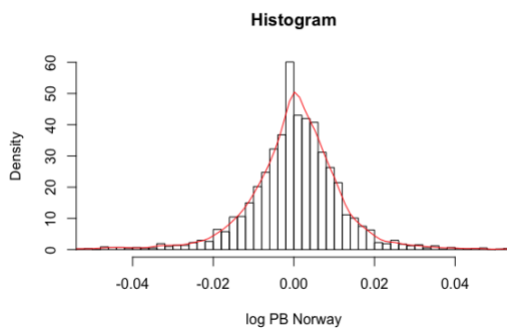
- Stock Returns



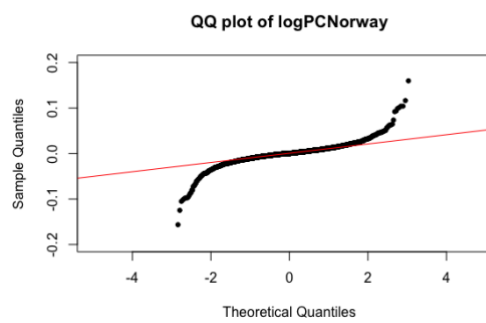
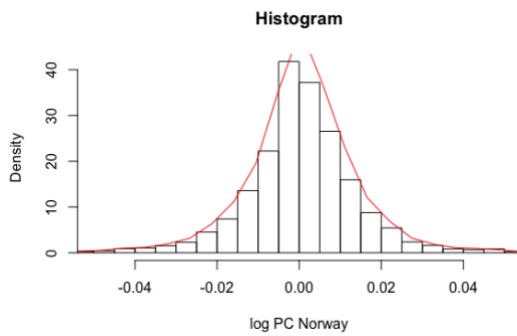
- P/E Ratio



- P/B Ratio



- P/C Ratio



Appendix 4: Companies included in the Danish Datastream Index

Name	Industry	Sector
DANSKE BANK	Financials	Banks
A P MOLLER MAERSK B	Industrials	Industrial Transportation
CARLSBERG B	Cons. Goods	Beverages
NOVO NORDISK 'B'	Healthcare	Pharmaceuticals and Biotechnology
ORSTED	Utilities	Gas, Water and Multiutilities
CHRISTIAN HANSEN HOLDING	Healthcare	Pharmaceuticals and Biotechnology
DSV 'B'	Industrials	Industrial Transportation
ISS	Industrials	Support Services
JYSKE BANK	Financials	Banks
NOVOZYMES B	Healthcare	Pharmaceuticals and Biotechnology
PANDORA	Cons. Goods	Personal Goods
VESTAS WINDSYSTEMS	Alternative energy	Alternative Energy
ALK-ABELLO B	Healthcare	Pharmaceuticals and Biotechnology
ALM BRAND	Financials	Nonlife Insurance
AMBU B	Healthcare	Health Care Equipment and Services
COLOPLAST B	Healthcare	Health Care Equipment and Services
FLSMIDTH AND CO.	Industrials	Construction and Materials
GENMAB	Healthcare	Pharmaceuticals and Biotechnology
H LUNDBECK	Healthcare	Pharmaceuticals and Biotechnology
ROCKWOOL INTERNATIONAL B	Industrials	Construction and Materials
TORM A	Industrials	Industrial Transportation
TRYG	Financials	Nonlife Insurance
WILLIAM DEMANT HOLDING	Healthcare	Health Care Equipment and Services
BANG AND OLUFSEN	Cons. Goods	Leisure Goods
BAVARIAN NORDIC	Healthcare	Pharmaceuticals and Biotechnology
DFDS	Industrials	Industrial Transportation
DMPKBT.NORDEN	Industrials	Industrial Transportation
GN STORE NORD	Healthcare	Health Care Equipment and Services
JEUDAN	Financials	Real Estate Investment and Services
NETCOMPANY GROUP	Technology	Software and Computer Services
NILFISK HOLDING	Industrials	Industrial Engineering
NKT	Industrials	Electronic and Electrical Equipment
NNIT	Technology	Software and Computer Services
PER AARSLEFF HOLDING B	Industrials	Construction and Materials
RINGKJOBING LANDBOBANK	Financials	Banks
ROYAL UNIBREW	Cons. Goods	Beverages
SCANDINAVIAN TOBACCO	Cons. Goods	Tobacco
SCHOUW AND	Industrials	General Industrials
SIMCORP	Technology	Software and Computer Services
SP GROUP	Basic Materials	Chemicals
SPAR NORD BANK	Financials	Banks
SYDBANK	Financials	Banks
TIVOLI 'B'	Cons. Services	Travel and Leisure
TOPDANMARK	Financials	Nonlife Insurance
UTD.INTENT.	Cons. Goods	Food Producers
VELOXIS PHARMACEUTICALS	Healthcare	Pharmaceuticals and Biotechnology
ZEALAND PHARMA	Healthcare	Pharmaceuticals and Biotechnology
A P MOLLER MAERSK A	Industrials	Industrial Transportation
CARLSBERG A	Cons. Goods	Beverages
ROCKWOOL INTERNATIONAL A	Industrials	Construction and Materials

Appendix 5: Companies included in the Swedish Datastream Index

Name	Industry	Sector
SWEDBANK A	Financials	Banks
VOLVO B	Industrials	Industrial Engineering
SKANDINAVISKA ENSKILDA BANKEN A	Financials	Banks
SVENSKA HANDELSBANKEN A	Financials	Banks
ATLAS COPCO A	Industrials	Industrial Engineering
ERICSSON B	Technology	Technology Hardware and Equipment
HENNES & MAURITZ B	Cons. Services	General Retailers
SANDVIK	Industrials	Industrial Engineering
ASSA ABLOY B	Industrials	Construction and Materials
ELEKTA B	Healthcare	Health Care Equipment and Services
EPIROC A	Industrials	Industrial Engineering
SKF B	Industrials	Industrial Engineering
SWEDISH MATCH	Cons. Goods	Tobacco
TELE2 B	Telecommunication services	Mobile Telecommunications
TELIA COMPANY	Telecommunication services	Mobile Telecommunications
ATRIUM LJUNGBERG B	Financials	Real Estate Investment and Services
BOLIDEN	Basic Materials	Mining
CASTELLUM	Financials	Real Estate Investment and Services
ELECTROLUX B	Cons. Goods	Household Goods and Home Construction
FABEGE	Financials	Real Estate Investment and Services
FASTIGHETS BALDER B	Financials	Real Estate Investment and Services
HOLMEN B	Basic Materials	Forestry and Paper
ICA GRUPPEN	Cons. Services	Food and Drug Retailers
INTRUM	Financials	Financial Services (Sector)
LUNDIN PETROLEUM	Oil&Gas	Oil and Gas Producers
MODERN TIMES GROUP MTG B	Cons. Services	Media
PEAB B	Industrials	Construction and Materials
SAAB B	Industrials	Aerospace and Defense
SECURITAS B	Industrials	Support Services
SKANSKA B	Industrials	Construction and Materials
SVENSKA CELLULOSA AKTIEBOLAGET SCA B	Basic Materials	Forestry and Paper
SWECO B	Industrials	Construction and Materials
SWEDISH ORPHAN BIOVITRUM	Healthcare	Pharmaceuticals and Biotechnology
TRELLEBORG B	Industrials	Industrial Engineering
AAK	Cons. Goods	Food Producers
ALFA LAVAL	Industrials	Industrial Engineering
AXFOOD	Cons. Services	Food and Drug Retailers
BEIJER REF B	Industrials	Industrial Engineering
BILLERUDKORSNAS	Basic Materials	Forestry and Paper
DOMETIC GROUP	Cons. Goods	Leisure Goods
EVOLUTION GAMING GROUP	Cons. Services	Travel and Leisure
GETINGE B	Healthcare	Health Care Equipment and Services
HEXAGON B	Technology	Software and Computer Services
HEXPOL B	Basic Materials	Chemicals
HUFVUDSTADEN A	Financials	Real Estate Investment and Services
HUSQVARNA B	Cons. Goods	Household Goods and Home Construction
INDUTRADE	Industrials	Electronic and Electrical Equipment
INVESTOR B	Financials	Financial Services (Sector)
KINDRED GROUP SDR	Cons. Services	Travel and Leisure
KINNEVIK B	Financials	Financial Services (Sector)
LATOUR INVESTMENT B	Financials	Financial Services (Sector)
LIFCO B	Industrials	General Industrials
LOOMIS B	Industrials	Support Services
LUNDBERGFÖRETAGEN B	Financials	Real Estate Investment and Services
NIBE INDUSTRIER B	Industrials	Construction and Materials
THULE GROUP	Cons. Goods	Leisure Goods
VITROLIFE	Healthcare	Pharmaceuticals and Biotechnology
WALLENSTAM 'B'	Financials	Real Estate Investment and Services
WIHLBORGS FASTIGHETER	Financials	Real Estate Investment and Services
INDUSTRIVÅRDEN A	Financials	Financial Services (Sector)
ESSITY B	Cons. Goods	Personal Goods
VOLVO A	Industrials	Industrial Engineering
EPIROC B	Industrials	Industrial Engineering
ERICSSON A	Technology	Technology Hardware and Equipment
SAGAX B	Financials	Real Estate Investment and Services
SSAB B	Basic Materials	Industrial Metals and Mining
ATLAS COPCO B	Industrials	Industrial Engineering
INDUSTRIVÅRDEN C	Financials	Financial Services (Sector)
INVESTOR A	Financials	Financial Services (Sector)

Appendix 6: Companies included in the Norwegian Datastream Index

Name	Industry	Sector
DNB	Financials	Banks
AKER BP	Oil&Gas	Oil and Gas Producers
EQUINOR	Oil&Gas	Oil and Gas Producers
SCHIBSTED A	Cons. Services	Media
AF GRUPPEN 'A'	Industrials	Construction and Materials
AKER	Financials	Financial Services (Sector)
DNO	Oil&Gas	Oil and Gas Producers
ENTRA	Financials	Real Estate Investment and Services
GJENSIDIGE FORSIKRING	Financials	Nonlife Insurance
NORSK HYDRO	Bas. Materials	Industrial Metals and Mining
NORWEGIAN AIR SHUTTLE	Cons. Services	Travel and Leisure
ORKLA	Cons. Goods	Food Producers
SALMAR	Cons. Goods	Food Producers
TELENOR	Telecom	Mobile Telecommunications
VEIDEKKE	Industrials	Construction and Materials
AKER SOLUTIONS	Oil&Gas	Oil Equipment and Services
ARENDALS FOSSEKOMPANI	Utilities	Electricity
ATEA	Technology	Software and Computer Services
AUSTEVOLL SEAFOOD	Cons. Goods	Food Producers
BAKKAFROST	Cons. Goods	Food Producers
BORR DRILLING	Oil&Gas	Oil and Gas Producers
BORREGAARD	Bas. Materials	Chemicals
EVRY	Technology	Software and Computer Services
GRIEG SEAFOOD	Cons. Goods	Food Producers
LEROY SEAFOOD GROUP	Cons. Goods	Food Producers
MOWI	Cons. Goods	Food Producers
NORWAY ROYAL SALMON	Cons. Goods	Food Producers
NORWEGIAN FINANS HOLDING	Financials	Banks
OLAV THON EIEP.	Financials	Real Estate Investment and Services
SBANKEN	Financials	Banks
SCATEC SOLAR	Oil&Gas	Alternative Energy
SPAREBANK 1 SR-BANK	Financials	Banks
STOREBRAND	Financials	Nonlife Insurance
SUBSEA 7	Oil&Gas	Oil Equipment and Services
TGS-NOPEC GEOPHS.	Oil&Gas	Oil Equipment and Services
TOMRA SYSTEMS	Industrials	Industrial Engineering
YARA INTERNATIONAL	Bas. Materials	Chemicals
EIENDOMSSPAR	Cons. Services	Travel and Leisure
ELKEM	Bas. Materials	Industrial Metals and Mining
FLEX LNG	Industrials	Industrial Transportation
FRONTLINE	Industrials	Industrial Transportation
KONGSBERG GRUPPEN	Industrials	Industrial Engineering
OCEAN YIELD	Industrials	Industrial Transportation
SPAREBANK 1 SMN ORDS	Financials	Banks
SPAREBANKEN HEDMARK	Financials	Banks
VICTORIA EIENDOM	Financials	Real Estate Investment and Services
WALLENIUS WILHELMSSEN	Industrials	Industrial Transportation
GOLAR LNG (OSL)	Oil&Gas	Oil Equipment and Services
SEADRILL (OSL)	Oil&Gas	Oil Equipment and Services
SCHIBSTED B	Cons. Services	Media