The relationship between volatility of price multiples and volatility of stock prices

A study of the Swedish market from 2003 to 2012

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ABSTRACT

The purpose of our study was to examine the relationship between the volatility of price multiples and the volatility of stock prices in the Swedish market from 2003 to 2012. Our focus was on the price-to-earnings ratio and the price-to-book ratio. Some previous studies showed a link between the price multiples and the volatility of stock prices, this made us question whether there should be a link between the volatility of the price multiples and the volatility of the stock prices.

The importance of this subject is accentuated by the financial crisis, as we provide investors with information regarding the movements of price multiples and stock prices. Moreover, we test if the volatility of the price multiples can be used to create a prediction model for the volatility of stock prices. Also we fill the gap in the previous researches as there is no previous literature about this topic.

We conducted a quantitative research using statistical tests, such as the correlation test and the linear regression test. For our data sample we chose the Sweden Datastream index. We first calculated the volatility using the GARCH model and then continued with our statistical tests. The results of our tests showed that there is a relationship between the volatility of the price multiples and the volatility of the stock prices in the Swedish market in the past ten years. Our findings show that the correlation coefficients vary across industries and over time in both strength and direction. The second part of our tests is concerned with the linear regression tests, mainly calculating the coefficient of determination. Our results show that the volatility of the price multiples do explain changes in the volatility of stock prices. Thus, the volatility of the P/E ratio and the volatility of the P/B ratio can be used in creating a prediction model for the volatility of stock prices. Nevertheless, we also find that this model is best suited when the economic situation is unstable (i.e. crisis, bad economic outlook) as both the correlation coefficient and the coefficient of determination had the highest values in the last five years, with the peak in 2008.

Keywords: correlation, volatility, GARCH, price multiples, price-to-earnings ratio, price-to-book ratio, stock prices, linear regression, r square.

GLOSSARY

Volatility – "*is defined as the standard deviation of the return provided by the variable per unit of time when the return is expressed using continuous compounding*" (Hull, 2012, p. 205).

Continuous compounding returns – is the product of the natural logarithm of the ending price and the beginning price (Hull, 2012, p. 205).

Stock return – *"is the gain or loss of a security in a particular period. The return consists of the income and the capital gains relative on an investment. It is usually quoted as a percentage"* (Investopedia, 2013a).

Stock index – *"index based on a statistical compilation of the share prices of a number of representative stocks"* (Farlex clipart collection, 2003-2008).

Price multiple – "*a ratio that compares the share price with some sort of monetary flow or value to allow evaluation of the relative worth of a company's stock*" (Nagorniak & Wilcox, 2013, p.262).

Cyclical company – *"is one which profits are strongly correlated with the strength of the overall economy"* (Doresy et al. 2013, p.190).

Non-cyclical company – *"is one whose performance is largely independent of the business cycle"* (Doresy et al. 2013, p.190).

ABREVIATIONS

P/E – Price-to-Earnings

P/B – Price-to-Book

ARCH – Autoregressive Conditional Heteroskedasticity

GARCH – Generalized Autoregressive Conditional Heteroskedasticity

CBOE – Chicago Board Options Exchange

VIX – Volatility Index

EPS – Earnings per Share

DPS – Dividends per Share

USBE – Umeå School of Business and Economics

CFA – Certified Financial Analyst

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CHAPTER 1: Introduction

In this chapter we start by describing the market volatility as an important valuation method. Then, we outline the connection volatility has with the price multiples, by a thorough literature search. We focus on the P/B and the P/E ratios and their relation with the volatility of the stock market. After we present the problem background, we concentrate on the research gap that is created by lack of research. Then, we formulate our research question. We also point out the contribution our research will bring. Lastly, we present the research limitations.

1.1. Problem Background

The financial crisis put the investors and the entire financial world in turmoil. The uncertainty and the fast changes in the price of stocks made even the most experienced market players feel in need of a preview of the stocks' performance. Moreover, market volatility is reported to be at very high levels in the past years (Ibbotson, 2011). Thus, investors are confronted with additional hardships in taking the decision of either buying or selling their stocks. The major driving force behind each investment is the expected future return. Thus, to be able to benefit of the opportunities of the return and avoid the risks created by stock price volatility, researches came up with mathematical models that describe the relationship between stock price earning in time, and help predict future volatility. These models recognize the fact that volatility is not constant in time, and they keep track of these variations (Hull, 2012, p.205). Moreover a widely accepted measure of the variance in volatility is the standard deviation of the continuously compounded returns (Hull, 2012, p.213). Still, volatility is not the only factor investors take into account when choosing whether to acquire the stocks or not. There are several indicators that are used to assess the attractiveness of a possible investment. When investors want to choose a model to analyse the volatility of a stock, they can use more complex models which may increase accuracy. However, the investors have to think about the "*law of parsimony: a model should be kept as simple as possible in light of the available inputs*" (Nagorniak & Wilcox, 2013, p.277). Therefore, a simple indicator such as price multiples or valuation ratio is interesting to be used and analysed.

> Price multiples are addressed in this paper, which is "*a ratio that compares the share price with some sort of monetary flow or value to allow evaluation of the relative worth of a company's stock*"（Nagorniak & Wilcox, 2013, p.262).

Seghal & Pandey (2009) reveal that, while the textbooks have a lot of information regarding price multiples, the academic research have a moderate number of studies published in this area. According to them, one of the earliest papers is treading the subject of value drivers, and belongs to Beaver et al. (1980, cited in Seghal & Pandey, 2009, p. 35). Beaver et al. looked at the stock price as a substitute for additional information, which was, according to Seghal & Pandey (2009), a "*contemporaneous association between price changes and earnings changes*" (Seghal & Pandey, 2009, p. 35). Thus, early studies emphasized on the link existent between stock prices (P) and company earnings (E).

According to Block (1999, citied by Nagorniak & Wilcox, 2013, p.262) the P/E ratio is arguably the price multiple most frequently cited by the media and used by analysts and investors. Nevertheless, more recent analysts state that there are two ratios most widely used, mainly for their simplicity: the price to earnings (P/E) ratio and the price to book (P/B) ratio (Bolduc, 2012).

- ***The P/E ratio*** is calculated as the stock price per share divided by the annual amount of the earnings per share. P/E attests the underlying relationship between a company's efficiency and its value (Cheng et.al, 1995, p. 25).

- ***The P/B ratio*** is determined as the report between the market price of a share and the book value per share. This indicator reflects the intrinsic value of a firm, thus helping in the identification of value stocks (Sriram, 2006).

Most of the research papers discuss P/E and P/B in the context of financial statement information. Moreover, the majority of the research is oriented towards the relationship between the P/E and a firm's earnings (Ou & Penman, 1989; Penman, 1991; Ou & Penman, 1993 and Barth, 1991, cited in Kwon, 2009). More recent studies looked into the the market valuation ratios and their link to the earnings volatility (Alcock & Steiner, 2011; Barnes, 2001). When it comes down to the link between the price multiples and the stock returns, we have to mention the seminal works of McWilliams (1996), Miller and Widmamn (1996), Nicholson (1968), Dreman (1977), and Basy (1977), that presented evidence of a return advantage to low P/E ratio (citied by Nagorniak & Wilcox, 2013, p.262). Thus, only a few research papers are done on the subject of the link between the price multiples and stock returns.

One of the first papers we found that inferred a link between the P/E ratio and the stock price is Beidleman (1973, cited in Barnes , 2001, p.4) who states that constant earnings could support a high level of dividend. From the model of residual income variation he used in the research paper, we can be infer that price to earnings (P/E) ratio is related to the dividend. Thus, he gives evidence that the P/E ratio looks at a relationship between stock price and earning and it connects with the volatility of stock. Additionally, Ou & Penman (1989) look into the ability of the P/E ratio to reflect future stock returns. Their findings show that the P/E ratio can be used to predict future stock returns (Ou & Penman, 1989). Early studies looked only at the P/E ratio, and they found that this ratio can be linked to the volatility of the stock and future stock returns.

When it comes to the P/B ratio, Fama & French (1992 & 1993, citied in the Alcock. & Steiner, 2011, p.3) said that the P/B ratio could affect the volatility of stock return. Many studies have used the P/B ratio in finance and found that this ratio is inversely related to the company's returns (Fama & French, 1992 & 1993, cited in the DeFusco et al., 2013a, p.535). Many previous researches show that P/B ratio causes the variation in expected stock returns (Daniel & Titman, 1997, p.1). However, Fama & French (1992, cited in Shefrin & Statmen,1995, p.26) found that the stock return is positive related to the P/B ratio. Shefrin & Statmen (1995, p.33) found that the stock of mature companies have low P/B ratio and stock of young companies have high P/B ratio. Therefore, the P/B has been investigated in relation to the company returns and with the stock prices returns. There are just two papers

that link P/B with the volatility of the stock returns, and there is no conclusive answer regarding the direction of this relationship.

Fama & French (1998) try to connect both P/E and stock return volatility. They use P/E and the dividend yield to forecast future stock returns. A specific point of interest is the direction of the relation between valuation ratios (P/E and P/B) and the stock price volatility. Several studies (Campbell & Cochrane, 1999 and Bansal & Yaron, 2004, cited in David & Veronesi, 2009) show a negative relation between volatility of stock and valuation ratios. Koutmos (2010) finds a positive relationship between the P/E and volatility. Furthermore, he ascertains that the P/E ratio has a tendency to revert to its mean in the long run. David & Veronesi (2009) find that this relationship has strong magnitude and direction variations in time. Thus, the research regarding the direction of P/E and volatility of the stock is still uncertain.

When it comes to the volatility of the price multiples, Cheng et.al (1995) looked at the volatility of the P/E ratio in the U.S. and for Japanese companies. They divided the P/E ratio in two components: P/B and B/E. This was the only study we found looking into the volatility of the P/E ratio. Moreover, this study also mentioned the volatility of the P/B ratio. Thus, there is only one paper analysing the volatility of the price multiples.

With the increasing market volatility, we find that the relationship between the behaviour of the volatilities of the P/E and P/B ratios with the stock price volatility is in need of further research. This would prove to be worthy to both investors and researchers.

From the formula of the P/E and P/B it is noticeable that there is a stochastic relationship between these two, the stock prices can affect the value of these price multiples. But in this paper we plan to look only into the explanatory power of the volatility of the price multiples can have over the volatility of the stock prices.

1.2. Research Question

According to a number of previous studies that used the P/E ratio and P/B ratio to analyse the stock volatility, there is a link between P/E ratios with volatility of stock price (Beildeman, 1973; cited in Barnes, 2001, p.4; Fama & French, 1992 & 1993, citied in the Alcock. & Steiner, 2011, p.3). But while some articles supported that lower P/E ratio leads to higher volatility, other studies assert that higher P/E ratio leads to lower volatility. Moreover, we did not find any articles clearly presenting whether the variation of P/B ratio should follow the same change of variation of stock price. So, our main concern is turned towards the strength and the direction of this relationship.

In order to acquire the knowledge regarding the volatility of the price multiples (P/E and P/B) in relation with the volatility of the stock prices, we address the following question:

- *What is the relationship between the movements of price multiples and the movements of stock prices in Sweden?*

By the movements of the price multiples and the movements of stock prices we intend to look at their volatilities. Moreover, for the measurement of the volatility of stock prices we use the standard deviation of stock returns as a proxy. Thus, we intend to look at the correlations between these volatilities, and test whether the volatility of price multiples can help create a model for predicting the volatility of stock prices.

1.3. Research Purpose

The lack of noticeable research regarding the connection between the movements of price multiples and the movements of the stock prices, made us interested in how this relation looks like. The focus of this paper is to understand the relationship between the volatility of the P/E & P/B ratios and the volatility of the stock price. We plan to look at the strength and the direction of this relationship, in the past 10 years, from 2003 to 2012, through the use of the correlation test. Once we find the correlations between the volatility of the price multiples (P/E and P/B) and the volatility of the stock price, our following step would be to compare it by industry, thus we will get an understanding of whether there are any differences. We will try to test the relationship between the volatility of the P/E ratio and of the P/B ratio with volatility of stock prices in Sweden during the last ten years, because not only we could start from the basis to prove the linkage exists among them and figure out the relationship of changing direction among them, but also we can also see if this relationship is affected by the industry. Also, we employ the linear regression test, that will help us observe whether the volatility of the price multiples can be used in creating a prediction model for the volatility of the stock prices. Here, we also divide our companies by industry and time horizon, thus enabling us to observe if there are any differences.

1.4. Research Gap and Contribution

In the past years, investing has become even more difficult due to the increasing market volatility. This made us turn towards the price multiples, which are widely used because of their simplicity. Moreover, our interest was captured by the two most used price multiples: P/E and P/B. We are interested in the ability of the volatility of the price multiples to align with volatility of the stock prices. As we mentioned before, the present difficulty investors are facing accentuates the need of a new prediction or estimation model, and thus we outline the practical gap our paper wants to fill. A thorough study of the literature regarding this topic made us aware of the lack of any article relating these aspects. Most researchers (Ou & Penman, 1989; Fama & French 1992 & 1993, cited in Alcock. & Steiner, 2011, p.3; Campbell & Cochrane, 1999, cited in David & Veronesi, 2009, p.1; David & Veronesi, 2009; Koutmos, 2010) look at either price multiples and stock prices, or price multiples and stock price volatility, there was only one study (Cheng et.al, 1995) that dived into the aspect of the volatility of P/E and of P/B, and this article made no connections with the stock prices or their volatility. Thus, we bring forth the research gap created by the lack of literature in this direction. So our research gap is to question the relationship between the volatility of P/E ratio and P/B and the volatility of stock prices.

Our contribution can be viewed through the theoretical approach we take on the existing research in the financial field, as we plan to fill the research gap existent in the volatility of

the P/E and P/B. Additionally, we plan to offer a proof that will explain whether there is any linkage between the volatility of price multiples and stock price volatility. Furthermore, we want to study the industry specifics in this area.

This study will also approach the practical side of investing, as it will provide results about the movements of price multiples and stock prices in the past 10 years in Sweden. It will also help investors have a better outlook of the market and make better use of the price multiples in deciding for either growth or value stocks. Also, form this study will benefit financial analysts, and the entire financial community.

Judging by the mentioned above, our study will have both practical and theoretical contribution. The theoretical aspect is important, as it can help future researchers induce the triggers behind the price multiples. The practical aspect is of equal importance because it can offer a better understanding of these indicators to the whole financial users.

1.5. Research Limitation

We analyse the data in Sweden from 2003 to 2012. And the number of industries is limited by the list and they are focusing on the Sweden stock market. So the un-listed companies won't be tested. The drawback in our thesis is about biases, and couldn't be avoided. One is sample selection bias because of collecting our data exclude the unlisted companies. Another bias is look-ahead bias. The prices in the stock market are showed at the point time, but fiscal price to book ratio could not be showed to the publicly available until the following fiscal period. Even though we are aware of this biases potentially inherent in a sample, but the sample selection bias could still have the chance to influence our result of study. Another limitation is created by the fact that we look only at the amount of changes in the volatility of stock prices that is explained by the volatility of price multiples. Thus, we ignore the fact that there could be a third factor that is influencing these two. Moreover, the linear regression is a very simple model that can cloud any external influences.

1.6. Thesis Disposition

In this section we present the outline of this paper. We include also a brief description of what each chapter will contain.

Chapter 1: Introduction

In this chapter we start by describing the market volatility as an important valuation method. Then, we outline the connection volatility has with the price multiples, by a thorough literature search. We focus on the P/B and the P/E ratios and their relation with the volatility of the stock market. After we present the problem background, we concentrate on the research gap that is created by lack of research. Then, we formulate our research question. We also point out the contribution our research will bring. Lastly, we present the research limitations.

Chapter 2: Research Methodology

In this chapter we start with explaining the choice of subject and the preconceptions of this research. Afterwards, we deal with a detailed formulation of the scientific methodology we are using. We thoroughly discuss the epistemological and ontological approaches. Moreover we look into the research paradigms together with the research approach, purpose and strategy of this paper. Also, we broach the literature search method, thus making light of the chapter to follow. Lastly, we bring up the ethical and societal issues. Thus, the purpose of this chapter is to present the scientific approach of the study.

Chapter 3: Theoretical Framework

In this chapter we will deal with the theoretical aspects of our research. We assume the reader is knowledgeable in finance, and thus present only notions linked with our research question. First we start with the concept of volatility; we divide it in two parts. The first part deals with the theoretical aspect. The second part deals with a more practical aspect, as we present how volatility looks like around the world. Following this are the price multiples. Here we take the same approach as with volatility: we divide the price multiples in two parts. In the end, we present the relationship between the price multiples and the volatility.

Chapter 4: Practical Method

The objective of the practical method chapter is to present the research design and describe the methods employed in data processing. We will start by defining our data population and sample. Then we move to the time horizon and the data collection method. Further, we describe the calculation of the returns and the transformations in the price to book and the price to earnings ratios. Lastly, we present the GARCH model, and the correlation tests corresponding to data calculation.

Chapter 5: Empirical Results

The empirical results chapter deals with presenting our results. First, we start with presenting the descriptive statistics for the aggregate data. Next, we divide the chapter in two parts: one part will deal with the correlation results, and the other will deal with the linear regression results. In the correlations subdivision, we will discuss the P/E and P/B ratios in the context of the industry section and the time section.

Chapter 6: Discussion of Results

This chapter is meant to bring light to the results presented in the previous chapter. Here we will analyse the results in regards to the hypotheses we have set before. We begin with the correlation test results and finish with the coefficient of determination.

Chapter 7: Conclusions and Recommendations

The purpose of this chapter is to make the conclusions in our thesis and provide some recommendations for further researches. We start from summarizing our empirical findings,

and then we assess our quality of research. Finally, we provide some suggestions for further researches.

CHAPTER 2: Research Methodology

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2.1. Choice of Subject

In choosing a topic for our thesis, we put forward several criteria. Firstly, we are both finance students, so by choosing to examine the stock prices alongside the price multiples, we hope to properly apply all the knowledge we have acquired during our studies. Moreover, in terms of career choice, our resolutions are very alike. We both plan to start our career in the financial analysis area. Thus, we chose a subject that will be helpful and will offer us important insights into this field, by researching whether the volatility of the price multiples is aligned with the volatility of the stock prices. In this study we form a connection between these two most important issues for any analyst: price multiples and stock price behaviour. Also, as mentioned in the previous chapter, there is no previous research into this direction, so we want to open up a new path for future researchers.

Our second criterion that pushed us towards this subject is based on our desire to deepen our knowledge in the practical field. We decided to conduct our study so that we'll get a clear view across industries. We chose Sweden as it was the environment we are both familiar with. We have spent here several years during our studies and got the chance to closely observe the specific aspects that may interfere with our research.

Lastly, we are both interested in the quantitative aspect of finance. Our thesis presumes the use of mathematical methods. We plan to use GARCH modelling in calculating volatility, moreover we plan to test the correlations between the volatility of the stock prices and the volatility of the price multiples. We both took courses in this area. One of us took also courses of analysis of financial data on the D-level. Thus, we are using the knowledge we have obtained and also enriching it with the practical aspects so necessary in the field of financial analysis.

2.2. Preconceptions

In this section we'll discuss about our former knowledge, abilities and experiences that can create a bias in our study conduction, interpretation of results and conclusion inducement.

As mentioned before, we have both studied finance at a Master's level, and Bachelor level. The courses we took gave us a fundamental understanding of the financial theories we have discussed in this research paper, such as volatility, market efficiency, behavioural finance, and the price multiples. When it comes down to the working experience, we have only

internships to mention. Thus, we lack the practical objectivity that a professional might manifest in this area. Nevertheless, we have both taken courses in the subject of academic writing and research, and we have been able to bypass the obstacle created by the lack of experience.

The use of mathematical models in our research is facilitated by the knowledge acquired during the statistics and financial analysis courses. Therefore, we are at no risk of misinterpreting our results. Moreover, the conclusions that have been drawn are free of preconceptions as they were constantly subjected to the criticism of our supervisor and our colleagues.

2.3. Perspective

The perspective section refers to whom this research is addressed. In this paper we presume to take the perspective of the investor. Nevertheless, as shown in the previous chapter, this paper broaches subjects of interest to financial analysts too. This research creates an environment that links several areas: financial markets, quantitative finance, and price multiples. The increasing market volatility has put investors and analysts under a continuous strain. The study plans to help investors get a clearer view of market volatility through the study of the price multiples' volatility.

At the same time, there can be industry specific behaviour. Thus, by doing a cross-industry study, we can notice whether the results vary in dependence of the industry. Moreover, this study will provide results regarding the movements of price multiples and variance of stock prices in the past 10 years in Sweden. It will also help investors have a better outlook of the market and make better use of the price multiples in deciding for an attractive stock.

2.3. Scientific Approach

Our research question entails data collection, but before being able to collect the data, one has to know the scientific approach the researcher is taking. The scientific approach is what dictates the flow of the research procedures. In conducting our research, we had little doubts as to which method is best for data collection. However, these types of thoughts are fitted to be placed in the centre of the "research onion" (Saunders et al., 2007, p. 102). The research onion is depicted in Figure 1, and it shows the aspects a researcher has to consider on a scientific level.

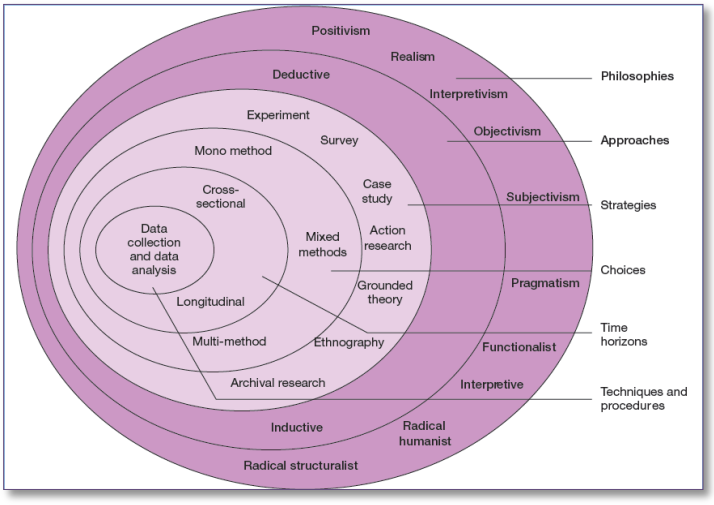

Figure 1. Research "onion"
Source: Saunders et al., 2007, p.102

2.4. Outline of the Research Approach

We have adapted the research "onion" presented earlier, to fit our study. Thus, we start by showing what view we took in defining knowledge, and the sources and limits of knowledge. Then we move on to the view on the world we take as researchers. The next layer deals with the approach of this study. Then we continue to show the purpose of our research. Continuing this sequence, the following layer depicts the time horizon we took in account in conducting this research. Lastly, in the middle of our customized research "onion" is the method of research.

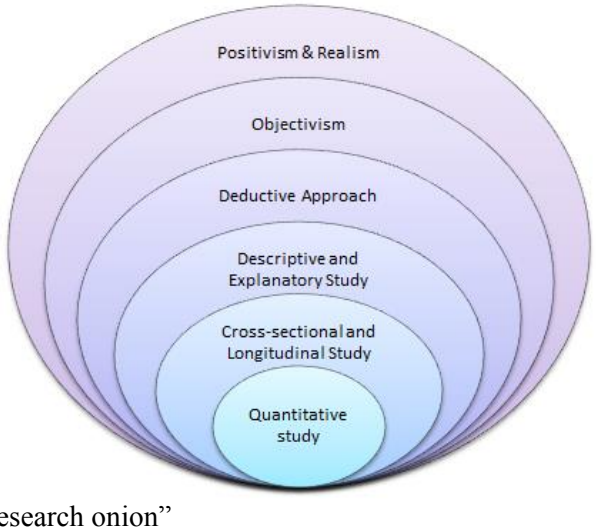

Figure 2. Customized "research onion"
Source: Adapted from Saunders et al., 2007, p.102

2.5. Research Philosophy

The research philosophy is a very important part, as it relates to the way knowledge is being constructed and the nature of the knowledge (Saunders et al., 2007, p. 101). Any

researcher has to take a clear stand in determining how he or she views the world. These choices will have a further impact on the research strategy and the methods used. Thus, the research philosophy deals with the way of thinking. There are two main directions of the research philosophy, these are: epistemology and ontology.

2.5.1. Epistemology

"*Epistemology concerns what constitutes acceptable knowledge in a field of study*" (Saunders et al., 2007, p. 102). As the definition tells us, epistemology deals with determining the appropriate knowledge that can be used to study the reality. It deals with questions such as: what is knowledge? what are the points of departure and the limitations of knowledge? (Saunders et al., 2007, p.102). There are three key divisions of the epistemological aspect, they are: positivism, realism, and interpretivism. In our research we adopted a stance of positivism and realism.

Positivism is a principle that entails "*working with an observable social reality and that the end product of such research can be law-like generalisations similar to those produced by the physical and natural scientists*" (Remenyi et al., 1998:32, cited in Saunders et al., 2007, p. 103). The positivistic approach implies that only observable phenomena can provide credible data. Moreover, it acknowledges the use of hypotheses, based on existing data. Thus, positivism is based on facts and disregards impression. Also, positivism sets the emphasis on quantifiable observations that can be used in statistical analysis (Saunders et al., 2007, p.104).

Realism is another aspect of epistemology. As the name suggests, realism promotes the idea that "*objects have an existence independent of the human mind*" (Saunders et al., 2007, p.104). It is very close to the positivistic view through the use of scientific methods in the creation of knowledge. Moreover, Staiton-Rogers (2006, cited in Bahari, 2010, p.23) explains that the "*positivist researcher beliefs that there is a clear-cut relationships between things and events in the outside world and people's knowledge of them*".

Contrasting the previous mentioned epistemological positions is the **interpretivism**. Interpretivism "*advocates that it is necessary for the researcher to understand differences between humans in our role as social actors*" (Saunders et al., 2007, p.106). Thus, an interpretivist approach would entail for the researcher to take a distinctive position, and to understand the social world from the point of view of its elements, acknowledging the uniqueness of each element or situation.

Our study follows both the positivist and the realist epistemology. In our research we look only at observable data. We calculate the volatility of the price multiples and the stock prices, and we assume they are independent from the beliefs of other individuals. Moreover, we set hypotheses to be tested based on the external reality. In our data processing we are using complex mathematical and statistical knowledge that sets us as researchers in an independent position. Thus we can generalise the findings, and we can't say that each case is unique, as the interpretivist approach would advocate. Even though we separate our sample by the industry, this is only to obtain more information; under no circumstance do we imply that each case is unique. Additionally, interpretivism is dealing

more with the psychological aspect, and this is different from what we are doing in this paper.

2.5.2. Ontology

Ontology is the part of research that looks into the nature of reality (Saunders et al., 2007, p. 108). "*The central point of orientation here is the question of whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can and should be considered social construction built up from the perceptions and actions of social actors*" (Bryman & Bell, 2007, p. 22). Similar to epistemology, ontology is divided in two directions: objectivism, and subjectivism. In our research we adopted a stance of objectivism.

Objectivism "*portrays the position that social entities exist in reality external to social actors*" (Saunders et al., 2007, p. 108). Thus, an objectivist ontology presumes that what we see is real, and is independent or separate from us, observers. The main reasoning behind the objectivist view is that "*reality is to be found in the concrete behavior and stresses on the importance of researching the nature of relationship among the elements in their constituents*" (Bahari, 2010, p. 25).

Opposing to the objectivist view is the **subjectivism**. "*The subjectivist view is that social phenomena are created from the perceptions and consequent actions of social actors*" (Saunders et al., 2007, p.108). Other sources (Bryman & Bell, 2007, p.22) call this view constructionism. This view presumes that the social phenomena are in a continuous state of change, through social interaction, and it's important to look into the motivation impending social actors to act (Saunders et al., 2007, p. 108). Bahari (2010, p.25) concludes that the "*central view of constructionism is that the researcher's role is to appreciate/interpret the different constructions and meanings based on people experience*".

In our paper we view reality as existing independent of the social actors. Thus, our ontological position is in accordance to the objectivism. We do not presume that the volatility of the stock prices or volatility of the price multiples can be viewed subjectively, nor do we assume they are changing as a result of social interaction. We use the correlation coefficient to measure the relationship between our variables, so we become detached form influencing the results with our opinions. Moreover, we use secondary data that are independent from the perception of the social actors, and we assume our results give a correct interpretation of the reality.

2.6. Research Paradigms

Guba and Lincoln (1994:105, cited in Saunders et al., 2007, p. 100) affirm that the choice of a paradigm is more important compared to the choice of a research method. They define paradigm as "*the basic belief system or world view that guides the investigation*" (Saunders et al., 2007, p. 100). Thus by choosing a paradigm, we choose a certain way of looking at the social phenomena. There are four paradigms: functionalist, interpretive, radical humanist, and radical structuralist. These are represented in Figure 2.3.

The **functionalist paradigm** is placed on the objectivist and regulatory dimensions. Objectivism refers to the ontological position taken by the researcher. The regulatory aspect refers to the fact that a researcher adopting this paradigm will most likely to be looking into the explanation of the problem, and/or come up with solutions (Saunders et al., 2007, p. 113).

The **interpretive paradigm** is situated at the intersection of the subjectivist and regulatory dimension. Similar to the functionalist paradigm it takes a regulatory aspect, but it has a subjectivist ontology. It deals more with identifying irregularities (Saunders et al., 2007, p. 113).

The **radical humanist paradigm** is set at the conjuncture of the subjectivist and radical change dimensions. The radical change dimension represents a "*critical perspective on organisational life*" (Saunders et al., 2007, p. 113). Thus, researchers adopting this paradigm will be concerned with finding a way to change the existing situation.

Lastly, the **radical structuralist paradigm** is placed on the radical change and objective dimension. Similar to the functionalist paradigm it takes an objective ontology, while the radical change makes the researcher want to implement change based on "*an analysis of such organisational phenomena as power relationships and patterns of conflict*" (Saunders et al., 2007, p. 113).

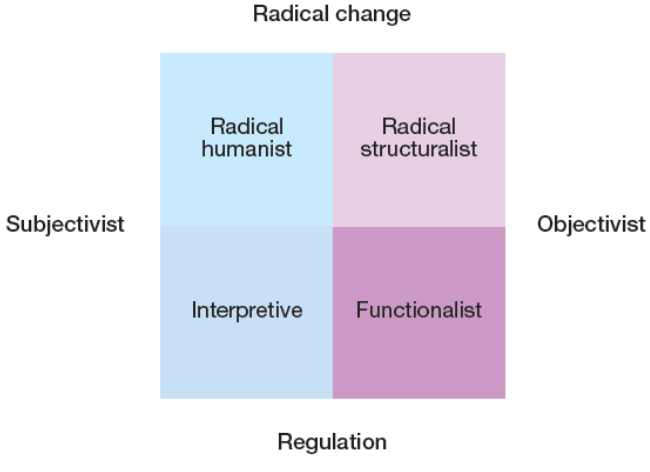

Figure 3. Four paradigms for the analysis of social theory
Source: Developed from Burrell and Morgan (1979, p.22). Sociological Paradigms and Organisational Analysis; cited in Saunders et al., 2007, p. 112.

As stated in the sections above, our research deals with reality as existing separate from the social actors. Thus the ontology is objectivist. When it comes down to the second dimension, our study takes a regulatory aspect, as we do not plan to change the situation. We study the relationship between the volatility of the stock price and the volatility of the price multiples. Moreover, our research can provide insights to the existing reality through hypotheses testing. Thus, we follow the functionalist paradigm.

2.7. Research Approach

When conducting any research, theory is involved, but the extent to which this theory is used is what creates the design of the research paper. Linked to the choice of the extent of the literature used is the research approach. Thus, there are two research approaches: the deductive and the inductive approach.

The **deductive approach** "*involves the development of a theory that is subjected to a rigorous test*" (Saunders et al., 2007, p. 117). According to the definition provided, the deductive approach has the purpose of subjecting an existing theory to tests, in order to either confirm or infirm the theory. It is an approach mostly used in the natural sciences, where laws and regulations are established, and make outcomes predictable. Thus, it becomes easier to test the occurrence of certain phenomena. Deduction has several characteristics, these are:

- employs controls to allow the testing of hypotheses;
- uses highly structured methodology to facilitate replication;
- concepts must be operationalized so that facts can be measured quantitatively;
- the concept of reductionism is followed;
- generalization is acquired. (Saunders et al., 2007, p. 118)

While deduction starts from an existing theory, the **inductive approach** does the complete opposite. The inductive approach empowers the researcher to "*collect data and develop theory as a result of data analysis*" (Saunders et al., 2007, p. 117). As the definition implies, a inductive approach would start by first collecting data, then drawing a conclusion on the data, and lastly forming a new theory. It is less structured and leaves room for more alternative interpretations. Also, inductive research is more likely to deal with qualitative data, and use several data-collection methods (Saunders et al., 2007, p. 119).

Figure 4. presents the flow of procedures in each type of approach: deductive and inductive

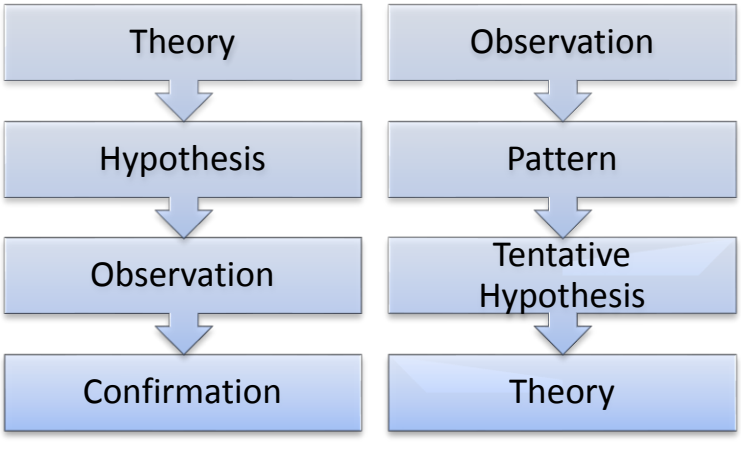

Figure 4. Induction vs. Deduction
Source: Adapted from Trochim, 2006

As mentioned before, our research has a deductive approach. We gather data relating to the stock prices and the price multiples for each industry and compare the volatility of these. We study first, the existing theories, and based on them form certain hypotheses. Afterwards we test the hypotheses to obtain either confirmation or contradiction. We plan to use quantitative data, thus making it almost impossible the use of induction. Moreover, we are more interested in understanding what the relationship is between the volatility of our study variables than to look into the causes that form this relationship. Thus, we have a strong positioning in the deductive approach.

2.8. Research Purpose

The formulation of the research question is of high importance, as it determines the purpose of the research. Accordingly a research can be either: exploratory, descriptive, or explanatory.

An **exploratory study** will look into what is happening, will search for new insights, and will try to look at phenomena in a new light (Saunders et al., 2007, p. 133). The purpose of this study is to clarify uncertainties surrounding a certain problem, by taking a very flexible approach.

The **descriptive study** shows the profile of a person or event. It is more of a "means to an end rather than an end in itself" (Saunders et al., 2007, p. 134). It does not draw any conclusions, it just states the facts, and as the name suggests, it only provides an accurate description.

The study of the "*causal relationships between variables*" is what the **explanatory study** does. "*The emphasis here is on studying a situation or a problem in order to explain the relationships between variables*" (Saunders et al., 2007, p. 134).

Our research deals with the description of the volatility of the stock prices and the volatility of the price multiples. Thus it begins as a descriptive study, but our main goal is not only presenting the data and stating facts. We want to look at an explanation regarding the relationship between our variables. Thus it takes the characteristics of an explanatory study. We divide our data by both years and industry, in order to get a possible explanation to the numbers we get.

2.9. Time Horizons

The choice of a time horizon for the research is very important, as the representation of events can be either at certain point in time or during a longer interval.

From a time perspective, **cross-sectional studies** are those that look at certain phenomena at a fixed point in time. These studies often use a survey to achieve their purpose (Easterby-Smith et al., 2002 and Robson, 2002, cited in Saunders et al., 2007, p. 148). These studies might look at the occurrence of the phenomena or the relationship between factors.

The **longitudinal studies** look at events over a period of time. "*The main strength of longitudinal research is the capacity that it has to study change and development*" (Saunders et al., 2007, p. 148).

Our study looks at the behaviour of the volatility of price multiples and the volatility of the stock priced over a period of 10 years. Thus, it leaves no doubt of this being a longitudinal study. Moreover it looks at these volatilities across several industries, so from a classification perspective it is a cross-sectional study.

2.10. Research Method

The choice of a research method has a big impact on the data collection and data analysis method. Accordingly, there are two main methods that can be employed, they are: the quantitative method, and the qualitative method.

The **quantitative research** "can be constructed as a research strategy that emphasizes quantification in the collection and analysis of data" (Bryman & Bell, 2007, p. 28). The purpose of a quantitative study is to test hypotheses, to look at the causes and/or effects of events. Moreover, a quantitative study will most likely study specific variables, using data, such as numbers and statistics collected from a large group usually selected randomly. The final report will be a statistical one that will include correlations, comparisons of averages, and the statistical significance of the tests (Xavier University, 2012).

The opposite of the quantitative research is the **qualitative research**. The qualitative research "is a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data" (Bryman & Bell, 2007, p. 28). The purpose of this type of study is to understand and give interpretation to social interactions. When it comes down to the variables, then a qualitative research will look at the whole, in order to identify patterns, features, or themes. Moreover, the collected data will consist of images, words, or objects. The final report will be a narrative one, with description and direct quotations from the research participants.

Our study is most obviously a quantitative study. We look at the current literature in the area of stock price volatility and the price multiples. Thus, we come forth with several hypotheses that we test, using data consisting of numbers. In our research we use the companies listed in the index created by Thomsons Reuters. We use the daily stock prices and the daily values of the P/E and P/B ratios. Once we have obtained the data, we apply statistical tests to identify the relationships between our variables. Thus we come up with a fully statistical report that includes quantitative analysis.

2.11. Credibility of the Research Findings

One important issue for any research is the credibility of the findings. The problem is that there is no bullet proof method to ensure that the results will be received with credibility. Thus, the researcher can only make sure that the probability of a wrong conclusion is

reduced. In this aspect a good research design becomes imperative. To reduce the probability of error, two concept must be considered: validity and reliability.

"***Validity*** *is concerned with whether the findings are really about what they appear to be about*" (Saunders et al., 2007, p. 150). In other words, it is looking at whether the conclusion formulates is sound and righteous. Generally, there are three types of validity distinguished: measurement validity, internal validity, and external validity (Bryman & Bell, 2007, p. 41).

Measurement validity is mostly applied in quantitative researches, and it deals with whether the measure employed shows what it is supposed to show (Bryman & Bell, 2007, p. 41). In our paper we construct the volatilities using GARCH modelling. Previous researchers found that the GARCH modelling is the most appropriate measure of volatility. Moreover, our tests for correlation are based on specialized literature that encourages their use.

Internal validity deals with the issue of causality, of how accurate we determine whether one variable causes the change in the other (Bryman & Bell, 2007, p. 41). As mentioned, our study employs the use of various statistical tests that help us get an answer to the research question. Moreover we consult specialized literature that discusses the strengths and weaknesses of each method employed.

External validity is also known as generalizability (Saunders et al., 2007, p. 151). Generalizability is whether the findings of the research can be generalized for other research settings. Our study looks at the volatility of the stock prices and the volatility of the price multiples in Sweden over the past 10 years. Sweden is a developed country, thus the findings of this paper can be adapted to some of the developed countries. Moreover, we look at data classified by the industry, thus we strengthen the generalizability of our findings.

"***Reliability*** *refers to the extent to which your data collection techniques or analysis procedures will yield consistent findings*" (Saunders et al., 2007, p. 149). Easterby-Smith et al. (2002, p.53, cited in Saunders et al., 2007, p.149) pose the following questions that can help assess the reliability of a paper:

- Will the measures render similar results in other instances?
- Will other researchers come to similar observations?
- Is there transparency in how sense was made from the raw data?

The first questions deals with the quality of the methods chosen for the study. If whether similar choices of measures will lead to similar results in another situation. The methods we have chosen for our study are the ones suggested by the specialised literature. Moreover, they render the much sought replicability. Also, our data is collected using Datastream. Thus, there can be no other results, if the same data is being used with the same methods.

The second question is related to the quality of the data used. As mentioned above, we deal with data from Datastream. Thus, it is high quality data, and if other researchers use similar methods to process the data, they should come to the same conclusions as we have.

Lastly, the third question is linked to the process of analysis and reasoning employed, and to the extent these are argued for. We construct the hypotheses in the fourth chapter, and describe the methods employed in detail. Moreover, we present consequently the results after each data processing. Therefore, we ensure the reliability of the research paper by offering a strong answer to each of the questions mentioned above.

2.12. Literature Search

The choice of the literature is an important step for any researcher. Literature sources are divided in three categories: primary, secondary and tertiary sources (Saunders et al., 2007, p.64). These categories represent the strength of the information these sources contain.

"***Primary literature sources*** *(also known as grey literature) are the first occurrence of a piece of work*" (Saunders et al., 2007, p.64). These are the reports, theses, unpublished manuscripts, etc. In our thesis we have not employed the use of such sources.

"***Secondary literature sources*** *such as books and journals are the subsequent publication of primary literature*" (Saunders et al., 2007, p.65). These are the books, journals, and newspapers. In our research we have used only secondary sources. These were easier to locate, and the amount is higher. In the first chapter we have used predominantly journals. In the second chapter we used also books, and newspapers. We used the databases available via the Umeå Library, such as: Business Source Premier, EBSCO, Scopus, Web of Knowledge. Moreover we used one external database, the Social Science Research Network. In order to get the articles we needed, we used keywords such as: price-to earnings, price-to-book, price multiples, volatility, relationship price multiples stock price, GARCH.

We use secondary data extracted from Datastream. The advantages of this consist in the easiness of access and the availability, as the university library provides free access to this database.

"***Tertiary literature sources****, also called search tools, are designed either to help to locate primary and secondary literature or to introduce a topic*" (Saunders et al., 2007, p.65). These sources consist of indexes, encyclopaedias, dictionaries, and catalogues. We have not used this type of sources, because they are too abstract for our purposes.

As the reader can notice we have used only secondary literature sources in our paper. Nevertheless, we have followed some selection criteria in our choices. Even though these selection criteria can't completely stand for the quality of this study, we can provide the reader with these arguments for our assessment of literature sources.

First, we have used published articles which can be trusted to reflect the truth of the facts, and thus inspire assurance in the research findings. We selected articles that were published in relevant journals. Moreover, the use of specialized databases, such as the ones mentioned above (Business Source Premier, EBSCO, Scopus, Web of Knowledge) can ensure that the quality of these articles is appropriate.

Secondly, we also used relevant books to our research area to develop our arguments. The books we used are the basic manuals for our core subjects in USBE, and also we used the CFA books which are known for their high quality in finance. Even though we used Investopedia, we limited the use only for the glossary section.

Lastly, we use Datastream for the collection of our data. This is a specialized database provided by Thomson Reuters, a leader in providing companies with financial information. Thus, we can trust the data we obtain through this source.

2.13. Ethical and Societal Issues

During the conduction of a research, ethical problems will most certainly arise, be they connected with the data collection or data analysis. Thus, an important issue is brought forth, that of the research ethics. "*In the context of research, **ethics** refers to the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or are affected by it*" (Saunders et al., 2007, p.178). Thus research ethics deals with finding a moral and responsible way of going through all the research procedures: formulating the research question, design the research format, acquire access to data, process the data, and present the results and the conclusions. There are two viewpoints as to the stand a researcher can take in regards to ethics. These are: the deontological view and the teleological view (Saunders et al., 2007, p.178).

The **deontological view** has its foundation on the fact that for a researcher "*the ends served by the research can never justify the use of research which is unethical*" (Saunders et al., 2007, p.178). Thus, the main idea is to maintain an ethical view throughout all the steps of the research. This is the view supported by the Umeå School of Business and Economics in the Academic Ethics Guide for Master's Program Students. In this guide it is emphasized on the reliability of the sources used, and on the correct method of citing and referencing, so as not to change the meaning intended by the original author.

The **teleological view**, on the other hand, "*argues that the ends served by your research justify the means*" (Saunders et al., 2007, p.178). This is to say that any employed means can be justifiable in achieving the desired purpose, including deceive in order to obtain the data. The Academic Ethics Guide for Master's Program Students classifies unethical behaviour in two categories: misconduct and fraud. Misconduct refers to unintentionally providing misleading information due to negligence and irresponsibility. The second category, the fraud, is the intentional presentation of false results.

In our paper, we have adopted the deontological view. We used materials that were approved through a peer review process. The articles we used have been published in scientific journals. Moreover, we used mostly primary sources, thus the meaning of the author is not diluted. We also provide the appropriate reference, so that the reader can easily trace the original information written by the original author. In regards to the practical aspect, we obtain our data through Datastream. Moreover, we have no preconceptions regarding the results. So, our conclusions are not influenced, and we have maintained the code of ethics that was discussed in the Academic Ethics Guide.

Additionally, this is not a commissioned paper, our research is not paid, we are fully independent and free.

The uncertainty brought by the financial crisis made more and more market players adopt unethical behaviour. Nevertheless, in our research we will maintain an ethical view on our data, and thus hope to influence this class of targeted readers (i.e. financial community). We hope that the increase in the level of knowledge will lead to an increase in the morality of these players, and thus reduce occurrence of unethical behaviour.

CHAPTER 3: Theoretical Framework

In this chapter we will deal with the theoretical aspects of our research. We assume the reader is knowledgeable in finance, and thus present only notions linked with our research question. First we start with the concept of volatility; we divide it in two parts. The first part deals with the theoretical aspect. The second part deals with a more practical aspect, as we present how volatility looks like around the world. Following this are the price multiples. Here we take the same approach as with volatility: we divide the price multiples in two parts. In the end, we present the relationship between the price multiples and the volatility.

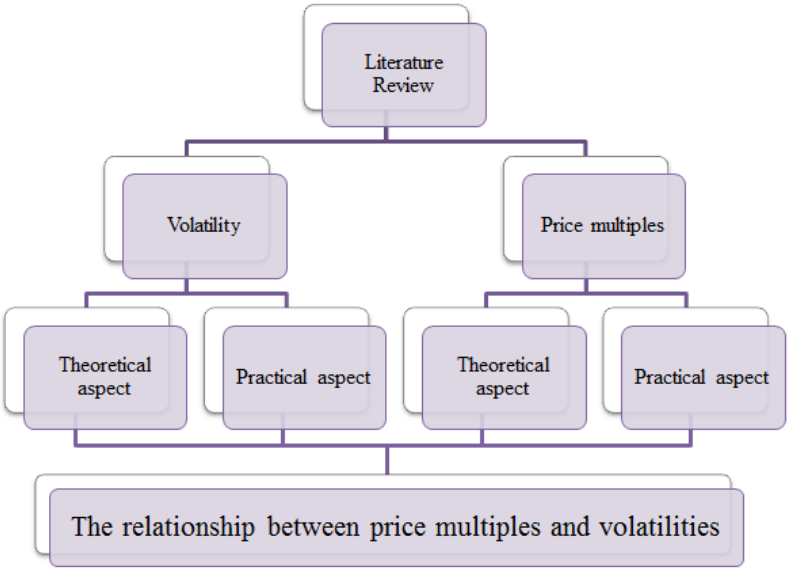

Figure 5. The outline of the Chapter
Source: the authors

3.1. The Concept of Volatility

The concept of volatility is very important in our research. When looking at the volatility of the stock prices and the volatility of the price multiples it is important to understand what is volatility, what it's characteristics are, how it can be measured, and the main financial theories that are linked to volatility.

Volatility is a concept that has increased in popularity during the last decades and continues to be important in the context of modern financial markets (Kalotychou & Staikouras, cited in Gregoriou, 2009, p.3). It is a measure that shows the fluctuations of the stock market prices over a period of time.

3.1.1. Definitions of Volatility

When defining volatility, researchers use a statistical definition, because volatility is a theoretical construct focusing on an unobservable variable (Visser, 2009). The definition of volatility we have used in this paper is presented below:

"*A variable's volatility, σ, is defined as the standard deviation of the return provided by the variable per unit of time when the return is expressed using continuous compounding*" (Hull, 2012, p. 205).

The continuously compounded return associated with a holding period, T, is the product of the natural logarithm of the ending price and the beginning price.

$$r = ln\frac{S_{t+1}}{S_t} \tag{3.1}$$

This means that, after we calculate the continuously compounded daily return (r), we can find the standard deviation (σ_{daily}). Assuming the standard deviation of continuously compounded daily return is σ_{daily}, then according to the formula

$$\sigma_{compound} = \sigma_{daily} * \sqrt{T} \tag{3.2}$$

The formula above shows that the volatility of return increases in time with the square root of the time measure (Hull, 2012, p.206). The sample standard deviation of on period continuously compounded returns is $\sigma_{compound}$. If we want to annualize,

$$\sigma_{annual} = \sigma_{daily} * \sqrt{252}, \text{ where} \tag{3.3}$$

T= 252 days

According to the stated above, volatility is measured by the return provided by the variable, in our case, the stock price.

Another definition of volatility, presented by Goldstein & Taleb (2007, p.84), emphasises on the measure used to capture volatility. Thus, according to them volatility is expressed by the root mean square deviations from the mean (Goldstein & Taleb, 2007, p.84).

Nevertheless, Visser (2009), argues that volatility can have different concepts, depending on the model used. Thus, he distinguishes between:

- Volatility as the conditional variance of the returns (standard deviation);

$$Var\ (r_t/F_{t-1}) = Var\ (a_t|F_{t-1}) = \sigma_t^2 \tag{3.4}$$

In this instance, volatility is perceived as dependent on the past values. Thus, according to the formula, the past information (F_{t-1}) can be used in estimating returns (r_t), and the positive square root of the variance gives us the standard deviation (σ) which is volatility. Here, a_t is the shock or innovation of an asset return at time *t* (Tsay, 2010, p. 113).

- Time series volatility

$$r_n = \sigma_n \varepsilon_n \tag{3.5}$$

Here, ε_n is mean zero, variance one innovation, innovations can be for example Gaussian (Visser, 2009).

- Volatility as the instantaneous diffusion coefficient or the quadratic variation over a given time period.

In this case we can estimate quadratic variation using realised volatility (Tsay,2010, p.162). Realised volatility is nothing else but historical volatility.

$$RV_t = \sum_{i=1}^{n} r_{t,i}^2 \tag{3.6}$$

RV is the realised volatility at time *t*, and rt is the log return. The quadratic variation is the limit of this sum as the length of the sampling interval goes to zero (Visser, 2009). It takes the following form:

$$\sigma^2 = \lim_{n \to 0} RV_t \tag{3.7}$$

- Implied volatility

Implied volatility refers to the market's valuation regarding future volatility. This concept of volatility relies on the use of the Black-Scholes option pricing model. Volatility is calculated based on the formula for the European call option (Tsay, 2010, p.110).

3.1.2. Volatility and Risk

The adepts of the modern portfolio theory define risk as being the same as volatility. Moreover, risk can be divided in three categories:

Systematic risk refers to that risk that can't be avoided and "*is inherent in the overall market*" (Singal, 2013, p.338). Moreover, the "*systematic variance is the market risk and it is influenced by the entire market or economy*". (Singal, 2013, p.338) The measure of the systematic risk is beta (β), which shows the risk investors take and are rewarded for.

Non-systematic risk is the local risk or otherwise limited to a specific asset or industry "*that need not affect assets outside of that asset class*" (Singal, 2013, p.338). Here, the non-systematic variance is specific to a single company or industry and can be eliminated by diversification (Singal, 2013, p.338).

Lastly, we have the **total risk**, which comprises both systematic and no-systematic risk. Total risk is estimated using the standard deviation.

Figure 6 presents the link between the systematic, non-systematic and total risk, and their variances.

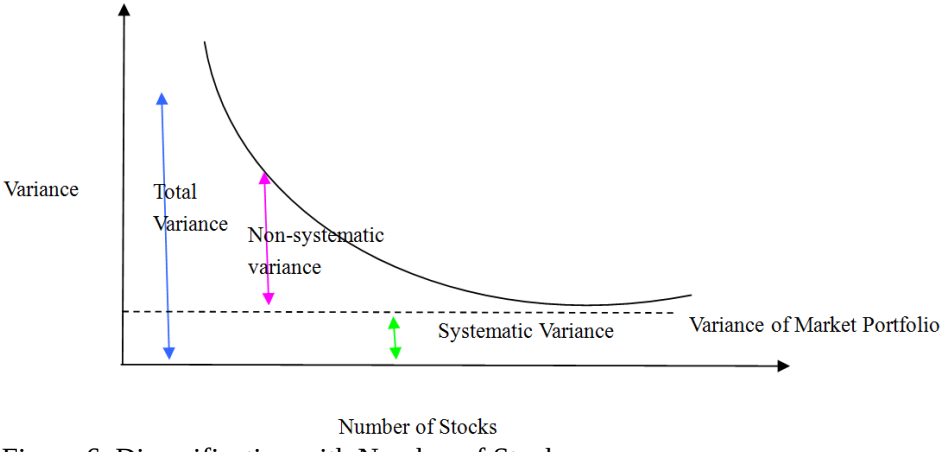

Figure 6. Diversification with Number of Stocks
Sourse: Singal, 2013, p.360

3.1.3. Reasons for Volatility Expressed Through Financial Theories

A social activity is to invest in speculative assets. The investors' behaviour is affected by the social movements. If many people buy or sell the asset, the social movements critically impact the behaviour of prices (Shiller, 1993, p.7). So "*stock price is heavily influenced by social dynamics comes from observations of participants in the market and of human nature"* (Shiller, 1993, p.41). The reason that the theories of random walk, market efficiency and behavioural finance are used is to explain the volatility of stock price.

Random walk and Market Efficiency

Maurice Kendall (1953, cited in Arnold, 2008, p.568) failed to identify the regular price cycles, which is the start of a concept of the random fashion. The definition states that the change of stock price could not be predicted by looking at the previous day's stock market price. Thus, there is no cycle or trend. In other words, "*there is no systematic correlation between on movement and subsequent ones*", random walk happens because the stock price changes if the new information is available (Arnold, 2008, p.568).

Many theories and the theory of random walks are used to explain the reason that the past history of stock price provides rich in information concerning the future price of the stock (Fama, 1965, p.34). The basic hypothesis of the random walk theory is that stocks are independent random variables, and the word of independents means that the past movement of stock is not relevant to predict future change (Fama & Blume, 1966, p.226). But the data evidenve shows that the stock prices don't follow the random walks (Jegadeesh, 1990, p.312; Lo & MacKinlay, 1988, pp.41-43). And the market inefficiency or systematic changes in expected stock return attribute the prediction of stock returns (Jegadeesh, 1990, p.312).

The stock market provided a way to collect resource such as equity in society. So it is critical that market functions are in an efficient way (Setterberg, 2011, p.3). Fama (1970, cited in Fama & French, 1988, p.246) concludes based on many previous researches that

the stock market is efficient. Market efficiency is the market where the price of asset could quickly and rationally respond to the new information (Cleary et al., 2013, p.116).

The difference between fundamental value and market value will create an opportunity to volatility of the stock price. Fundamental value is based on the understanding of investors about the asset's investment, but market value is price which the investor can currently buy or sell (Cleary et al., 2013, p. 118). If the market is highly efficient, investors believe the market price could accurately reflect the fundamental value. Then the investors will get profit through buying or selling the assets at the current market price according to their estimated fundamental value. But when the market is inefficient, the investors have to develop their analysing model to estimate the fundamental value of the assets. Because information is related to the analysing model they use, the estimated price of fundamental value will change; of course the market value will change following the change of fundamental value. (Cleary et al., 2013, p. 119) In the conclusion, the new information will contribute to the estimated price of fundamental value, when investors find the difference between estimated price and market price and will be profitable, they will buy or sell stock in the financial market, hence, stock price will vary. Moreover, because the more complex model they use, the more difficult to estimate the fundamental value (Cleary et al., 2013, p.119), we decide to use the simple analysing model such as P/E and P/B ratio in our thesis.

A number of factors affect the degree of financial market efficiency. First of all, **market participants** are a critical factor. A lot of investors will act when they find the mispricing exist, and if the number of investors is large, the trading activities have a high possible to vary significantly through time (Cleary et al., 2013, pp.119-122). Mispricing causes approximately 4 to 12% of the daily variance (French & Roll 1986, p.23). Lacking of trading activities will impact the market perfection and damage the market efficiency. For example, the trading stock policies in China restrict some foreigners. But if trading activities are restricted, this causes that market participants are limited, the market efficiency will become lower. (Cleary et al., 2013, pp.119-122)

The second factor, **information availability** and **financial disclosure** have to been mentioned. For example, the information about trading activities are readily available in New York Stock Exchange market and London Stock Exchange market, as a result, these market are more efficient. Of course the differences exist in the different types of market such as bond market and future market. Financial disclosure provides equal and fair opportunities to investors, which is important to encourage market participants to active in the market. (Cleary et al., 2013, pp.119-122)

The last main factor is **limitation to trading**. Market inefficient will create the arbitrage and shot selling. Arbitrage is to create the riskless profits. And short selling is to sell shares but these shares are not owned by borrowing from a broker and can be replaced in the future. (Cleary et al., 2013, pp.119-122)

In Fame framework, he defines three forms of market efficiency. The first one is the **weak-form efficient** market hypothesis. The market prices only reflect all past market data, which is the "*all historical price and trading volume information*". It means that investors are hard to predict the change of future price. (Cleary et al., 2013, pp.123-128)

The second form of market efficiency is **semi-strong form**. The market prices reflect all public information and past market data. The public information about financial statement data and financial market data are available to be found. It means through analysing the earning announcements of companies, investors could identify under-pricing or overpricing in the stock market. Moreover, no single investor is free to access the unavailable information, as a result, no single investor take advantage to predict future stock prices. The market price "*adjusts quickly and accurately to new information*". For example, an earnings announcement in one company is higher than expected; investors could not act on the earing announcement and earn abnormal returns. (Cleary et al., 2013, pp.123-128)

The third is in the **strong form** efficient market, the market prices reflect the past market data, public information and private information. The abnormal returns neither be earned. Many researchers hold the consistent opinion that stock market is not strong form market efficient, and find that "abnormal profits is earned when nonpublic information is used". (Cleary et al., 2013, pp.123-128)

From the above theories about market efficiency: the differences between fundamental value and market value, the three main factors and the three form of market efficiency, we make the assumption in Swedish stock market. The reason is because the contribution factors of market participant, information availability and financial disclosure and limits to trading are lack of enough perfect evidence to prove the market stays in the strong form market efficient. In this way, the assumption of stock market in Sweden is that it takes a semi-strong form market efficiency. It reflects that the investor can identify the under-priced or overpriced opportunities through finding the differences between the fundamental value and the market value. Hence, the stock market price presents always volatility. Moreover, abnormal return is ignored in the theory, but in fact abnormal returns will appear in the stock market causing volatility of stock and show in our analysing data, which is the disadvantage in our thesis.

Next we will mention the two main anomalies in the hypothesis of market efficiency: size effects and timing effects. Market efficiency seems to be less evident among smaller firms (Pike & Neale, 2003, p.54). According to Dimson & Marsh (1986, citied in Pike & Neale, 2003,p.54), smaller firms outperform larger firms. Thus, the size effect is clearly argued for in terms of volatility. The time effect can be noticed in the stock price volatility.

The differences between trading and non-trading variances are caused by the differences in the flow of information during trading and non-trading hours (French & Roll 1986, p.23), which indicates how much information disclosure to the public is important. And it is related to the market efficient hypothesis.

Behavioural finance

Market efficiency is based on the rational market but not the individual investor. Behaviour finance is to explain why individual investor make the investment decision no matter the decision is rational or irrational. Behaviour finance is to test how investor behaviour affects the financial market. It pays attention to the cognitive biases that impact investment strategies. (Cleary et al., 2013, p.136) But if the individual investors are rational, it is not

sense to do profitable arbitrage for any observed the differences between fundamental value and market value in the stock market.

The behavioural finance is used to argue that investors usually make systematic errors and the error influence the prices in the stock market away from the fundamental value. For example, the theory of behavioural finance explains the outperformance of low price to earnings ratio. (Arnold, 2008, p.596)

One of the behavioural biases offered to explain pricing anomalies is loss aversion. Risk aversion refers to the risk which the investors are willing to bear to earn higher expected return. In many cases, researchers assume the investors don't like the risk, which seems like to be symmetrical. However, behaviour finance thinks it is not symmetrical. (Cleary et al., 2013, p.136) According to DeBondt & Thaler (1985, cited in Cleary et al., 2013, p.136) and Tversky & Kahneman (1981, cited in Cleary et al., 2013, p.136), "*behavioural theories of loss aversion can explain observed overreaction in markets*". If risk aversion is less important than loss aversion, investors' overreaction should be observed (Fama, 1998, cited in Cleary et al., 2013, p. 136).

Another factor is overconfidence. Overconfidence implies the investors don't use the information appropriately; they put too much confidence on their abilities. It still generates mispricing in the stock market, which is prices react slowly to new information. But most researchers think the mispricing is not forever, the stock market will correct it. However, the investors still earn abnormal return. (Cleary et al., 2013, pp,136-137). Moreover, according to Xu et al. (2003, cited in Cleary et al., 2013, p.137) and Bouri et al. (2009, cited in Cleary et al., 2013, p.137), the reason for mispricing in U.S., U.K., German, French, and Japanese markets is overconfidence. And overconfidence is predominantly in higher-growth companies. (Cleary et al., 2013, p.137) Overconfidence of the traders increases the volatility (Odean, 1988, p.1889), which is also proved by Shiller, 1981&1989; LeRoy & Porter, 1981; Kleidon, 1986; Marsh and Merton, 1986, cited in Odean, 1988, p.1889). Overconfidence is common but not universal (Griffin & Tversky, 1992, p.412). And no evidence to support the benefits of overconfidence outweighs its costs (Griffin & Tversky, 1992, p.432).

Using the theory of behavioural finance to explain the pricing in the stock market is necessary to understand how to determine the price. Abnormal price doesn't mean it doesn't support the market efficiency. Because the general conclusion of the efficient market hypothesis is that "*it is not possible to beat the market on a consistent basis by generating returns in excess of those expected for the level of risk of the investment*" (Cleary et al., 2013, p.138). So the market can still be considered efficient even though some market participants have irrational behaviours. Moreover, the feedback of price changes is likely to be an important factor to change the price (Shiller, 1993, p.374).

3.1.4. Characteristics of Volatility

Tsay (2010, p. 110) points out that one of the stock volatility characteristics is that it can't be directly observed. Besides this, the basic characteristics are similar to the asset returns, and they are:

- Volatility clustering

This characteristic was first noted by Mandelbrot (1963). He observed that "*large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes*" (Mandelbrot, 1963, p.418). This means that the volatility is high in one period and low in another. This characteristic can also bring forth the idea that volatility has a mean return tendency.

- Volatility jumps are rare

This property entails that volatility has a continuous evolution over time (Tsay, 2010, p.111). Volatility jumps make the prediction and analysis process distorted and hard to implement. Nevertheless, studies show that volatility is a process that is highly representative of jumps (Todorov & Tauchen, 2011, p.356). These studies show that the most used models for volatility are based on the Gaussian process, and thus, they fail to detect these jumps.

- Volatility has a fixed range variation

Volatility does not diverge to infinity; it has a certain range of variation. According to Li (2008, p.2) many researcher have put this quality to test, and in the end, the result was supporting of the original characteristic.

- The leverage effect

This is an asymmetric behaviour of the volatility in relation to the changes in the price. Thus, volatility has a different reaction to price increase or decrease. More specific, negative returns lead to a higher volatility magnitude, while positive returns lead to a lower volatility magnitude (Black, 1976).

3.1.5. Measures of Volatility

As mentioned before, volatility can be interpreted differently. Thus, volatility can have different values, depending on the method used for calculation. There are several methods that are employed in the measurement of volatility.

Random Walk Model

The random walk is the most basic model that can be used to measure volatility. In order to be a random walk, a series (p_t) must fulfil the following condition:

$$p_t = \alpha + p_{t-1} + \varepsilon_t \tag{3.8}$$

Here, ε_t is the white noise series, α is a drift parameter, and the price is not mean reverting or predictable. The drift parameter decides where the series is going (upwards or

downwards). The volatility is assumed to be constant over time, and it can be calculated through the following formula:

$$Var\ (p_t|p_{t-1}) = \sigma^2 \tag{3.9}$$

Historical Average

Historical average measures how far the price is diverging from the mean value. It best suited for a low number of observations, and where the trend is strongly observed. It is a simple method used mostly by investors.

$$\sigma^2 = \frac{\sum R_i}{n} \tag{3.10}$$

In this formula, R_i is the returns, and n is the number of observations.

Moving Average

This is another simple model used for volatility measurement. Moving-average models present a weak stationarity. These models imply that the present value is not dependant of the past value, but on the average of the past values.

Exponentially Weighted Moving Average

This model entails, that the present value depends on the past values, the weight (α_i) of which decrease in time. The volatility takes the following form:

$$\sigma_n^2 = \lambda\sigma_{n-1}^2 + (1-\lambda)u_{n-1}^2 \tag{3.11}$$

Here, λ is a constant, and $\alpha_{i+1} = \lambda\alpha_i$, and σ_n is the volatility at day n, and u_{n-1} is the most recent percentage change. The attractive feature of EWMA is that it needs not very much data. And the volatility obtained using this model is in more smooth series.

Models of the Nonconstant Variance (Conditional Heteroskedasticity)

Conditional heteroskedasticity models can be divided in two types of models (Tsay, 2010, p.113). The first type of models consists of those that employ a function to oversee the evolution of volatility (GARCH models). The second type uses stochastic equations to describe the volatility. The stochastic volatility needs the use of methods like Kalman filtering or a Monte Carlo method (Tsay, 2010, p.154).

3.2. Historical Volatilities around the World

Volatility is attracting a lot of attention from both investors and researchers. The current stock market is characterised by increased volatility (Valetkevitch, 2013; ETF Daily News, 2013). When it comes down to the investors, the CBOE Volatility Index® VIX® is considered a general accepted measure of market volatility (CBOE, 2013). VIX ® is an

index that traces the implied volatility of the 30-day options on the S&P 500 (Hull, 2012, p.208).

During the last 5 years, the implied volatility of index VIX looks as follows:

Figure 7. Chart of the VIX during the last 5 years
Source: CBOE, VIX Charts on Prices and Volume, 2013

As the graph conveys, the market has been characterized by high instability in the last 5 years. During the beginning of 2013 though, we can see that the volatility is decreasing. Nevertheless, investors are warning about an increase. The political instability of the world's leaders gives rise to and feeds the market volatility.

3.2.1. Emerging and Developed Country Volatility

Volatility and returns have distinct patterns in emerging and developed countries. Emerging markets have a higher volatility compared to the developed markets. (Raju & Gosh, 2004) Moreover, a study done by Solakoglu et al. (cited in Gregoriou, 2009, p.531) finds that the volatility in emerging countries can be explained by both: internal macro factors and global factors together. Emerging markets volatilities are found to present four characteristics: (Bekaert & Harvey, 1995, cited in Raju & Gosh, 2004)

- higher average returns;
- low correlations with developed markets returns;
- more predictable returns;
- higher volatility.

When it comes down to the developed markets, most studies focus on USA, UK, France, and Germany. Raju & Gosh (2004) looked at the volatilities in these countries over a 24 year period. They found the volatilities to be higher in Germany compared to the volatility in France, UK, and USA. The lowest level of volatility was registered in the USA in this period (Raju & Gosh, 2004).

3.2.2. Sweden

Articles that refer to the Swedish market volatility are scarce and outdated. Hassler (1999) looked into the reason of the increase of the volatility in that period. Acording to him, volatiliy has increased on the Swedish stock market under the influence of the world volatility increase. Thus, the Swedish stock market is highly sensitive to the world market.

The OMX Stocholm 30 Index is a market value weighted index, and it is comprised of 30 of the most traded stocks on the Stockholm Stock Exchange. The volatility of this index is presented below:

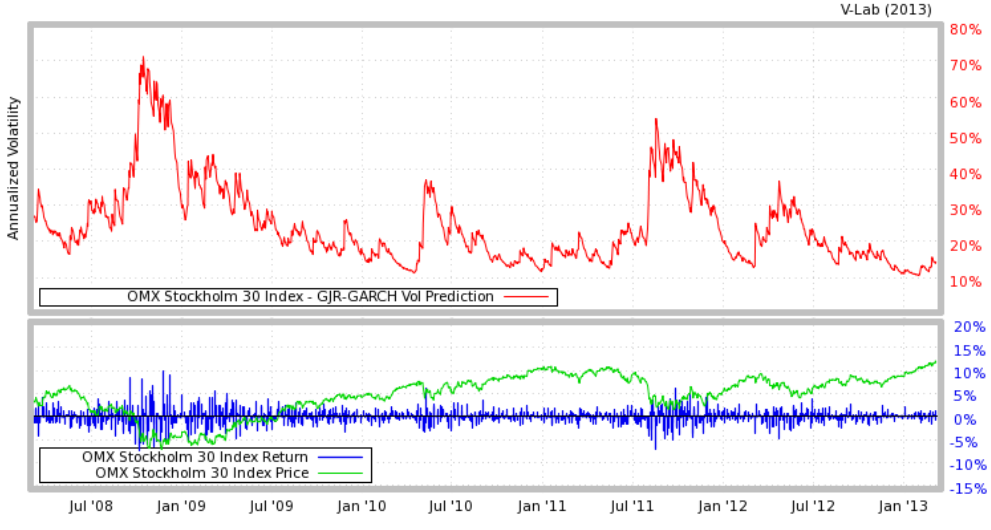

Figure 8. OMX Stockholm 30 volatility chart
Source: V-Lab, NyuStern the volatility institute, 2013

3.3. Price Multiples

Nagorniak & Wilcox (2013, p.262) define that "*price multiples refers to a ratio that compares the share price with some sort of monetary flow or value to allow evaluation of the relative worth of a company's stock*". Some practitioners use the ratios as a signal to buy or sell the stock. When the ratio is lower than a specified value, it is the time to purchase the stock, when the ratio is higher than a specified value, it is the time to sell the stock (Nagorniak & Wilcox, 2013, p.262). There are four ratios are used to analyse the stock value by Nagorniak and Wilcox (2013, p.262):

Price to earnings ratio (P/E): the ratio of stock price to earnings per share.
Price to book ratio (P/B): the ratio of stock price to book value per share.
Price to sales ratio (P/S): the ratio of stock price to sales per share.
Price to cash flow ratio (P/CF): the ratio of stock price to cash flow per share.

Price multiples are usually used independently of the present value model. One price multiple valuation approach is the comparable method, which doesn't include cash flow forecasts or discounting to present value (Nagorniak & Wilcox, 2013, p.262). And the method using the price multiple to evaluate whether the stock is fairly valued, undervalued

and overvalued compares with the benchmark value of the multiple (Nagorniak & Wilcox, 2013, p.266). Some participates treat the average or past price multiple as the benchmark value of the multiple.

The main advantage of using price multiples is that these price multiples could use the method of comparable in the cross sectional and in time series, which benefit to identify the expected best performing stock within the industry. The second advantage is that the price multiples are easy to calculate. The third advantage is many price multiples are already available in the financial report or webpages. (Nagorniak & Wilcox, 2013, p.270)

However, the disadvantages should be attention. The differences in reporting results in the differences earning, book value, sales revenues and cash flow, especially in the different markets. Of course these differences add difficulties when comparing the price multiples. Moreover, for the cyclical companies, they are highly affected by the current economic conditions. (Nagorniak & Wilcox, 2013, p.270)

3.3.1. Price to Earnings Ratio

Price to earnings ratio is of special significance when analysers compare it with many other data that are used to forecast stock price, and this ratio is "*extraordinarily bearish in the U.S stock market*" (Campbell & Shiller, 1998, p.24). This ratio has the special space because it is related to the stock prices to evaluate the fundamental value of companies (Campbell & Shiller, 1998, p.24).

It is possible that the relationship between earnings ratio and stock return does work in the past and maybe ceases to work now or in the future, but this relationship is tested continually over the last century (Campbell & Shiller, 1998, p.25). It is possible that the relationship between the price to earnings ratio and the stock returns for a long time is non-linear, but in the bear market this relationship will change to be linear regression (Campbell & Shiller, 1998, p.25). Therefore, the relationship between price to earnings ratio and prediction of stock return does exist even though it might have existed only in the past.

The price to earnings ratio is a popularly used performance indicator, which is "*a measure of the market's confidence in a particular company or industry*" (Pike & Neale, 2003, pp.59-60). The share price is based on the investor's expectations of future profits (Pike & Neale, 2003, p.71). And this ratio is one of the basic valuation methods (Pike & Neale, 2003, p.114).

The meaning of price to earnings ratio is a measure of market price to each company earnings. It is vary directly with share price, but it also derives from the share price (Pike & Neale, 2003, p.123). Using this ratio to detect the presence of underprice or overprice "*implies that the market is slow or inefficient processors of information*" (Pike & Neale, 2003, p.123).

According to Shiller, (1993, p.27), during 1926 to 1983 "*the correlation between real price P and the real earnings series E is 0.75*". So there is a relationship between P and E. A high price to earnings ratio predicts high returns, and a low price to earnings ratio predicts

low returns. This means to buy stock when the price is low relative to earnings and sell stock when earnings are high. (Shiller, 1993, p.34)

First we DO treat that buying stock with low price to earnings ratio as an investment strategy. And this investment strategy indicates that these stocks create abnormal returns (Arnold, 2008, p.584). Moreover, according to Arnold, (2008, p.584), Basu (1975, 1988, 1983, cited in Arnold, 2008, p.584), Keim (1988, cited in Arnold, 2008, p.584), and Lakonishok et al. (1994, cited in Arnold, 2008, p.584) proved it, using U.S data based on semi-strong market efficiency hypothesis. However, the stocks with lower price to earnings ratio generate abnormal return but there is some argument whether it is the small - size effect. Jaffe et al. (1989, cited in Arnold, 2008, p.584) claimed that there was both a price to earnings ratio effect and a size effect based on the study between 1951 and 1986 in U.S. However, Fama & French (1992, cited in Arnold, 2008, p.584) argued that the stocks with low price to earnings ratio could not produce extra return but the size and price to market ratio could produce extra return. Moreover, Sanjoy Basu (1983, cited in Shiller, 1993, p.384) concluded that the correlation between risk -adjusted returns and the price to earnings ratio is positive even after controlling for firm size.

So there are three questions produced by the above arguments. The first question is about whether stock with low price to earnings ratio creates abnormal return. The second question is about whether the price to market ratio creates abnormal return, the last question is about whether the size effect creates abnormal return. However, our research question does not directly analyse them. But it creates it interesting to analyse the relationship between the movements of price multiple ratio and movements of the stock price. Moreover, the stock price could reflect the abnormal return in the financial market and testing the correlation between the various performances of price multiply ratios and volatility of stock price can indirectly analyse the price to earnings ratio and price to market ratio whether create abnormal return.

Explanation for the low price to earnings ratio anomaly is that investors pay too much attention on the short term earnings data and they could not sufficiently analyse the performance of firm (Arnold, 2008, p.584). Because investors believe the high stock price relates to the firm's current earnings, which reflect a view of an increasing growth of profits. Then the market will present variation because of overprices. The reasons explaining it go back to what we have presented before in section 3.1.2.

Secondly, we do NOT treat buying stock with low price to earnings ratio as an investment strategy. From the previous researches, different arguments are showed: the lower P/E ratio leads to higher volatility of stock prices, other studies assert that higher P/E ratio leads to lower volatility of stock price. If we explain the volatility by using the term of risk, then the arguments can be translated: the lower P/E ratio leads to higher risk, the higher P/E ratio leads to lower risk. Avoiding the higher risk when the return is the same is the best investment strategy. Moreover, no articles clearly presented whether the variation of P/B ratio will follow the same change of variation of stock price. So testing the correlation between the movements of price multiple ratio and volatility of stock price is necessary.

There are three main kinds of price to earnings ratio (Penman, 2009, p.79):

$$Trailing\ \frac{P}{E} = \frac{Price\ per\ share}{most\ recent\ annual\ earnings} \quad (3.12)$$

$$Rolling\ \frac{P}{E} = \frac{Price\ per\ share}{Some\ of\ EPS\ for\ most\ recent\ four\ quarters} \quad (3.13)$$

$$Forward\ or\ leading\ \frac{P}{E} = \frac{Price\ per\ share}{Forecast\ of\ next\ year's\ EPS} \quad (3.14)$$

The rolling price to earnings ratio is usually to value the total twelve months. The forward price to earnings ratio is usually to modify the trailing price to earnings ratio for considering the earnings growth in the next year. (Penman, 2009, p.79) The trailing price to earnings ratio is influenced by the dividend. The dividend will reduce the stock price, but the earnings should not be influenced by it, so the trailing price to earnings ratio is also calculated as: (Penman, 2009, p.79)

$$Dividend\ adjusted\ \frac{P}{E} = \frac{(Price\ per\ share + annual\ DPS)}{EPS} \quad (3.15)$$

Where:
EPS= earnings per share
DPS= dividends per share.

3.3.2. Price to Book Ratio

The value of the price to book ratio links the price of a company's stock with the book or value of the shareholders' equity per share. This indicator shows how many times of the book value investors are ready to pay for one share (Financial Times Lexicon, 2013). A high price to book ratio should mirror larger expected future gains because of perceived growth opportunities, competitive advantages, and reduced risk. At the same time, it shows that the price of one share is higher (Financial Times Lexicon, 2013). Many studies have used the price to book ratio in finance and found that this ratio is inversely related to the company's returns (Fama & French, 1992 & 1993, cited in the DeFusco et al., 2013a, p.535). Moreover, price to book ratio is used to create many popular value and growth indexes (DeFusco et al., 2013a, p.535).

Many previous researches show that many characteristics for example size, price to earnings ratio and price to book ratio cause the cross sectional variation in expected stock returns (Daniel & Titman, 1997, p.1). But according to Jegadeesh & Titman (1993, cited in the Daniel & Titman, 1997, p.1), the cross sectional variation in expected returns is only caused by the size and price to book ratio. And the Shefrin & Statmen (1995, p.26) stated that the size and price to book ratio are two important variables related to stock return. Moreover, the Fama & French (1992, cited in Shefrin & Statmen, 1995, p.26) found that the stock return is inversely related to size and positive related to price to book ratio. In the

research of Shefrin & Statmen (1995, p.33), they found that the stock of mature companies have low price to book ratio and stock of young companies have high price to book ratio.

One drawback in using the price to book ratio is sample selection bias because the collecting of data excludes the unlisted companies. But Kothari et al. (1995, cited in the DeFusco et al., 2013a, p.535) argued that low returns and low price to book ratio are showed in the failing stocks. If excluding unlisted stocks, returns in the stocks with low price to book ratio are higher than if all stocks with low price to book ratio include. Moreover, Kothari et al. (1995, cited in Fama & French, 1997, p.80) also believes that sample selection bias just take charge for the previous findings of an inversely relationship between average return and price to book ratio.

Another bias is look ahead bias, it is used the data information which is not available on the test date. This bias must be not omitted in using stock market returns, and the common used ratio is price to book ratio (DeFusco et al., 2013a, p.536). The prices in the stock market are showed at the point time, but fiscal price to book ratio could not be showed to the publicly available until the following fiscal.

3.4. Price Multiples around the World

The price to earnings ratio has received increasing more attention compared to the price to book ratio. Analysts look mostly into the cyclically-adjusted P/E (CAPE) ratio, known as the Shiller P/E ratio (Larrabee, 2012).

"*The Shiller P/E ratio is computed by taking the current price and dividing by the average inflation-adjusted earnings from the previous 10 years*" (Marotta, 2012).

As one may assume, all the attention is focused on the US market. Thus the Shiller P/E for the S&P 500 has been studied over the interval of more than 100 years. The resulting graph is presented in figure 9.

Figure 9. Shiller P/E ratio
Source: Asness, 2012, cited in Larrabee, 2012

In his book, Shiller also showed that the Shiller P/E ratio is correlated with the expected returns. Thus the Shiller P/E can be viewed as a proxy for the investor's reward. According to Asness (2012, cited in Larrabee, 2012) since 1926 the Shiller P/E has been 80% higher. Marotta (2012) states that a low Shiller P/E is good for investors, while a high Shiller P/E implies lower expected returns. The graph presented above implies that since 1926 the expected returns have decreased.

The Wall Street Journal (2013) presents data about the trailing P/E. For the Dow indexes, the trailing P/E is presented as follows:

Friday, March 15, 2013

	P/E RATIO		
	3/15/2013†	Year ago†	Estimate^
Dow Industrial	**15.79**	14.81	12.97
Dow Transportation	**21.10**	20.84	15.85
Dow Utility	**23.32**	16.27	15.72

† Trailing 12 months

^ Forward 12 months from Birinyi Associates; updated weekly on Friday.

P/E data based on as-reported earnings; estimate data based on operating earnings.

Sources: Birinyi Associates; WSJ Market Data Group

Figure 10. The trailing P/E for the Dow indexes
Source: The Wall Street Journal, 2013

Data regarding the P/B ratio is relatively hard to find. We can easily find the stocks that are trading closest to their historical low values of the P/B ratios, but a graph showing the value this ratio takes for an index was hard to come across. Nevertheless, we managed to obtain the historical P/B for the S&P 500. The graph shows the value of this ratio during the last 12 years, from 2000 until 2012.

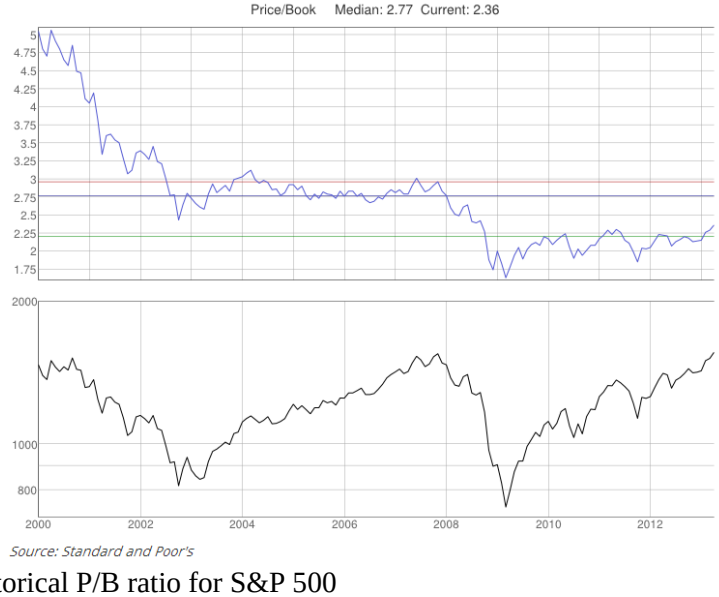

Figure 11. The historical P/B ratio for S&P 500
Source: Vector Grader, 2013

3.5. The Price Multiple and Volatility

A market participant will need to estimate the fundamental value and question if it matches the market value. When the estimated value exceeds the market price, the analyst indicates that the stock is undervalued. But, if the estimated value is less than the market price, then, the analyst indicates that the stock is overvalued. When making the valuation the investor includes also the volatility, so the market participants are required to find the mispricing. Moreover, there is no doubt that an analyst uses more than one valuation model because different valuation models have a different applicability, variability and inputs. "*Three main categories of equity valuation models are present value, multiplier, and asset based valuation model*". (Nagorniak & Wilcox, 2013, pp.277-278) Considering this, in our thesis we just focus on price multiplier, so we pay attention to the multiplier model, which estimates the value "*based on the a multiple of some fundamental variable*". (Nagorniak & Wilcox, 2013, p.278) Furthermore, in this thesis, we just analyse the price to earnings ratio and the price to book ratio.

The volatility is one of the methods for choosing attractive stock. When investors want to choose a model to analyse the volatility of stock, they can use more complex models which maybe increase accuracy. However, the investors have to consider firstly the rules that "*a model should be kept as simple as possible in light of the available inputs*" (Nagorniak & Wilcox, 2013, p.277). Therefore, the simple indicator such as price multiples or valuation ratio is interesting to be used and analysed.

Beidleman (1973, cited in Barnes, 2001, p.4) found that there is a relationship between that price to earnings ratio and the stock price. Moreover, Ou & Penman (1989) also found that the stock price could be reflected by that price to earnings ratio. And Fama & French (1998) also proved that the price to earnings ratio could predict the future expected stock returns.

Fama & French (1992 & 1993, citied in the Alcock. & Steiner, p.3) found that the price to book ratio could influence the volatility of stock return. Moreover, Fama & French, 1992 & 1993, cited in the DeFusco et al., 2013a, p.535) also found that the price to book ratio has the positive relationship with stock returns. And Shefrin & Statmen (1995, p.33) found that the stocks with lower price to book ratio are always presented by good companies, the stocks with higher price to book ratio are always presented by small companies.

Therefore, the price to earnings ratio and price to book ratio are related to the stock return. Furthermore, David & Veronesi (2009) made a conclusion from some previous researches and found that the volatility of stock is inversely related to price to earnings. However, Koutmos (2010) found that the volatility of stock is positive related to price to earnings ratio.

3.6. Theoretical Framework of our Research

The purpose of this section is to briefly summarize the main concepts that helped us construct our research question. We focus on the behaviour of stock prices and the stock market, but they are affected by many factors. We summarize them through the use of the

following financial theories: the random walk, market efficiency, and behavioural finance. Thus, these theories provide explanation for the existence of volatility.

Then we discuss the price multiples: the price-to-earnings ratio and the price-to-book ratio. We collect previous research papers that creates the link between the stock prices, the price multiples and the volatility.

Relevant previous research can be divided in two categories: first we have papers that relate the price multiples with the stock prices, and then we have papers relating the price multiples with the volatility. Table 1 presents the papers and their main findings bellow:

Author(s)	Year	Title	Findings
Price Multiples and Stock Prices			
Beidleman *(cited in Barnes, 2001, p.5)*	1973	Income Smoothing: The Role of Management *(Earnings Volatility and Market Valuation: An Empirical Investigation)*	there is a relationship between the P/E ratio and the stock price
Ou & Penman	1989	Accounting Measurement, Price-Earnings Ratio, and the Information Content of Security Prices	the stock price could be reflected by the P/E ratio
Fama & French	1998	Value versus Growth: The International Evidence	the P/E ratio could predict the future expected stock returns
Price Multiples and Volatility			
Fama & French *(cited in Alcock. & Steiner, 2011, p.3)*	1992 & 1993	The cross-section of expected stock returns & Common risk factors in the returns on stocks and bonds *(Earnings growth volatility and the value premium)*	the P/B ratio could influence the volatility (variation) of stock returns
David & Veronesi	2009	What Ties Return Volatilities to Price Valuations and Fundamentals?	there is a negative relationship between P/E and volatility
Koutmos	2010	The P/E Multiple and Market Volatility Revisited	the volatility of stock is positively related to the P/E ratio.

Table 1. Previous studies

The contents of this paragraph can be summarized in Figure 12. As shown above, the previous studies are placed in the middle, as they made it possible to connect all the relevant concepts.

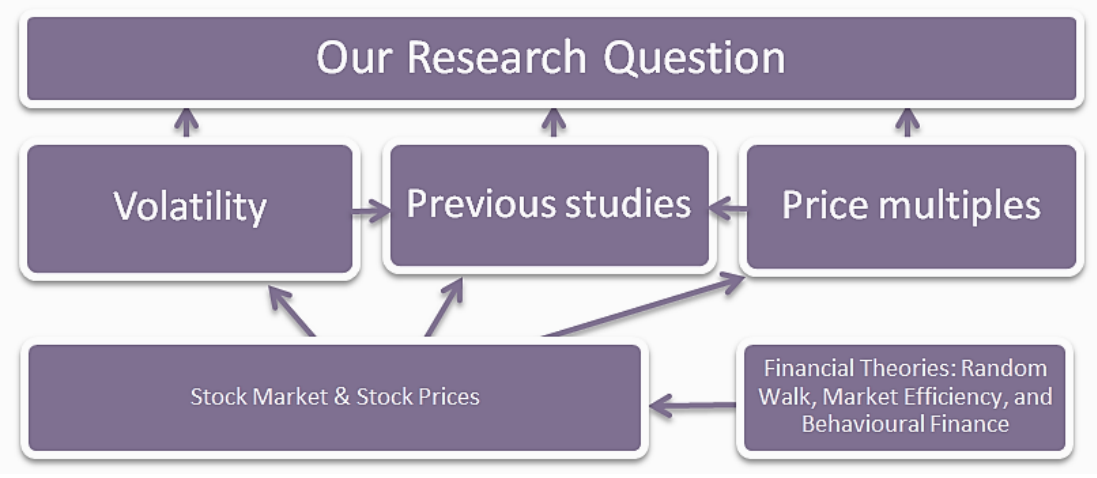

Figure 12. Theoretical Framework of our Research
Source: created by the authors

The stock price is an important component of the price multiples. From the formula of the P/E and of the P/B, we observe that the stock price can affect the value of these price multiples. Thus, there is a stochastic relationship between these two, with the stock price acting as the independent variable and the price multiples as the dependents. Taking into consideration the volatility of the stock prices and the volatility of price multiples, it makes sense that the variation of the stock prices will affect the variation of the price multiples, making the correlation between them high.

Nevertheless, several studies (Fama & French, 1998; Beidleman, cited in Barnes, 2001, p.5; Ou & Penman, 1989) tested whether the price multiples can act as independent variables and influence the stock prices. Their results were significant and concluded that the price multiples can affect the stock prices. Moreover, there are previous studies (Fama & French, 1992 & 1993, cited in Alcock & Steiner, 2011, p.3; David & Veronesi, 2009; Koutmos, 2010) that examine the relationship between the price multiples and the volatility stock prices. These studies show different results. Taking into consideration the above mentioned things we want to extend this relationship (with the price multiples as independent and the stock prices as dependent) and see whether the volatility of the price multiples can affect the volatility of the stock prices, and if the correlation differs.

Thus, we are taking a new perspective. We don't ignore the stochastic relationship between the volatility of stock prices and the volatility of price multiples. We don't integrate it in our paper. We look exclusively at the correlation between the volatility of price multiples and the volatility of stock prices. We do not examine the components of the price multiples. We look only into the explanatory power of the volatility of the price multiples can have over the volatility of the stock prices.

CHAPTER 4: Practical Method

The objective of the practical method chapter is to present the research design and describe the methods employed in data processing. We will start by defining our data population and sample. Then we move to the time horizon and the data collection method. Further, we describe the calculation of the returns and the transformations in the price to book and the price to earnings ratios. Lastly, we present the GARCH(1,1) model, and the correlation test corresponding to data calculation.

4.1. Population and Sample Data

We are doing a quantitative study. Before explaining the concepts of population and sample, we start to define the term of statistics because statistics refers to the data and the method. The meaning of statistics is to "*collect and analyze data*" (DeFusco et al., 2013b, p.324).

It is important to distinguish between a population and a sample. "*A population is defined as all members of a specified group*" (DeFusco et al., 2013b, p.325). In our thesis, the population consists of all the Swedish Listed Companies.

"*A sample is subset of a population*" (DeFusco et al., 2013b, p.325). Due to high cost to observe the entire population, the sample is an appropriate way to "*achieve the objective the representing the population well*" (DeFusco et al., 2013b, p.325). In our thesis, the selected sample is Sweden Datastream index with its Listed Companies from 2003 to 2012. Figure 13 shortly presents the population and the sample data for this study.

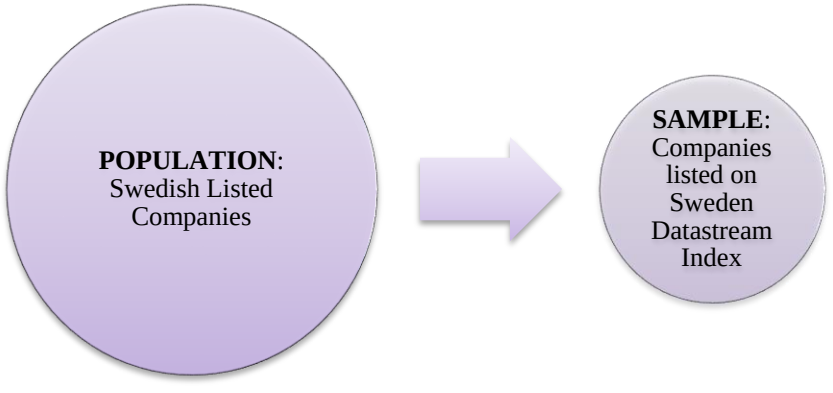

Figure 13. Our population and sample data

The purpose of this paper is to study the volatility of the stock prices in relation with the volatility of the P/E ratio and of the P/B ratio. In order to obtain an answer to our research question we plan to take data from the Swedish market during the past 10 years. Nevertheless, this interval is rather long, and we need a safe index that will include a relevant number of companies within different industries with data starting from 2003. Fortunately, our library provides with access to the Datastream database, it was through it that we became acquainted with the Sweden Datastream index. Thomson Reuters

Datastream database creates the Datastream Global Equity Indices which provide a variety of equity Indices across the 53 countries and 170 industry sectors worldwide and they are formed comprehensive and independent standard in equity research. (Thomson Reuters Datastream, 2008, p.1)

Moreover, the three main reasons of choosing Sweden Datastream Index are:

- "*For each market, a representative sample of stocks covering a minimum 75 - 80% of total market capitalisation enables market indices to be calculated*" (Thomson Reuters Datastream, 2008, p.1).

- "*Within each market, stocks are allocated to industrial sectors using the Industry Classification Benchmark (ICB) jointly created by FTSE and Dow Jones. Sector indices are then calculated*"(Thomson Reuters Datastream, 2008, p.1).

- "*Across the range of Datastream Global Equity Indices, daily data is available for a minimum of five years wherever possible, and from 1973 for the major markets*" (Thomson Reuters Datastream, 2008, p.1).

Therefore, a simple explanation as to why we prefer to use Sweden Datastream Index as our basic data is because it is a representative stock sample in Sweden, allocated into different sectors and having available daily data from 2003 to 2012.

We downloaded the data for Sweden Datastream Index from Thomson Reuters Datastream which is available from Umea University library. This index consists of 69 companies, they are presented in Appendix 1. We collect daily data from 2003 to 2012 regarding the stock prices, the price to book ratio, and the price to earnings ratio for each company included in the index. Then we divide the companies by the industry they belong to. However, not all data can be found, which forms the limitation of the thesis and can bias the results. We summarize the industries, the data availability for each industry, the number of companies in each industry, as well as the percentage of missing data for each indicator per industry in table 2.

Industry	**Available data**	**Number of companies**	**Missing data (in %)**		
			Stock price	**P/E ratio**	**P/ B ratio**
Oil & Gas	yes	2	0.0	10.5	0.0
Basic Materials	yes	5	0.0	6.3	0.0
Industrials	yes	21	4.1	8.5	8.9
Consumer Goods	yes	7	8.9	11.2	8.9
Technology	yes	3	9.3	15.0	9.3
Health Care	yes	4	7.3	17.3	7.3
Consumer Services	yes	4	0.0	14.7	0.0
Telecommunications	yes	2	2.9	16.8	2.9
Financial	yes	21	0.0	18.0	0.0
Utilities	no	0	-	-	-
Total	-	**69**	**4.0**	**10.5**	**5.5**

Table 2. The industries with data availability, number of representatives, and missing data (%)

Furthermore, the statistical methods are used to summary and analyze data. There are different measurement scales: nominal, ordinal, interval, or ratio (DeFusco et al., 2013b, p.325). Nominal scales categorize data but not rank them (DeFusco et al., 2013b, p.325). Ordinal scales sort data and order them according some characteristic (DeFusco et al., 2013b, p.326). Interval scales rank data and guarantee "*the differences between scale values are equal*" (DeFusco et al., 2013b, p.326). Ratio scales include all characteristic of interval scales and "*a ture zero point as the origin*" (DeFusco et al., 2013b, p.326).

In our thesis, our statistical method for our sample data is nominal scale, because our sample data is divided into different industries. We distinguish the following industries: Oil & Gas, Basic Materials, Industrials, Consumer Goods, Health Care, Consumer Services, Telecommunications, Financials, and Technology.

4.2. Time Horizon

An important issue in our paper is the time horizon. As we have mentioned in chapter 3, our study will use the cross-sectional studies and longitudinal studies. Thus, we will observe the industries, and we will also observe the changes of the volatility of stock prices and the volatility of price multiples during the last 10 years.

In our study, we will use the daily stock prices and the daily P/E and P/B ratios for each company. Our tests will be performed for each year from 2003 to 2012. Additionally, we build three periods:

- Period one: 2003-2012;
- Period two: 2003-2007;
- Period three: 2008-2012.

Moreover keeping in mind our calculation specifics, we collect raw data from 2002-12-31 until 2012-12-31. This enables us to obtain volatility measures starting from 2003-01-01 until 2012-12-31.

4.3. Stock Price Transformations

As we said before, we employ the use of the returns to calculate the volatility of stock prices. Our raw data consists of the daily stock price which is available to download from Thomson Reuters Datastream. We calculated the continuously compounded return using the following formula:

$$r = \ln(S_{t+1}) - \ln(S_t) = ln\frac{S_{t+1}}{S_t} \tag{4.1}$$

Where:
S_t = the stock price at the day t;
S_{t+1} = the stock price at the next day (t + 1).

When we calculate the annual volatility (sample standard variance), we will use formula 4.2 to calculate it:

$$\sigma_{annual} = \sigma_{daily} * \sqrt{T} \tag{4.2}$$

Where:
T = the number of days in one year, usually 252.

The advantages of using log-returns can be summarized as follows:

- ease of comparison – the compounding frequency loses importance, and comparison becomes easier.
- useful in multi-period analysis – the log-returns are "*time additive and it is easier to derive the time series properties of additive processes than multiplicative processes*". (Hudson & Gregoriou, 2010, p.5)

A common characteristic of stock returns is the leptokurtosis, also now as the presence of fat tails (Bai et al., 2003, p. 349). While it is generally assumed that financial returns follow a normal distribution, Egan (2007) concludes that the t-distribution is a perfect fit. The t-distribution looks similar to the normal distribution, only it has "fatter" tails. Thus, we assume that our returns will not have a normal distribution.

Throughout this paper we will refer to log-returns simply as returns.

4.4. Price Multiples

The purpose of this study is to compare the volatility of the stock prices with the volatility of the P/E ratio and of the P/B ratio. In order to make the results comparable we employ the same transformations for all our variables. Thus, we use the logarithmic values to calculate volatility. Moreover, for the aggregate data we use the indicators calculated by Datastream, so we have to clarify their calculation.

In the Datastream, the index P/E ratio is "*derived by dividing total market value by the total earnings, thus providing an earnings-weighted average of the P/E ratio of the constituents*" (Thomson Reuters Datastream, 2008, p.23). The formula that is used is presented below:

$$\frac{P}{E} = \frac{\sum_{1}^{N} (P_t * N_t)}{\sum_{1}^{n} (E_t * N_t)} \tag{4.3}$$

Where:
P/E = price to earnings ratio at the day t;
P_t = unadjusted share price at the day t;
N_t = number of shares in issue at the day t;
E_t = earnings per share at the day t (negative earnings per share = 0);
n = number of constituents in index.

For the company P/E it is used the basic formula of the daily stock price divided by the value of equity per share.

The aggregate P/B ratio is calculated according to the following formula:

$$\frac{P}{B} = \frac{\sum(P * NOSH)}{\sum(X(1308) * NOSH)} \tag{4.4}$$

Where:
P = latest daily price;
NOSH = latest number of shares in issue;
X = each constituent equity in the index;
1308 = book value per share ("*the proportioned common equity divided by outstanding shares at the company's fiscal year end*") (Thomson Reuters Datastream, 2008, p.25).

The company's P/B is also calculated accordingly to the basic fraction between the stock price and the book value per share.

In our study, we can directly download the daily data for the P/E and P/B ratios from Thomson Reuters Datastream.

4.5. GARCH Model

As mentioned in chapter 3, one of the properties volatility has is clustering, this process is also known as heteroskedasticity (Engle et al., 2007, p. 689). ARCH and GARCH models were created in order to capture this feature. Thus, the ARCH/GARCH family assumes that the time series is stationary (none of its distributions is time dependent) and the conditional expected value of variance is dependent on time.

The ARCH (Autoregressive Conditional Heteroskedasticity) model was introduced first, by Engel (1982, cited in Bollerslev, 1986, p.307), but this model requires many parameters in its estimation, so it's rather complicated in practice (Bollerslev, 1986, p.307; Tsay, 2010, p.131). Therefore, Bollerslev (1986) introduces the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model. This model is widely used in order to analyse volatility. It counts for all the past values (even lagged conditional variances) in estimating future volatility (Bollerslev, 1986, p. 309). Thus, it is a time adaptive process (Bollerslev, 1986, p. 309). The GARCH (p,q) process has the following shape:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i a_{t-i}^2 + \sum_{j=1}^{q} \beta_i \sigma_{t-i}^2 \tag{4.5}$$

Where:
p = the number of autoregressive lags;
q = the number of moving average lags;
a^2 = the squared residuals;
α, β = GARCH parameters.

While theory implies that the order (p and q values) is different for each time series, Hansen & Lunde (2001) conclude in their research that the best model to be used is GARCH (1,1). GARCH (1,1) is the simplest model with the following shape:

$$\sigma_t^2 = \alpha_0 + \alpha_1 a_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (4.6)$$

Here the same interpretation follows as for the GARCH (p, q). This model is widely used by researches. Nevertheless, it can be applied only in cases data is following a normal distribution. But as we know, financial time series usually display leptokurtosis and negative skewness (Zhang, 2009, p.3; Bai et al., 2001, p. 349). Thus the family of GARCH models was adapted accordingly. Now we have GARCH with Student's t distribution, GARCH with Generalized Error distribution, and GARCH with Gaussian distribution (Zhang, 2009, p.3). There is not much research as to which distribution is most accurate, but a study done by Egan (2007) concludes that the Student's t distribution is the best fit for financial data. Thus, in our paper, we use the GARCH (1,1) model with Student's t distribution.

In order to obtain the value of volatility we use the RATS (Regression Analysis of Time Series) program, but first we use SPSS (Statistical Product and Service Solutions) to get the descriptive statistics that will show whether t distribution GARCH is appropriate.

4.6. Correlation Tests

Correlation describes the statistical relationship between two variables. The relationship can be linear or nonlinear, accordingly different tests are used to test these relationships. The most common test used is the Pearsson correlation. According to UWE (2006), the use of the "*Pearsson correlation coefficient is to measure of the strength of the association between [...] two variables*". The first step to study the relationship between two variables is to "*draw a scatter plot of the variables to check for linearity*" (UWE, 2006).

The correlation between two variables (X_1, X_2) is calculated

$$\rho(X_1, X_2) = \frac{Cov(X_1, X_2)}{\sigma(X_1)\sigma(X_2)} \quad (4.7)$$

When the correlation is equal to 1, it is a perfect linear with a positive relationship, which is shown in the second graph of figure 14. When the correlation is equal to -1, it is a perfect linear with a negative relationship, which shows in the third graph. When the correlation is equal to 0, it is not relationship, which shows in the first graph.

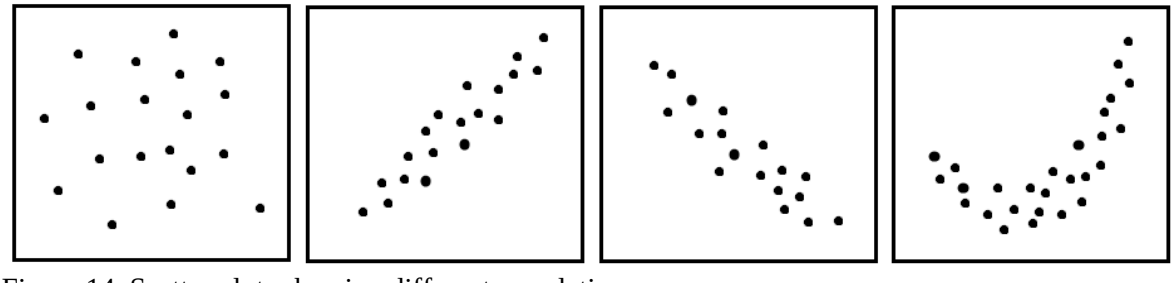

Figure 14. Scatter plots showing different correlations
Source: the authors

Nevertheless, sometimes, the scatter pot of the data can take the shape shown in the last graph of figure 14. Then, our data has a non-linear relationship. In the case of nonlinear relationship we can at best assume the function it follows.

4.7. Linear Regression and R^2

While the correlation coefficient describes the strength and direction of a relationship between any two variables, the regression line describes the relationship between an explanatory variable (x) and a response variable (y) (Moore et. al, 2011, p.100). Thus, the linear regression creates the suitable model where the explanatory variable predicts the response variable. The most common method is the least-squares regression. "*The least-squares regression line of y on x is the line that makes the sum of the squares of the vertical distances of the data points from the line as small as possible*" (Moore et. al, 2011, p.102). The general equation for a linear regression takes the following form:

$$b_0 + b_1 x + e = y \tag{4.8}$$

Where:
b_o = the intercept
b_1 = the slope
e = the error
y = the dependent variable
x = the independent variable

The most important facts about the least-square regression are presented in Moore et al. (2011, p.105):

- there is a close connection between the slope of the linear regression equation and the correlation;
- the regression line will always pass through the point $(\bar{x}, \bar{y})$;
- the least-squares regression sets the model only for x as the explanatory variable and y as the response variable, if x and y are switched, the results would be different.

An important indicator is the coefficient of determination, also known as r square (R^2). The coefficient of determination shows us "*the percent of variation explained by the least-squares equation*" (Moore et. al, 2011, p.106). R^2 is calculated based on the following formula:

$$R^2 = \frac{\sum(\hat{y} - \bar{y})^2}{\sum(y - \bar{y})^2} \tag{4.9}$$

Where:
$\hat{y}$ = the predicted values
$\bar{y}$ = the mean of y

Thus, the R^2 comes as a "*measure of how successful the regression was in explaining the response*" (Moore et. al, 2011, p.106). We use the SPSS software to calculate the value of R^2.

4.8. Hypothesis Testing

Hypothesis testing is the part of the statistical inference part (DeFusco et al. 2013c, p.552). The first step in hypothesis testing is to define the null hypothesis. The "*null Hypothesis is the hypothesis to be tested*" (DeFusco et al. 2013c, p.553). The null hypothesis states that there is no relationship, while the alternative hypothesis states the contrary. When the null hypothesis fails to provide evidence to its correctitude, we reject it and turn towards the alternative hypothesis (DeFusco et al., 2013c, pp.552- 553).

We use the P-value to test the null hypothesis and provide the evidence to accept or reject it. In our data testing we use the p-value of 0.01 and 0.05. So when the p-value is smaller than 0.01 and 0.05 respectively, we reject the null hypothesis.

As we presented in our first chapter, we did not find any article that looks into the relationship between the volatility of price multiples and volatility of stock return. Thus we perform this analysis on the Swedish market from 2003 to 2012, across all industries. In our theoretical chapter we presented the link between the price multiples and the stock prices or their volatility found by different studies. These findings led us to form the following hypotheses:

Hypothesis 1

Null Hypothesis: *There is no correlation between the volatility of stock prices and the volatility of the P/E ratio.*

Alternative Hypothesis: *There is a correlation between the volatility of stock prices and the volatility of the P/E ratio.*

$H_0 : \rho = 0$
$H_a : \rho \neq 0$

As stated before, researchers looked only at the relationship between the P/E ratio and either the stock prices or the volatility of the stock prices. The previous findings lead us to question whether there is a relationship between the volatility P/E and the volatility of the stock prices.

Hypothesis 2

Null Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/E ratio does not vary across industries.*

Alternative Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/E ratio varies across industries.*

$H_0 : \rho_{\text{industry x}} = \rho_{\text{industry y}}$
$H_a : \rho_{\text{industry x}} \neq \rho_{\text{industry y}}$

This relationship can be different across industries, as the P/E ratio of companies from one industry are different compared to the P/E ratios in another industry. That is why most investors use the industry specific price multiple.

Hypothesis 3

Null Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/E ratio is constant in time.*

Alternative Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.*

$H_0 : \rho_t = \rho_{t-1}$
$H_a : \rho_t \neq \rho_{t-1}$

From a time perspective the relationship between P/E volatility and stock price volatility is uncertain. David & Veronesi (2009) find in their study a negative relationship between the P/E and volatility. Nevertheless, they say that this relationship varies in time in both direction and magnitude.

The next three hypotheses are set similar to the ones above, and from the same rationale, only they refer to the P/B ratio.

Hypothesis 4

Null Hypothesis: *There is no correlation between the volatility of stock prices and the volatility of the P/B ratio.*

Alternative Hypothesis: *There is a correlation between the volatility of stock prices and the volatility of the P/B ratio.*

$H_0 : \rho = 0$
$H_a : \rho \neq 0$

As stated before, researchers looked mostly at the relationship between the P/E ratio and either the stock prices or the volatility of the stock prices. Thus, we question whether there is a relationship between the volatility of P/B ratio and the volatility of the stock prices.

Hypothesis 5

Null Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/B ratio does not vary across industries.*

Alternative Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/B ratio varies across industries.*

$H_0 : \rho_{\text{industry x}} = \rho_{\text{industry y}}$
$H_a : \rho_{\text{industry x}} \neq \rho_{\text{industry y}}$

This relationship can be different across industries, as the P/B ratio of companies from one industry are different compared to the P/B ratios in another industry. That is why most investors use the industry specific price multiple.

Hypothesis 6

Null Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/B ratio is constant in time.*

Alternative Hypothesis: *The correlation between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.*

$H_0 : \rho_t = \rho_{t-1}$
$H_a : \rho_t \neq \rho_{t-1}$

Lastly, we want to test the ability of the volatility of price multiples to predict the volatility of stock prices, thus we bring forth the next hypotheses, with the focus on the coefficient of determination:

Hypothesis 7

Null Hypothesis: *The volatility of the P/E ratio does not explain the changes in the volatility of stock prices.*

Alternative Hypothesis: *The volatility of the P/E ratio explains the changes in the volatility of stock prices.*

$H_0 : R^2 = 0$
$H_a : R^2 \neq 0$

The following hypotheses refer to the industry and the time aspect.

Hypothesis 8

Null Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio does not vary across industries.*

Alternative Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio varies across industries.*

$H_0 : R^2_{\text{industry x}} = R^2_{\text{industry y}}$
$H_a : R^2_{\text{industry x}} \neq R^2_{\text{industry y}}$

Hypothesis 9

Null Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio is constant in time.*

Alternative Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.*

$H_0 : R^2_t = R^2_{t-1}$
$H_a : R^2_t \neq R^2_{t-1}$

The last set of hypotheses relates to the volatility of the P/B ratio, but otherwise is similar to the previous three hypotheses.

Hypothesis 10

Null Hypothesis: *The volatility of the P/B ratio does not explain the changes in the volatility of stock prices.*

Alternative Hypothesis: *The volatility of the P/B ratio explains the changes in the volatility of stock prices.*

$H_0 : R^2 = 0$
$H_a : R^2 \neq 0$

The following hypotheses refer to the industry and the time aspect.

Hypothesis 11

Null Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio does not vary across industries.*

Alternative Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio varies across industries.*

$H_0 : R^2_{\text{industry x}} = R^2_{\text{industry y}}$
$H_a : R^2_{\text{industry x}} \neq R^2_{\text{industry y}}$

Hypothesis 12

Null Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio is constant in time.*

Alternative Hypothesis: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.*

$H_0 : R^2_t = R^2_{t-1}$
$H_a : R^2_t \neq R^2_{t-1}$

CHAPTER 5: Empirical Results

The empirical results chapter deals with presenting our results. First, we start with presenting the descriptive statistics for the aggregate data. Next, we divide the chapter in two parts: one part will deal with the correlation results, and the other will deal with the linear regression results. In the correlations subdivision, we will discuss the P/E and P/B ratios in the context of the industry section and the time section.

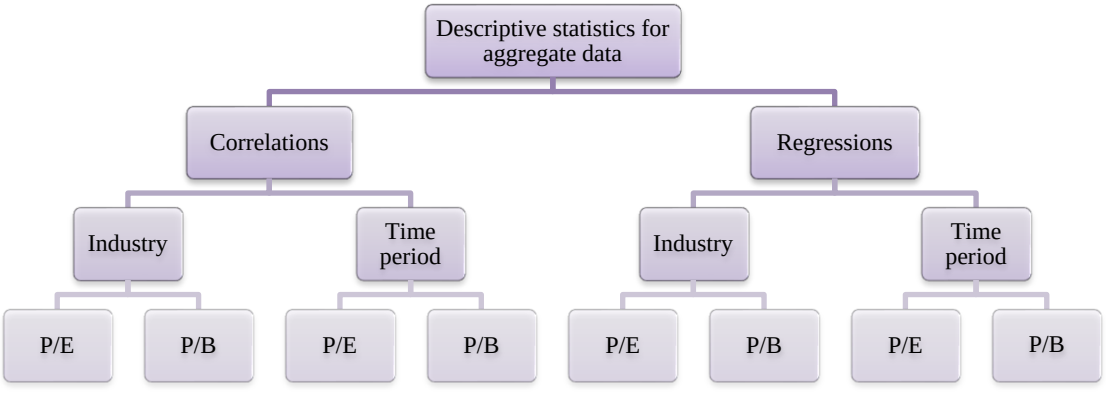

Figure 15. The outline of the Empirical Results
Source: the authors

5.1. Descriptive Statistics and Preliminary Analysis

5.1.1. Logged Values

Before performing our statistical tests, it is important to have a general view of the data we analyse. As mentioned before, we use the log returns and we use the logged ratios for the P/E and P/B ratios, as proposed by Cheng et al. (1995). The graphs of the logged values are presented in Appendix 3.

Table 3 includes the descriptive statistics for our logged values. As suggested by Zhang, (2009, p.3) and Bai et al. (2001, p. 349) the data for the stock returns displays negative skewness and leptokurtosis, as the level of kurtosis is bigger than 3 (normal distribution). At the same time, the data for the logged values of P/E and P/E also display negative skewness and leptokurtosis, similar to the stock returns.

Statistics	Logged stock returns	Logged P/E ratio	Logged P/B ratio
Mean	0.000432	-0.000032	0.000143
Std. Deviation	0.013641	0.015228	0.015475
Variance	0.000186	0.000232	0.000239
Skewness	-0.150318	-0.283092	-3.684806
Kurtosis	5.268691	6.047018	73.481131

Table 3. The descriptive statistics for the logged values

Furthermore, we perform two normality tests: the Kolmogorov-Smirnov and the Shapiro-Wilk. The results are presented in table 4.

Indicator	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistic	Sig.	Statistic	Sig.
Logged stock returns	0.09360	0.000	0.92288	0.000
Logged P/E ratio	0.10212	0.000	0.90879	0.000
Logged P/B ratio	0.11631	0.000	0.80191	0.000

Table 4. Tests of normality

The null hypothesis in these tests is that data follows a normal distribution, and the alternative is that data is abnormal. Our results show a zero significance level. Thus, we can reject the null hypothesis and conclude that our data is not normal. Consequently this enables us to use the GARCH model with t distribution.

5.1.2. Volatility Values

The movements of the volatility levels for the stock prices are presented in figure 16.

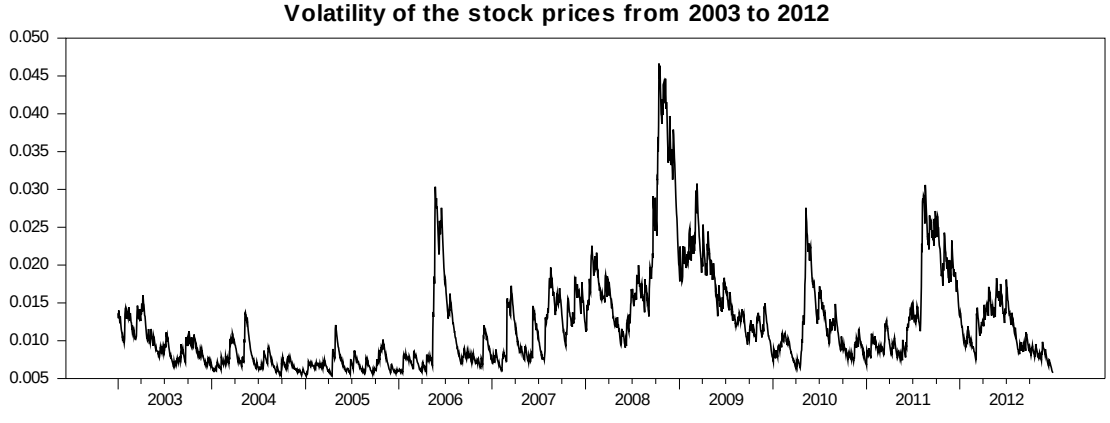

Figure 16. Volatility of the Stock prices

The figure shows four big spikes in the volatility of the stock prices. These occurred in 2006, end of 2008, 2010, and end of 2011. Thus most of the volatility spikes occurred in the past 5 years, confirming that market volatility has increased. Moreover, the highest volatility level was registered in October 2008 (0.0466), when the financial crisis started taking proportions. And the lowest level of volatility was in January 2005 (0.0052)

Figure 17 presents the volatility levels for the P/E ratio. While the stock prices had only four significant volatility spikes, the P/E ratio looks more volatile. The values of the volatility are higher, and the periods of high volatility last longer. Furthermore, it has yearly spikes, but the highest level in the volatility of the P/E ratio was registered in October 2008 (0.0461) and it continued until the end of 2009. The timing of the highest spike in the volatility of the P/E ratio is just 2 days after the spike in the volatility of stock prices. At the same time, the lowest value in the volatility of the P/E ratio was in December 2004 (0.0064).

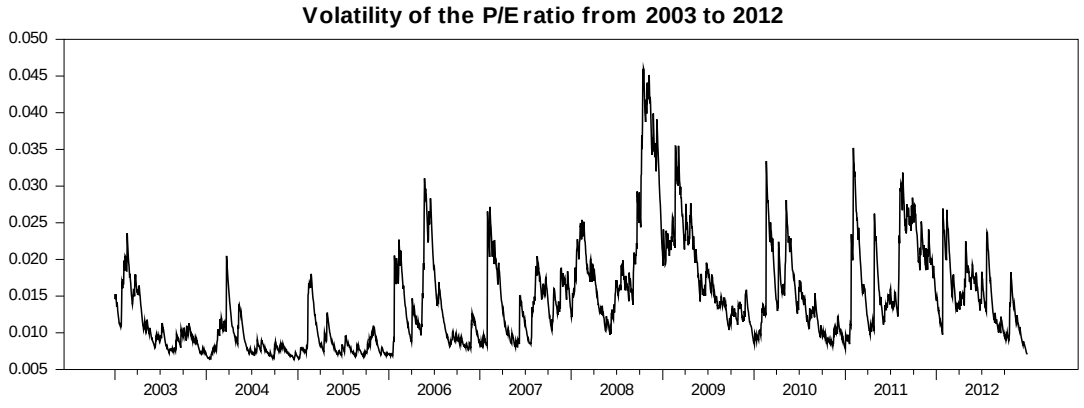

Figure 17. Volatility of the P/E ratio

Lastly, we have the volatility of the P/B ratio in the same period. Here the highest spike in volatility (0.0929) is in January 2005, when both the P/E and the stock prices registered the lowest value in their volatility. At the same time, the lowest value of the volatility of this ratio was in December 2004 (0.0121), just a few days before the biggest spike in volatility. Also, in the period the volatility of the stock prices and the volatility of the P/E ratios had the highest values, the volatility of the P/B was around 0.0366 and 0.0353 respectively.

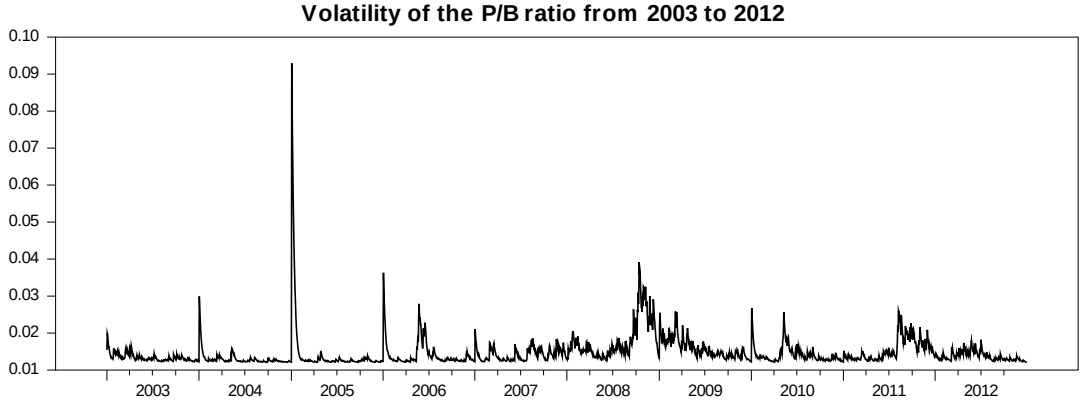

Figure 18. Volatility of the P/B ratio

We remind that up until now and in the biggest part of our paper we deal with the daily volatility. The yearly volatility values are presented in table 5. To get the yearly volatility we applied formula 4.2 discussed in chapter 4.

From the table we see that on an aggregate level the highest level of yearly values of the volatility was in the same year for the stock prices, the P/E ratio, and the P/B ratio – 2008 (0.3303, 0.3458, and 0.2874). Moreover, for the stock prices the highest values across industries are all in year 2008, while for the P/E and P/B ratios the highest values of volatility in different industries occur in different years.

Industry	Volatility of stock prices									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aggregate	0.1573	0.1174	0.1104	0.1656	0.1866	0.3303	0.2591	0.1784	0.2401	0.1767
Oil & Gas	0.5714	0.3980	0.3688	0.3961	0.3308	0.6004	0.4414	0.3459	0.3995	0.3283
Basic Materials	0.1948	0.1628	0.1469	0.2533	0.2338	0.4305	0.3600	0.2379	0.3216	0.2438
Industrials	0.1970	0.1495	0.1421	0.2017	0.2347	0.3814	0.3157	0.2139	0.2893	0.2196
Consumer Goods	0.1696	0.1292	0.1229	0.1551	0.1680	0.2944	0.2392	0.1771	0.2064	0.1681
Technology	0.4246	0.3285	0.2432	0.2577	0.2909	0.4433	0.3529	0.2618	0.3194	0.2676
Health Care	0.2445	0.2423	0.2575	0.2578	0.2418	0.2760	0.2365	0.2488	0.2694	0.2455
Consumer Services	0.2070	0.1753	0.1672	0.1804	0.1848	0.2660	0.2056	0.1775	0.2104	0.1713
Telecommunications	0.2685	0.2311	0.2149	0.2300	0.2383	0.3389	0.2823	0.2095	0.2484	0.2055
Financials	0.1448	0.1042	0.1094	0.1576	0.1993	0.3597	0.2907	0.1808	0.2368	0.1776
	Volatility of the P/E ratio									
Aggregate	0.1765	0.1387	0.1394	0.2092	0.2214	0.3458	0.2856	0.2258	0.3002	0.2312
Oil & Gas	1.0759	0.5529	0.4762	0.5090	0.4994	0.6807	0.5431	0.4356	0.5618	0.4280
Basic Materials	0.3768	0.3648	0.3963	0.4330	0.4242	0.5132	0.5178	0.4163	0.5568	0.5021
Industrials	0.2249	0.1871	0.1884	0.2427	0.2722	0.4233	0.3425	0.2805	0.3790	0.2674
Consumer Goods	0.5243	0.5188	0.5219	0.5621	0.5859	0.5409	0.5844	0.5907	0.5272	0.5644
Technology	0.4878	0.4883	0.4883	0.4879	0.4881	0.4877	0.4876	0.4860	0.4865	0.4880
Health Care	0.3672	0.3672	0.3672	0.3671	0.3669	0.3671	0.3671	0.3671	0.3671	0.3668
Consumer Services	0.3437	0.2569	0.2967	0.3255	0.2922	0.4133	0.4593	0.3555	0.3362	0.3199
Telecommunications	0.4518	0.4640	0.4457	0.4441	0.4485	0.4563	0.4471	0.4499	0.4477	0.4445
Financials	0.2237	0.1505	0.1812	0.3112	0.2671	0.4445	0.3841	0.2993	0.3756	0.3015
	Volatility of the P/B ratio									
Aggregate	0.2133	0.2066	0.2321	0.2264	0.2255	0.2874	0.2521	0.2247	0.2462	0.2179
Oil & Gas	0.6036	0.5131	0.5329	0.5550	0.4997	0.5774	0.5194	0.4998	0.5141	0.4956
Basic Materials	0.2291	0.2084	0.2069	0.2896	0.2613	0.3913	0.3441	0.2639	0.3166	0.2573
Industrials	0.2282	0.2123	0.2287	0.2454	0.2494	0.3493	0.2961	0.2469	0.2865	0.2394
Consumer Goods	0.2044	0.1855	0.1938	0.2167	0.2047	0.2882	0.2379	0.2092	0.2473	0.2013
Technology	0.4142	0.3712	0.3361	0.3135	0.3184	0.4047	0.3769	0.2982	0.3259	0.3102
Health Care	0.2978	0.2967	0.3013	0.2980	0.2976	0.2999	0.2984	0.2971	0.2985	0.2963
Consumer Services	0.2332	0.2213	0.2352	0.2110	0.2120	0.2692	0.2285	0.2093	0.2330	0.2052
Telecommunications	0.2761	0.2560	0.2528	0.2633	0.2584	0.3213	0.2828	0.2443	0.2796	0.2407
Financials	0.2751	0.2729	0.3007	0.2854	0.2849	0.3290	0.3044	0.2841	0.2918	0.2788

Table 5. Yearly values for the volatility

5.2. Correlations Results

Our next part deals with the results obtained from the correlations tests. First of all, we put on the same graph the values of the volatility of the stock prices and P/E ratios, then the stock prices against the P/B ratio.

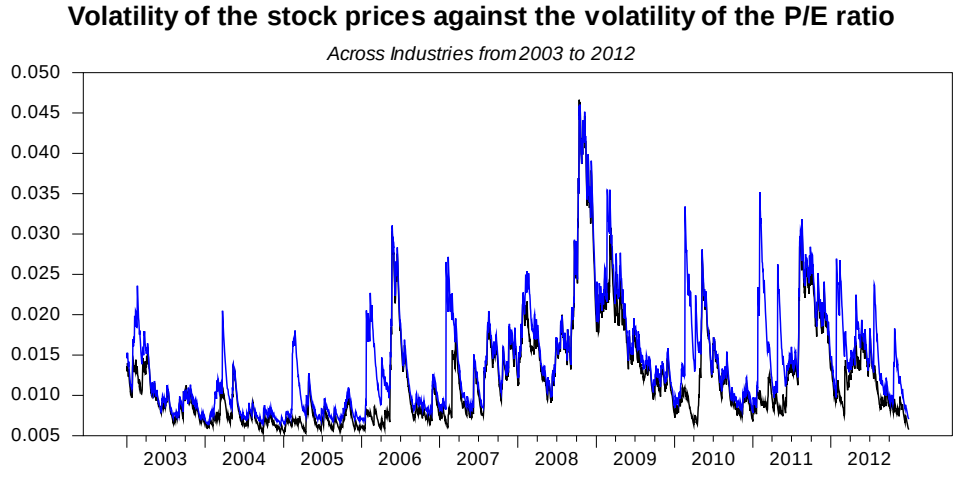

Figure 19. Volatility of the stock prices (black line) against the volatility of the P/E ratio (blue line)

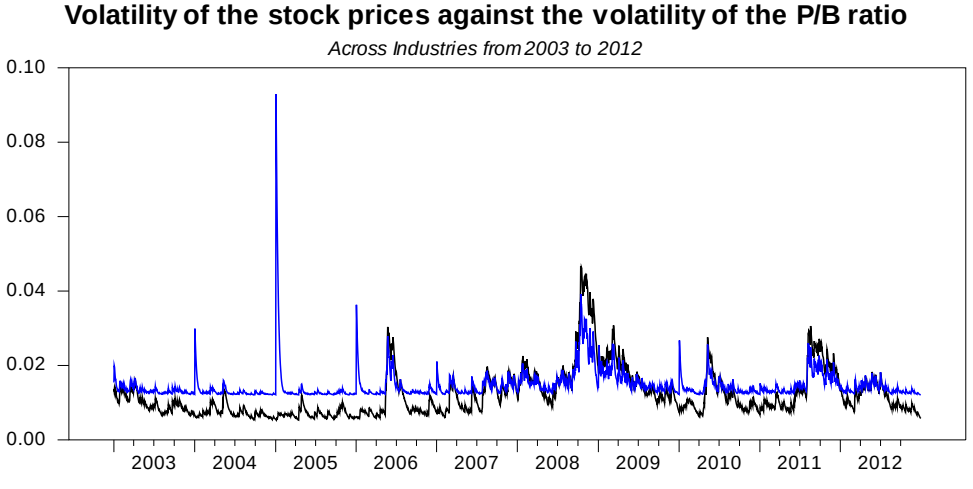

Figure 20. Volatility of the stock prices (black line) against the volatility of the P/B ratio (blue line)

At a first glance it would seem that the volatility of the P/E ratio is more aligned with the stock prices compared to the volatility of the P/B ratio, despite having so many spikes. Thus we look at the scatter plots too. Figures 21 and 22 present the scatter plots for the volatility of the stock prices against the volatility of the P/E ratio and the P/B ratio respectively from 2003 to 2012. The figure regarding the P/E ratio shows a positive linear relationship. The relationship seems strong as the line is easily detected. Nevertheless, we see some values that tend to gather along the x-axis.

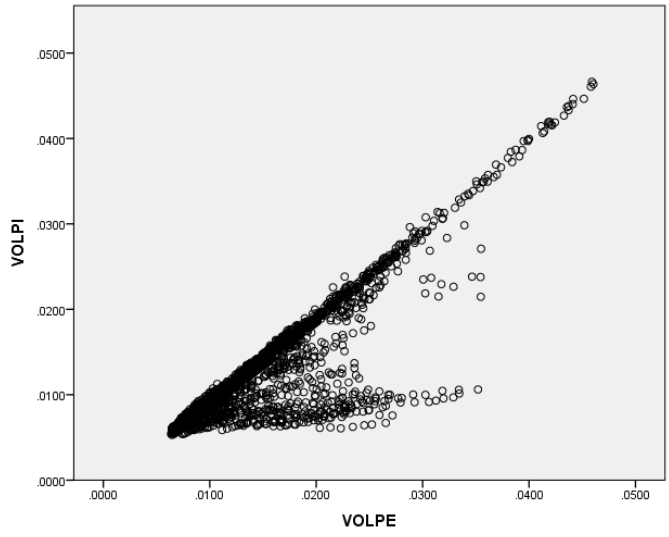

Figure 21. Scatter plot of the volatility of stock prices (y) against the volatility of the P/E ratio (x)

The scatter plot for the volatility of the P/B ratio along the volatility of stock prices is rather hard to interpret; it would seem the relationship is weakly linear, positive. Nevertheless it can also be non-linear.

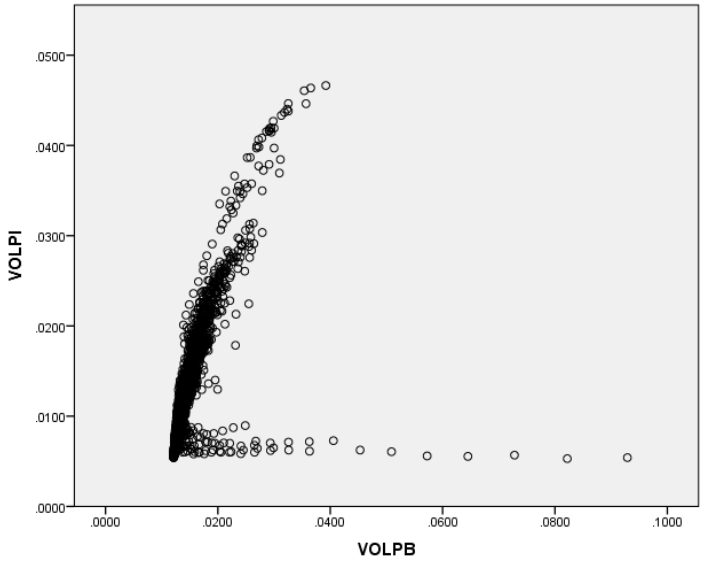

Figure 22. Scatter plot of the volatility of stock prices (y) against the volatility of the P/B ratio (x)

To get more reliable results we use the Pearsson correlation coefficient to look at the strength of the relation between our variables. Table 6 presents the values these coefficients take. The results are for the aggregate daily data from 2003 to 2012.

Volatility of stock prices	Volatility of the P/E ratio	Volatility of the P/B ratio
Pearsson Correlation	0.864**	0.584**
**. Correlation is significant at the 0.01 level (2-tailed).		

Table 6. Correlation table on aggregate data

As the scatter plots suggested, there seems to be a stronger correlation between the stock price volatility and the P/E volatility (0.864). While the relation between the volatility of the stock prices and the volatility of the P/B ratio is weaker with a value of 0.584. Both results are significant.

5.2.1. Correlations across Industries

As mentioned before, we have reason to believe the correlation coefficients will take different values for each industry. Table 7 presents the values the correlation coefficient takes across each industry from 2003 to 2012. The coefficients were obtained using daily volatility.

Industry	Pearsson correlation coefficient	
	Volatility of the P/E ratio	Volatility of the P/B ratio
Oil & Gas	0.754**	0.411**
Basic Materials	0.273**	0.932**
Industrials	0.682**	0.856**
Consumer Goods	0.045*	0.612**
Technology	0.012	0.862**
Health Care	-0.021	0.115**
Consumer Services	0.377**	0.659**
Telecommunications	0.057**	0.813**
Financials	0.625**	0.278**
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).		

Table 7. The correlation coefficients for each industry from 2003 to 2012

From the table, we notice that the values for the correlation between the volatility of stock prices and the volatility of the P/E ratio have very different values across industries. Thus, it ranges from -0.021 in the Health Care to 0.754 in Oil & Gas. Moreover, there seems to be a high correlation only in three industries: Oil & Gas, Industrials, and Financials. The correlations between the volatility of stock prices and the volatility of the P/B ratio, on the other hand, have rather steady values, at least all in the positive range. Thus, we notice strong correlations in six industries: Basic Materials, Industrials, Consumer Goods, Technology, Consumer Services, and Telecommunications. The highest correlation for the P/B ratio is in the Basic Materials (0.932), and the lowest for Health Care (0.115).

5.2.2. Time Horizon

When we constructed our hypotheses we stated also our reasoning behind the idea the time horizon is very important in determining the correlation coefficients. First we divide our data in two periods, as stated in the practical method chapter: period one, from 2003 to 2007; and period two, from 2008 to 2012.

First, we present the scatterplots for these two periods. Figure 23 shows the plot for the values of the volatility of stock prices against the volatility of the P/E ratio from 2003 to 2007. From the picture we notice that here seems to be a rather strong positive linear relationship in this period.

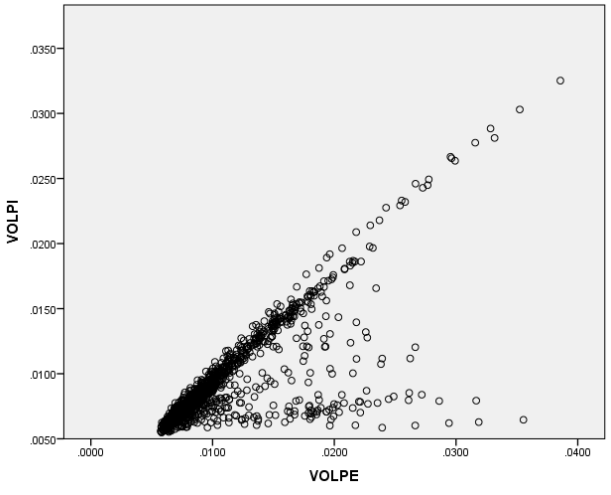

Figure 23. The volatility of stock prices (y) against the volatility of the P/E ratio (x), 2003-2007

Figure 24 presents the values of the volatility of stock prices against the volatility of the P/B ratio from 2003 to 2007. In this picture we notice that here seems to hardly be any relationship between our values, as the line formed is vertical.

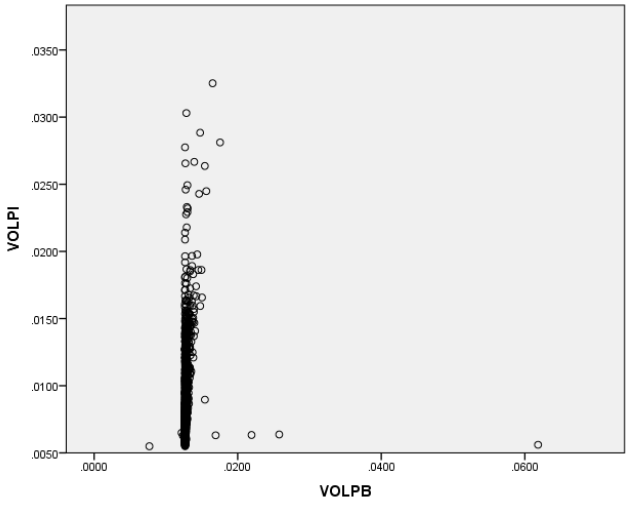

Figure 24. The volatility of stock prices (y) against the volatility of the P/B ratio (x), 2003-2007

Next, we have the scatter plots for the second period. Figure 25 presents the volatility of stock prices against the volatility of the P/E ratio from 2008 to 2012. We notice that it looks almost identical to the previous period (2003-2007), any changes should be small.

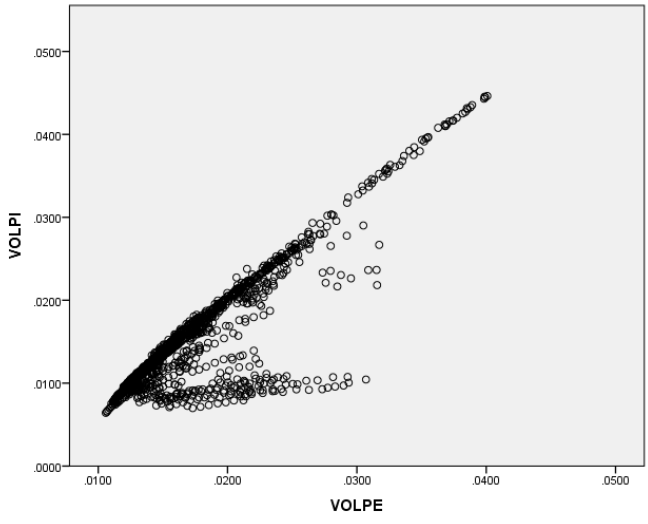

Figure 25. The volatility of stock prices (y) against the volatility of the P/E ratio (x), 2008-2012

The second figure, of the volatility of stock prices against the volatility of P/B ratio, looks completely different from the previous period. Here, we notice a very obvious linear trend, what's more this trend is positive.

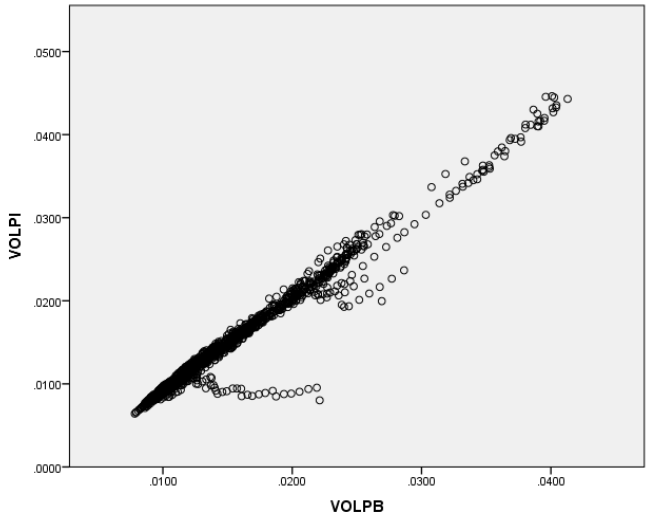

Figure 26. The volatility of stock prices (y) against the volatility of the P/B ratio (x), 2008-2012

Lastly, to support and verify the accuracy of the scatter plots, we present the values for the correlation coefficients for these two periods in table 8.

The first thing to draw our attention is the fact that the correlation between the volatility of stock prices and volatility of P/E ratio does not change very much in time, and even these small changes don't have any obvious direction, it either increases in the second period or decreases. At the same time, the correlation between the volatility of stock prices and the volatility of P/B ratio is increasing in the second period, and comes very close to 1.

Industry	Pearsson correlation coefficient			
	Volatility of the P/E ratio		Volatility of the P/B ratio	
	2003-2007	2008-2012	2003-2007	2008-2012
Aggregate	0.758**	0.855**	0.093**	0.979**
Oil & Gas	0.828**	0.764**	0.280**	0.908**
Basic Materials	0.225**	0.205**	0.748**	0.979**
Industrials	0.697**	0.604**	0.554**	0.942**
Consumer Goods	-0.012	0.035	0.319**	0.662**
Technology	-0.086**	0.031	0.780**	0.965**
Health Care	-0.017	-0.024	0.073**	0.323**
Consumer Services	0.459**	0.334**	0.341**	0.913**
Telecommunications	0.052	0.106**	0.738**	0.834**
Financials	0.416**	0.628**	0.021	0.610**
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).				

Table 8. Correlation coefficients for each industry, divided by periods.

Furthermore, we segment or results by calculating the correlations in each year from 2003 to 2012. Table 8 presents the values these coefficients take on an aggregate level, and for each industry. We notice that in 2008 and 2009 the correlations were highest for both the volatility of P/E and of P/B. The correlation of the volatility of stock prices with the volatility of the P/E ratio does not show any trend, it seems to move at random throughout the years for all industries, and the highest level is in 2008. Moreover, for the Health Care, we can easily note that it is an inverse relationship.

Regarding the correlation between the stock prices and P/B ratio, the table above (8) showed a stronger value for the period between 2008 and 2012. Table 9, shows that this relationship was also strong in 2003, and then it decreased in 2004 and had a minimum value in 2005. But starting from 2006 it continuously increased, on the aggregate level. The same sequence is characteristic for almost all the industries.

Industry	Pearsson Correlation Coefficient between the Volatility of Stock Prices and:									
	Volatility of the P/E ratio									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aggregate	0.876**	0.777**	0.390**	0.823**	0.502**	0.992**	0.961**	0.503**	0.649**	0.502**
Oil & Gas	0.977**	0.759**	0.424**	0.802**	0.265**	0.994**	0.695**	0.782**	0.241**	0.603**
Basic Materials	0.407**	0.257**	-0.104	0.575**	-0.006	0.833**	0.500**	0.345**	-0.004	-0.097
Industrials	0.730**	0.566**	0.386**	0.780**	0.675**	0.921**	0.919**	0.186**	0.279**	0.460**
Consumer Goods	0.553**	0.762**	0.548**	-0.022	-0.239**	0.560**	0.206**	-0.021	0.586**	-0.033
Technology	-0.130*	-0.225**	-0.240**	0.061	-0.226**	-0.176**	-0.099	0.076	0.089	-0.214**
Health Care	-0.026	-0.367**	-0.591**	-0.658**	0.027	-0.683**	-0.260**	-0.431**	-0.681**	-0.017
Consumer Services	0.793**	0.382**	0.433**	0.242**	0.629**	0.953**	0.397**	0.075	0.960**	0.169**
Telecommunications	0.198**	0.033	0.067	0.421**	0.118	0.265**	0.433**	0.024	0.124*	0.053
Financials	0.686**	0.445**	0.001	0.160**	0.702**	0.888**	0.929**	0.121	0.329**	0.228**
Industry	**Volatility of the P/B ratio**									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Aggregate	0.833**	0.149*	-0.133*	0.575**	0.746**	0.962**	0.912**	0.678**	0.949**	0.936**
Oil & Gas	0.317**	0.722**	-0.1	0.136*	0.630**	0.909**	0.817**	0.813**	0.833**	0.818**
Basic Materials	0.812**	0.807**	0.041	0.735**	0.430**	0.995**	0.991**	0.763**	0.985**	0.984**
Industrials	0.986**	0.402**	-0.008	0.735**	0.996**	0.931**	0.998**	0.658**	0.935**	0.996**
Consumer Goods	0.813**	0.841**	0.182**	0.204**	0.754**	0.786**	0.899**	0.830**	0.209**	0.882**
Technology	0.957**	0.748**	0.566**	-0.033	0.938**	0.983**	0.989**	0.954**	0.976**	0.974**
Health Care	0.102	0.213**	0.038	0.569**	0.079	0.400**	-0.003	0.654**	0.652**	0.680**
Consumer Services	0.659**	0.099	0.259**	0.481**	0.846**	0.926**	0.763**	0.955**	0.805**	0.960**
Telecommunications	0.975**	0.871**	0.350**	0.481**	0.945**	0.947**	0.984**	0.969**	0.228**	0.974**
Financials	0.549**	0.021	-0.210**	0.126*	0.344**	0.548**	0.567**	0.269**	0.795**	0.698**

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 9. Yearly correlation coefficients across industries

5.3. Regression Results

As we discussed in the hypotheses setting paragraph, we want to test if the volatility of stock prices is linearly dependent on the volatility of P/E or P/B ratios. We are not interested in constructing the equation for a linear regression, our purpose is looking at R^2, the coefficient of determination. The values this coefficient takes across industries are presented in this section.

First, we have table 10 that presents the values for R^2 in each industry during our three periods between the volatility of stock prices as a dependent variable and the volatility of the P/E ratio and P/B ratio respectively, as independent variables. From 2003 to 2012, with volatility of P/E as a variable, the highest value was registered in the Oil & Gas industry (0.568). Moreover, this holds with the other two periods. When we have the volatility of the P/B as a variable, the highest coefficient of determination was registered in the Basic Materials for the period between 2003 and 2012, but it is not similar for the other two periods. From 2003 to 2007, the highest value for R^2 was in the Technology industry, and from 2008 to 2012 it was in the Basic Materials. Also, the values for R^2 are higher in the period from 2008 to 2012 compared to the values from 2003 to 2007.

Industry	The coefficient of determination					
	Volatility of the P/E ratio			Volatility of the P/B ratio		
	2003-2012	2003-2007	2008-2012	2003-2012	2003-2007	2008-2012
Aggregate	0.746	0.574	0.730	0.341	0.009	0.959
Oil & Gas	0.568	0.686	0.584	0.169	0.078	0.824
Basic Materials	0.075	0.051	0.042	0.869	0.560	0.958
Industrials	0.465	0.486	0.365	0.733	0.307	0.887
Consumer Goods	0.002	0.000	0.001	0.374	0.102	0.438
Technology	0.000	0.007	0.001	0.743	0.608	0.932
Health Care	0.000	0.000	0.001	0.013	0.005	0.104
Consumer Services	0.142	0.211	0.111	0.434	0.116	0.834
Telecommunications	0.003	0.003	0.011	0.660	0.545	0.696
Financials	0.391	0.173	0.394	0.077	0.000	0.372

Table 10. R^2 across industries for each period

Lastly, we present in table 11 the values for R^2 for each industry on a yearly basis. On an aggregate level the R^2 for the volatility of the stock prices and volatility of the P/E ratio had its highest level in 2008 (0.984) and the lowest value in 2005 (0.152), exactly as for the volatility of the P/B ratio where the highest value was in 2008 (0.925) and the lowest was in 2005 (0.018). These values differ across industries, but the tendency seems to be the same (highest in 2008, lowest in 2005).

Industry	R2 for the linear regression									
	Volatility of the P/E ratio									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aggregate	0.767	0.604	0.152	0.678	0.252	0.984	0.924	0.253	0.422	0.252
Oil & Gas	0.954	0.577	0.180	0.643	0.070	0.988	0.483	0.612	0.058	0.364
Basic Materials	0.166	0.066	0.011	0.330	0.000	0.695	0.250	0.119	0.000	0.009
Industrials	0.533	0.321	0.149	0.608	0.456	0.849	0.845	0.035	0.078	0.211
Consumer Goods	0.306	0.581	0.300	0.000	0.057	0.314	0.042	0.000	0.343	0.001
Technology	0.017	0.050	0.058	0.004	0.051	0.031	0.010	0.006	0.008	0.046
Health Care	0.001	0.135	0.350	0.432	0.001	0.466	0.068	0.186	0.464	0.000
Consumer Services	0.629	0.146	0.188	0.058	0.396	0.908	0.158	0.006	0.922	0.029
Telecommunications	0.039	0.001	0.004	0.177	0.014	0.070	0.188	0.001	0.015	0.003
Financials	0.471	0.198	0.000	0.026	0.493	0.789	0.863	0.015	0.108	0.052
Industry	**Volatility of the P/B ratio**									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Aggregate	0.693	0.022	0.018	0.330	0.556	0.925	0.831	0.459	0.900	0.875
Oil & Gas	0.100	0.522	0.010	0.018	0.397	0.826	0.667	0.660	0.693	0.670
Basic Materials	0.660	0.651	0.002	0.541	0.185	0.990	0.982	0.582	0.969	0.968
Industrials	0.972	0.161	0.000	0.540	0.992	0.867	0.997	0.433	0.875	0.993
Consumer Goods	0.660	0.706	0.033	0.042	0.569	0.618	0.808	0.689	0.044	0.778
Technology	0.916	0.560	0.320	0.001	0.881	0.966	0.978	0.910	0.953	0.949
Health Care	0.010	0.045	0.001	0.324	0.006	0.160	0.000	0.428	0.425	0.462
Consumer Services	0.434	0.010	0.067	0.924	0.716	0.858	0.582	0.911	0.648	0.921
Telecommunications	0.950	0.759	0.123	0.231	0.893	0.897	0.967	0.938	0.052	0.949
Financials	0.302	0.000	0.044	0.016	0.119	0.300	0.322	0.072	0.632	0.487

Table 11. R^2 across industries for each year

Moreover, table 11 shows that the volatility of the P/E ratio could explain the changes in the volatility of the stock prices, best within the Oil & Gas industry, followed closely by the Industrials, but they also greatly varied within our ten years' time frame. The least level of explanation was provided within the Technology and Telecommunications industries, as the values are lowest, but did not change considerably in the last 10 years. Furthermore, the volatility of the P/B ratio appears to explain more of the changes in the volatility of stock prices. Thus, the highest values were registered in the Basic Materials and Technology industries, with vast changes from year to year. The lowest level of explanation is provided by the Health Care and Financials, which also had the lowest level of variation.

CHAPTER 6: Discussion of Results

This chapter is meant to bring light to the results presented in the previous chapter. Here we will analyse the results in regards to the hypotheses we have set before. We begin with the correlation test results and finish with the coefficient of determination.

6.1. Correlation between the Stock Price Volatility and Price Multiples' Volatility

This section deals with the analysis of the correlation results on a general level. Thus, we have tested the following hypothesises:

Hypothesis 1*: There is a correlation between the volatility of stock prices and the volatility of the P/E ratio.*

Hypothesis 4: *There is a correlation between the volatility of stock prices and the volatility of the P/B ratio.*

The results show (see table 6) that there is a correlation between the volatility of the stock prices and the volatility of the P/E and the volatility of the P/B ratio. Moreover, this correlation is significant at the 0.01 level. Thus, we have evidence to accept both hypothesis 1 and 4.

The presence of correlation is in accordance to the previous research (Fama & French, 1992 & 1993, cited in Alcock. & Steiner, 2011, p.3; David & Veronesi, 2009; Koutmos, 2010). Moreover the correlation coefficient shows that the relationship between the volatility of stock prices and volatility of price multiples is positive in the last 10 years, and is stronger for the volatility of the P/E ratio.

6.1.1. Correlation across Industries

Another part of our research is concerned with whether the correlation between the volatility of stock prices and the volatility of price multiples is constant across industries. In order to test this we have the next hypotheses:

Hypothesis 2: *The correlation between the volatility of stock prices and the volatility of the P/E ratio varies across industries.*

Hypothesis 5: *The correlation between the volatility of stock prices and the volatility of the P/B ratio varies across industries.*

The results presented in tables 7, 8, and 9 serve as enough evidence for us to accept the above hypotheses. Our findings are in accordance with the fact that the P/E and the P/B ratios have benchmarks for each industry. Also, these results are due to the problems specific to each ratio.

Thus, the P/B ratio is advised to be used in companies that are capital intensive, and have a big number on the book value of assets. The concerns around this ratio arise from the fact that it ignores the intangibles, is not suitable for service companies, and can artificially rise because of high debts and liabilities.

On the other hand, we have the P/E ratio and its problems: useful only within a sector or group, negative earnings, is very dependent on the expectation of investors. (Investopedia, 2013b) These problems can cause fluctuations in each industry, thus the correlation results are more relevant for each industry separately. The highest correlation between the volatility of stock prices and the volatility of P/E ratio was registered in the Oil & Gas industry, which is characterised by high sensitivity to the expectations of the investors. At the same time, between the volatility of stock prices and the volatility of the P/B ratio, the highest correlation value was in the Basic Materials industry. This industry is known to be highly sensitive to changes in the business cycle, and the general economic outlook.

Surprising was the fact that for the Health Care industry, the correlation between the volatility of stock prices and the volatility of the P/E ratio takes negative values, close to 0 in most periods, except in 2008, when it comes to -0,683. The same negative pattern was observed in the Technology industry. Here, the correlation between the volatility of stock prices and the volatility of the P/E ratio are mostly negative and close to zero. This is explained by the fact that these industries are characterized by non-cyclicality, thus companies are less susceptible to bad economic situations. The correlation between the volatility of stock prices and the volatility of the P/B ratio hardly takes any negative values across industries, except in 2005, for Oil & Gas, Financials, and Industrials.

Moreover, we present table 12 to indicate strength of the correlation as a weak, moderate or strong relationship. Where:

- Values between |0| and |0.3| show a weak linear relationship.
- Values between |0.3| and |0.7| present a moderate linear relationship.
- Values between |0.7| and |1.0| show a strong linear link. (Ratner, 2013)

Industry	**Strength of the linear relationship**	
	Volatility of the P/E ratio	Volatility of the P/B ratio
Oil & Gas	strong	moderate
Basic Materials	weak	strong
Industrials	moderate	strong
Consumer Goods	weak	moderate
Technology	weak	strong
Health Care	weak	weak
Consumer Services	moderate	moderate
Telecommunications	weak	strong
Financials	moderate	weak

Table 12. The strength of the linear relationship across industries

6.1.2. Correlation across Time Periods

The last section regarding correlation deals with the time factor. So we have the following hypotheses to test in order to observe the values the correlation coefficient takes for different time periods:

Hypothesis 3: *The correlation between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.*

Hypothesis 6: *The correlation between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.*

Based on tables 8 and 9 we can accept the above hypotheses and conclude that the time factor is essential in the correlation results. It is consistent with the results provided by David & Veronesi (2009), as it shows that the relationship between the volatility of the stock prices and the volatility of price multiples is never constant, and always in change. Moreover, we observe that the correlation coefficients have no patterns, other than the fact that the highest results of correlation were in the years of the financial crisis (post 2008), and the lowest values in 2005, leading us to infer that our variables are more aligned in periods of high instability. Also, the link between the volatility of stock prices and the volatility of P/E ratio seems less affected by time, while the correlation with the volatility of the P/B is highly sensitive to the time aspect.

Figure 27 presents the values for the correlation coefficients for each year; on an aggregate level (we make no distinctions for each industry). Here we can notice the lack of any significant pattern, and that the highest values are in the past 5 years, while the lowest in 2005.

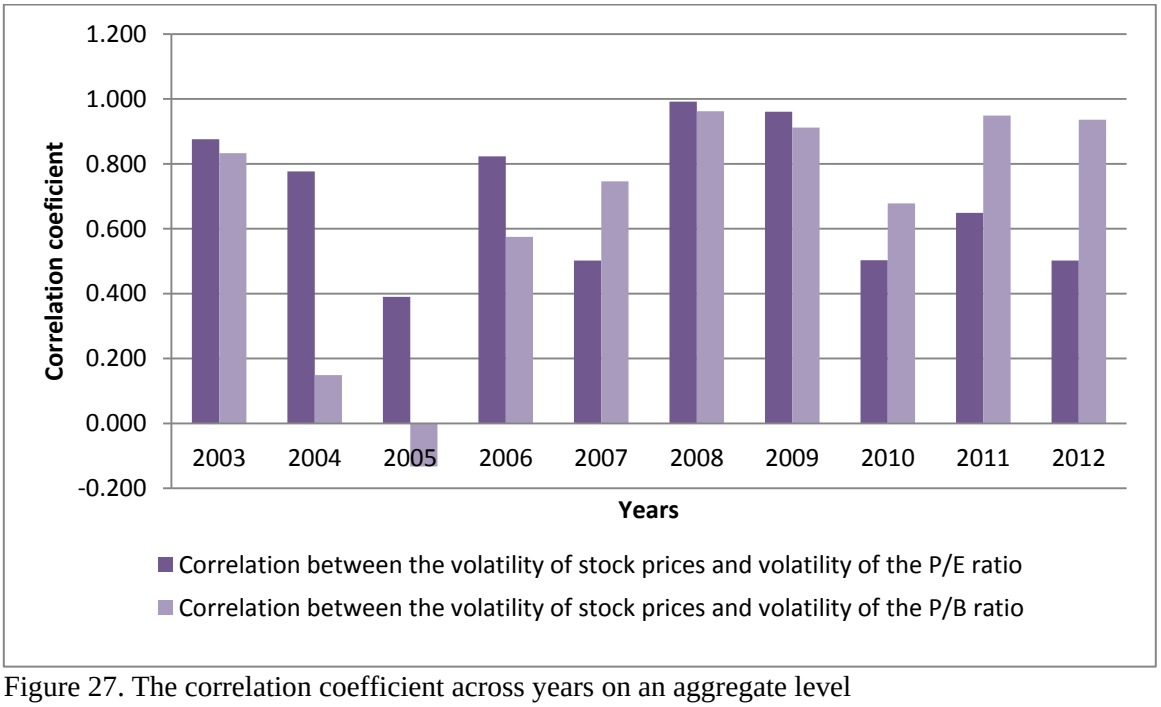

Figure 27. The correlation coefficient across years on an aggregate level

6.2. Linear Regression

The second part of our tests deal with the ability of the changes in the volatility of price multiples to predict changes in the volatility of stock prices. Thus we have the first hypotheses below:

Hypothesis 7: *The volatility of the P/E ratio explains the changes in the volatility of stock prices.*

Hypothesis 10: *The volatility of the P/B ratio explains the changes in the volatility of stock prices.*

We accept the above hypotheses based on the results from table 10. We infer that the volatility of each of the price multiples can explain the changes in the volatility of stock prices. Moreover, we strengthen the results of the studies done (Fama & French, 1992 & 1993, cited in Alcock. & Steiner, 2011, p.3; David & Veronesi, 2009; Koutmos, 2010) and reach a new level where the volatility of price multiples can be used to create a prediction model for the volatility of stock prices.

6.2.1. Linear Regression across Industries

The assumptions for the hypotheses related to the correlation hold also for the coefficient of determination. Thus we set forth the next hypotheses related with the industry aspect:

Hypothesis 8: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio varies across industries.*

Hypothesis 11: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio varies across industries.*

The above hypotheses are accepted based on the results from tables 10 and 11. Thus, we confirm that the best prediction model can be created only within one industry. Moreover the results are similar with the correlation tests, and the highest prediction level with the volatility of the P/E as an independent variable was registered in the Oil & Gas industry, and when the independent was the volatility of the P/B ratio the highest coefficient of determination was in the Basic Materials. Moreover we already know that these industries are fast to react to changes in the economic outlook, this strengthens our supposition that a prediction model is most advisable in situations of high uncertainty.

6.2.2. Linear Regression across Time Periods

The last section regarding the linear regression is concerned with the time factor. Thus, we set forth the following hypotheses to test in order to observe the values the coefficient of determination takes for different time periods:

Hypothesis 9: *The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.*

Hypothesis 12: *The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.*

The test results (see tables 10 and 11) show that we can accept the above mentioned hypotheses. Moreover, it gives conclusive evidence that the volatility of stock prices is more dependent on the volatility of price multiples in periods of market instability, as the highest level for the coefficient of determination was in the last 5 years, with the peak in 2008.

6.3. Discussion

In this section we have summarized the main empirical findings and also related them with the existing theory. Previous researchers have shown that the price multiples of cyclical companies are sensitive to the economic condition. We notice that the correlation of the volatility of the price multiples with volatility of stock prices for the cyclical industries is also more sensitive to the economic situation. Thus, cyclicality and non-cyclicality are important issues in our analysis. The non-cyclical companies are less susceptible to economic situations. In contrast with the non-cyclical companies, the cyclical companies are more susceptible to the economic situations. (Doresy et al. 2013, p.190)

Moreover, if just comparing the consumer goods industry and consumer services industry in the year of 2003 and 2008, we can find that during the 2003 to 2008, the correlation of the volatility of stock prices with the volatility of P/E and of P/B ratios in the consumer goods industry is smaller than the correlation coefficients in the consumer services industry. The reason to explain is that the companies in consumer goods industry are consumer-related companies, which is less sensitive to the economic situation, and for the companies are in the consumer service in industry, their big part of revenue is based on the sale volume of consumer-related products or services, which is more sensitive to the economic situations (Doresy et al. 2013, p.193).

Furthermore, we assume that the consumer goods industry companies belong to the non-cyclical industry and the consumer service companies belong to the cyclical industry. From the data(table 9) we can conclude that the correlation of the volatility of stock prices with the volatility of P/E or of P/B ratios in the Consumer Goods industry is smaller than the correlation values in the Consumer Services industry.

The next step in our empirical analysis was to determine the correlation between the volatility of stock prices and the volatility of price multiples in the last 10 years on Sweden Datastream Index. Our results show that there is a significant correlation between the volatility of stock price and volatility of price multiples. This comes as a development of the studies done regarding the link between the price multiples and the volatility by Fama & French (1992 & 1993, cited in Alcock. & Steiner, 2011, p.3), David & Veronesi (2009), and Koutmos (2010).

Our results show the existence of differences in the correlation results across industries and that the correlation varies in time. The time variance aspect is supported by David & Veronesi (2009). During the 10 years period we took into account we found no pattern other than that the correlation coefficient has higher values in conditions of high market instability (e.g. financial crisis). Furthermore, the correlation between the volatility of stock prices and volatility of the P/E ratio is less affected by the time aspect than the correlation between the volatility of stock prices and volatility of the P/B ratio. This makes us infer that from a time aspect the volatility of the P/B ratio is more sensitive. For instance, when we divided the 10 years in two 5-year periods, the correlation in the first period (0.093) was much lower than the correlation in the last 5 years (0.979). Also, this is valid for each industry.

Across industries, we noticed that the highest correlation between the volatility of stock prices and the volatility of P/E ratio was registered in the Oil & Gas industry, an industry known to be sensitive to the expectations of the investors. At the same time, between the volatility of stock prices and the volatility of the P/B ratio, the highest correlation value was in the Basic Materials industry. This industry reacts fast to changes in the business cycle, and the general economic outlook. The correlation though was not always positive, for example in the Health Care industry, the correlation between the volatility of stock prices and the volatility of the P/E is negative and low through all the years except in 2008, when it comes to -0,683. The same negative pattern was specific to the Technology industry. Here, the correlation coefficients are mostly negative and close to zero. This is explained by the fact that these industries are characterized by non-cyclicality, thus companies are largely independent of economic situations (Doresy et al. 2013, p.190). The correlation between the volatility of stock prices and the volatility of the P/B ratio hardly takes any negative values across industries, except in 2005, for Oil & Gas, Financials, and Industrials.

Our second part of empirical tests deal with the ability of the volatility of price multiples to predict the changes in the volatility of stock prices. Our results indicate that an appropriate model can exist only in periods of high market uncertainty, and it is best suited on a separate industry basis. Thus, if we want to construct a prediction model, we have to do it for each industry separate and for time periods no longer than one year.

CHAPTER 7: Conclusions and Recommendations

The purpose of this chapter is to make the conclusions in our thesis and provide some recommendations for further researches. We start from summarizing our empirical findings, and then we assess our quality of research. Finally, we provide some suggestions for further researches.

7.1 Conclusions

The purpose of this paper was to look at the behaviour of the volatility of price multiples in relation with the volatility of stock prices. In order to achieve this purpose we used statistical tests. The first of our tests were concerned with whether there is a correlation between the volatility of price multiples and the volatility of stock prices, and if this correlation varies in time and across industries. Thus, we test for the strength and the direction of the relationship between the volatility of price multiples and the volatility of stock prices. The second part of our tests are concerned with whether the volatility of price multiples can explain the movements in the volatility of stock prices. The coefficient of determination helps us observe if the volatility of price multiples can help create a model for predicting the volatility of stock prices. The sample in our study consisted of companies that were listed on the Sweden Datastream Index, our time period is the period during 2003-2012.

Previous literature did not study the aspect of the link between the volatility of price multiples and the volatility of the stock prices. Even though one paper (Cheng et.al, 1995) looked into the aspect of the volatility of P/E and of P/B, this article made no connections with the stock prices or their volatility. Thus, our paper fills the research gap created by the lack of literature in this direction. Moreover, we contribute not only to the research field, but we provide investors with more detailed information about the movements of the price multiples in relation with the stock prices. We also find that the volatility of the price multiples can predict the movements of the stock prices.

The answer to our research question can be summarized as follows: *there exists a correlation between the volatility of price multiples and the volatility of stock prices in Sweden*.

First, our findings show that the correlation between the volatility of price multiples and the volatility of stock prices vary across industries and over time in both strength and direction.

Secondly, the correlation between the volatility of the P/E ratio and volatility of stock prices is higher than the correlation of the volatility of the P/B ratio and volatility of stock prices in the past ten years on an aggregate level.

Thirdly, for the time period from 2008 to 2012 the correlation between the volatility of stock prices and the volatility of the P/B ratio takes higher values than in the period 2003-2008. At the same time, the correlation between the stock prices and the volatility of the P/E ratio does not vary significantly. The highest correlation values for the volatilities of both P/E and P/B were registered in 2008, making us infer that the volatility of price

multiples and volatility of stock prices have similar behaviour in periods of high market instability

Fourthly, on an industry basis, the correlation coefficients are different for each year. However, the correlation coefficients are higher between the volatility of stock prices and the volatility of the P/B ratio.

Lastly, the results of the coefficient of determination lead us to conclude that a prediction model for the volatility of stock prices based on the volatility of price multiples can be accurate only in periods of market uncertainty (i.e. crisis, bad economic situations), and it should be created for each industry separately. Moreover, the prediction ability decreases with a longer time interval.

The hypotheses that we have used to find the answer to our research question and make the above conclusions are presented in table 13. All the hypotheses we have set forth were accepted.

		Reject	Accept
Hypothesis 1	There is a correlation between the volatility of stock prices and the volatility of the P/E ratio.		x
Hypothesis 2	The correlation between the volatility of stock prices and the volatility of the P/E ratio varies across industries.		x
Hypothesis 3	The correlation between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.		x
Hypothesis 4	There is a correlation between the volatility of stock prices and the volatility of the P/B ratio		x
Hypothesis 5	The correlation between the volatility of stock prices and the volatility of the P/B ratio varies across industries.		x
Hypothesis 6	The correlation between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.		x
Hypothesis 7	The volatility of the P/E ratio explains the changes in the volatility of stock prices.		x
Hypothesis 8	The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio varies across industries.		x
Hypothesis 9	The coefficient of determination between the volatility of stock prices and the volatility of the P/E ratio is non-constant in time.		x
Hypothesis 10	The volatility of the P/B ratio explains the changes in the volatility of stock prices.		x
Hypothesis 11	The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio varies across industries.		x
Hypothesis 12	The coefficient of determination between the volatility of stock prices and the volatility of the P/B ratio is non-constant in time.		x

Table 13. Summary of the hypotheses tests

7.2. Quality of the Results

The results we have presented in the empirical results chapter and the discussion of results chapter can help investors and analysts to investigate the relationship between volatility of price multiples and volatility of stock prices. Thus, assessing or estimating the reliability and validity of the results is very important. The financial crisis may cause the analysts to question the accuracy of the price multiple. Moreover, price multiple is not the only one method to measure the equity valuation. For example, an asset-based valuation, one measure to estimate the equity valuation, uses estimates of the market or fair value of assets and liabilities. However, this valuation is just an appropriate measure for the companies which have a high proportion of tangible and have a high of current assets and liabilities. For now we don't find any measure method of equity valuation which is perfect. As we mentioned before, using the price multiple has disadvantages such as price multiples especially for the cyclical companies are highly impacted by the economic condition.

When the readers try to use our findings from our paper, three aspects must be kept in mind. Firstly, we choose the price multiples as a measure of analysis because they provide a simple way of calculation and make it easy to explain the relationship between volatility of price multiples and volatility of stock price. Moreover, there is no clearly evidence from what we have found to prove price multiple is a bad or wrong measure in the equity valuation. Secondly, our findings are based on the Swedish market, which is a developed market and has a better market efficient information system in comparison with the developing countries. Lastly, differences in reporting rules among different markets and accounting methods will result in the different earnings and book values, which makes it hard to compare the data and which can't be avoided.

7.3. Theoretical and Practical Contribution

The contribution of our paper can be interpreted on two aspects: the theoretical aspect and the practical one.

First of all, we present the theoretical contribution this paper has. When conducting our literature review, we could not find any research papers done in this area. Most of the papers were looking at the link between price multiples and stock prices, and at the relationship between price multiples and volatility. Thus, our study fills the literature gap and show that there is a link between the volatility of price multiples and volatility of stock prices. Our results show that the direction and the strength of this link vary in time across different industries.

The practical contribution of our research is outlined by the insight it provides the investors with. We did this study on the Swedish market, which is a developed country, and took into consideration the financial crisis, an event that affected investors greatly. Our study contains recent data (last 10 years). Therefore, our paper updates investors with the real market condition in Sweden, and enables them to make the appropriate investment decision. Additionally, we show that the volatility of the price multiples can be used in predicting the volatility of the stock prices.

7.4. Suggestions for Further Research

Through the process of performing our research we came across several inconsistences in the related literature. Moreover, our own results led us to propose the following suggestions for future researchers. Firstly, we suggest that further researches could be done on the same research questions as ours but in different markets or expanding the time periods, non-listed companies should also be taken into consideration. This would help provide more evidence as to developing countries, private companies, and periods with no market instability. Also, the aspect of the price multiples' behaviour in relation to the company's size and business cycle should be looked into. We suggest the use of another model to calculate volatility, as GARCH is known to have limitations. Future researchers can use a different model, and check if the relationship between the volatility of stock prices and the volatility of price multiples still holds.

Secondly, taking the limitations of linear regression models, we propose that future researchers extend the model and check whether there are any other external factors that can bias the results and influence both volatility of price multiples and volatility of stock prices. Moreover, macro-economic indicators should also be considered in this model.

Thirdly, researchers can use our results about the direction of the correlation between the volatility of price multiples and the volatility of stock prices to analyse the behaviour the investors, when they prefer to buy the stock and when they prefer to sell the stocks. Because the direction and strength are different across the industries, it means that the investors' buying or selling behaviour is different across each industry across time. Thus, these two aspects should also be taken into consideration by future researchers. The financial behaviour theory can be used as a basis for this type of research.

Fourthly, as there are few papers about the volatility of the price multiples, we recommend future researchers look into the factors that affect the volatility of price multiples. Additionally, other price multiples could be used, such as the price-to-cash flow ratio, or the price-to-sales ratio. This would help broaden the knowledge regarding the behaviour of these ratios.

Lastly, we propose that future researchers investigate how investors perceive volatility in the price multiples: if they look at it in a positive or negative light. This would provide the researchers and the entire financial community with more information in relation with the behavioural finance theory.

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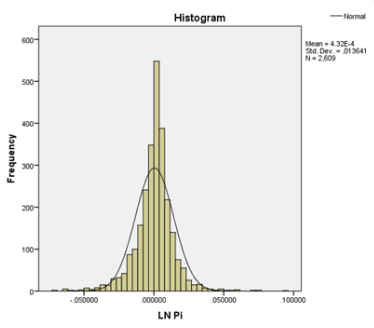
APPENDIX 1: Companies Included in the Sweden Datastream Index

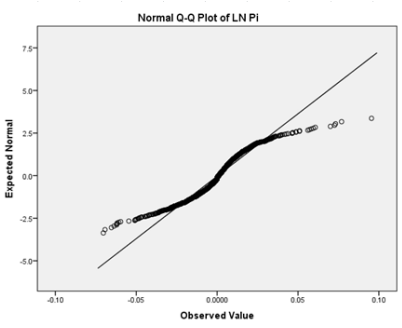
Company Name	Sector	Industry
ASSA ABLOY AB ("B")	Construction & Materials	Industrials
ATLAS COPCO AB ("A")	Industrial Engineering	Industrials
ATLAS COPCO AB ("B")	Industrial Engineering	Industrials
ATRIUM LJUNGBERG AB ("B")	Real Estate Investment & Services	Financials
AXFOOD AB	Food & Drug Retailers	Consumer Services
AXIS AB	Technology Hardware & Equipment	Technology
BILLERUD KORSNAS AB	Forestry & Paper	Basic Materials
BOLIDEN AB	Mining	Basic Materials
CASTELLUM AB	Real Estate Investment & Services	Financials
ELECTROLUX AB ("B")	Household Goods & Home Construction	Consumer Goods
ELEKTA AB ("B")	Health Care Equipment & Services	Health Care
ERICSSON 'B' AB ("A")	Technology Hardware & Equipment	Technology
ERICSSON 'B' AB ("B")	Technology Hardware & Equipment	Technology
FABEGE AB	Real Estate Investment & Services	Financials
GETINGE AB	Health Care Equipment & Services	Health Care
HAKON INVEST AB	Food & Drug Retailers	Consumer Services
H&M HENNES & MAURITZ AB ("B")	General Retailers	Consumer Services
HEXAGON AB	Electronic & Electrical Equipment	Industrials
HOGANAS AB	Industrial Metals & Mining	Basic Materials
HOLMEN AB	Forestry & Paper	Basic Materials
HUFVUDSTADEN AB	Real Estate Investment & Services	Financials
HUSQVARNA AB	Household Goods & Home Construction	Consumer Goods
INDUSTRIVARDEN AB	Financial Services (Sector)	Financials
INDUSTRIVARDEN AB	Financial Services (Sector)	Financials
INDUTRADE AB ("B")	Electronic & Electrical Equipment	Industrials
INTRUM JUSTITIA AB	Financial Services (Sector)	Financials
INVESTOR AB ("A")	Financial Services (Sector)	Financials
INVESTOR AB ("B")	Financial Services (Sector)	Financials
JM AB	Real Estate Investment & Services	Financials
INVESTMENT AB	Financial Services (Sector)	Financials

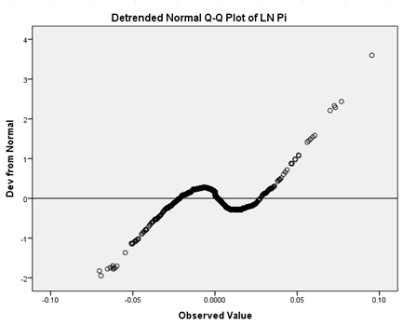
KINNEVIK ("B")		
LATOUR INVESTMENT AB ("B")	Financial Services (Sector)	Financials
LOOMIS AB ("B")	Support Services	Industrials
LUNDBERGFORETAGEN AB ("B")	Financial Services (Sector)	Financials
LUNDIN PETROLEUM AB	Oil & Gas Producers	Oil & Gas
MEDA AB ("A")	Pharmaceuticals & Biotechnology	Health Care
MEKONOMEN AB	Automobiles & Parts	Consumer Goods
MELKER SCHORLING AB	Financial Services (Sector)	Financials
MODERN TIMES GROUP MTG AB ("B")	Media	Consumer Services
NCC AB ("B")	Construction & Materials	Industrials
NIBE INDUSTRIER AB ("B")	Construction & Materials	Industrials
NORDEA BANK AB	Banks	Financials
PEAB AB ("B")	Construction & Materials	Industrials
RATOS AB ("B")	Financial Services (Sector)	Financials
SAAB AB ("B")	Aerospace & Defense	Industrials
SANDVIK AB	Industrial Engineering	Industrials
SCA AB ("A")	Personal Goods	Consumer Goods
SCA AB ("B")	Personal Goods	Consumer Goods
SCANIA AB ("A")	Industrial Engineering	Industrials
SCANIA AB ("B")	Industrial Engineering	Industrials
SEB 'A' SA ("A")	Banks	Financials
SECURITAS AB ("B")	Support Services	Industrials
SKANSKA AB ("B")	Construction & Materials	Industrials
SKF AB ("A")	Industrial Engineering	Industrials
SKF AB ("B")	Industrial Engineering	Industrials
SSAB AB ("A")	Industrial Metals & Mining	Basic Materials
SVENSKA HANDELSBANKEN AB ("A")	Banks	Financials
SWEDBANK AB ("A")	Banks	Financials
SWEDISH MATCH AB	Tobacco	Consumer Goods
SWEDISH ORPHAN BIOVITRUM AB	Pharmaceuticals & Biotechnology	Health Care
TELE2 AB ("B")	Mobile Telecommunications	Telecommunications
TELIASONERA AB	Mobile Telecommunications	Telecommunications
TRELLEBORG AB ("B")	Industrial Engineering	Industrials
VOLVO AB ("A")	Industrial Engineering	Industrials
VOLVO AB	Industrial Engineering	Industrials
WALLENSTAM AB ("B")	Real Estate Investment & Services	Financials
WIHLBORGS FASTIGHETER AB	Real Estate Investment & Services	Financials

APPENDIX 2: Normality Plots for Aggregate Data

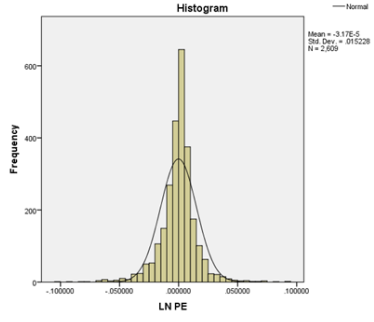
- Stock returns

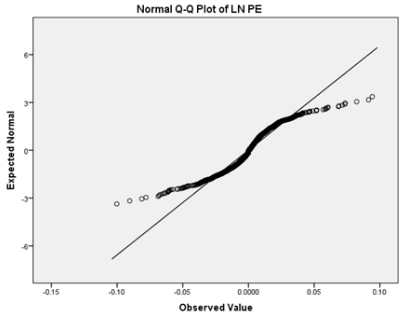


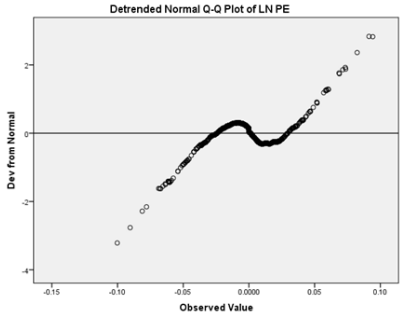




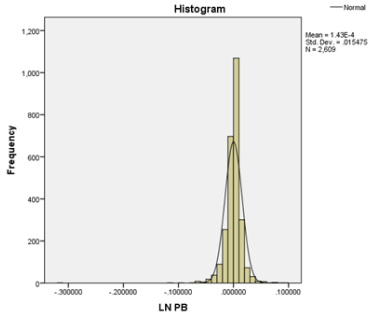
- P/E ratio

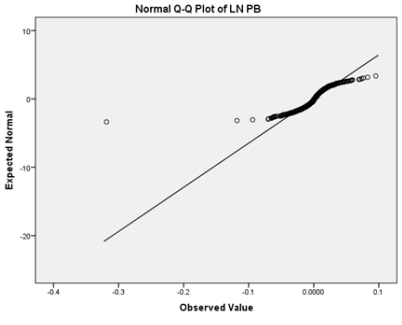


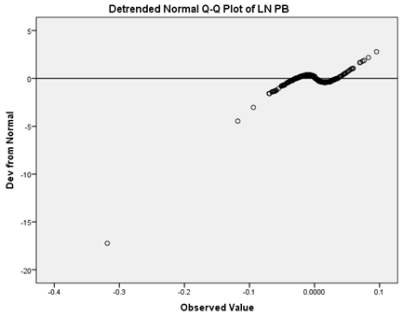




- P/B ratio



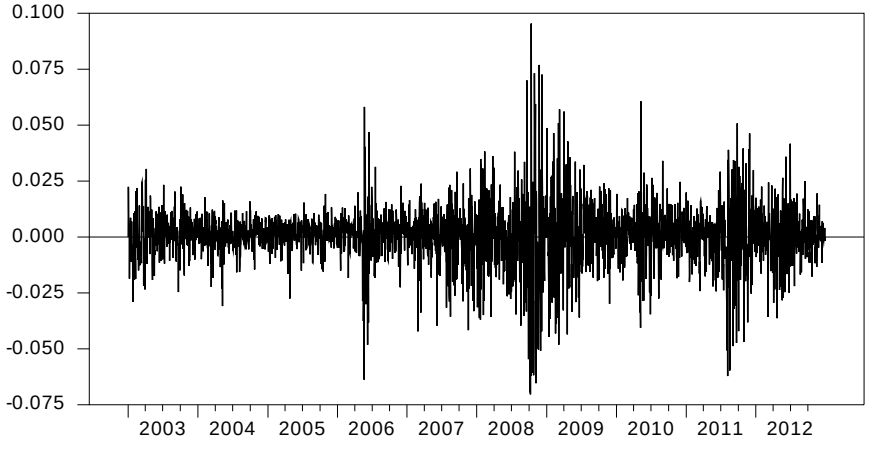




APPENDIX 3: The Graphs for the Logged Values

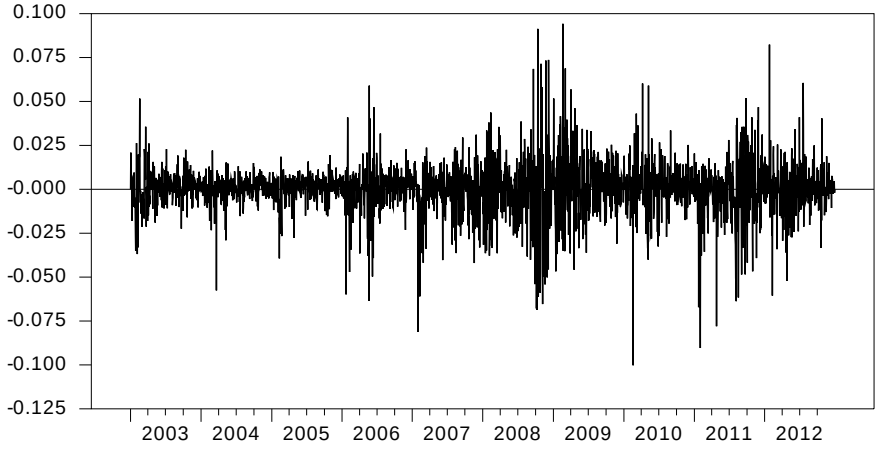
Logged values of the Stock Price Returns from 2003 to 2012

Across Industries



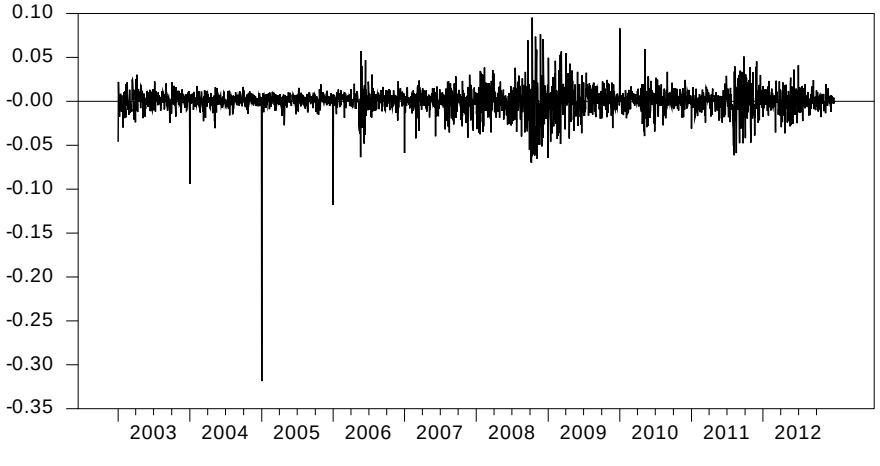
Logged values of the P/E Ratio from 2003 to 2012

Across Industries



Logged values of the P/B Ratio from 2003 to 2012

Across Industries



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