The Return Volatility Effect of Stock Splits

An Empirical Study Questioning Whether or Not a Stock Split is Merely a Cosmetic Accounting Change

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Sincerely,

Cecilia Nylander and Sandra Renberg

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Abstract

There are many possible explanations as to why management of a firm would declare a stock split. Many studies thus focus upon examining those explanations. There are also many studies that focus on what the effect of a stock split is. According to textbook theory a stock split should be of economic irrelevance for firm value. This because only outstanding shares increase and the value of the share decrease when a stock split is conducted, thus shareholder value should be constant.

Investors are of course concerned with shareholder value, but often they are also interested in receiving the highest return whilst taking on the least possible risk. With previous research suggesting that stock splits actually may have real effects on shareholder value and return volatility we wanted to investigate this relationship further. This lead to the following research question:

“Does a stock split affect stock return volatility of stocks listed on NASDAQ OMX Stockholm?”

The main research purpose of this study is to answer the above research question as well as examining if there are differences in effects depending upon the firms’ market capitalization. This is a quantitative study with a deductive approach and a cross-sectional and longitudinal research design covering historical data from 2002 through 2012. The study uses two different measures of return volatility, standard deviation and beta. The paired samples t-test, Wilcoxon Signed Ranks Test and binomial Z test are conducted in SPSS in order to empirically answer the research question.

The results indicate that there actually is a significant increase in return volatility, measured as both standard deviation and beta, in the post-split period. However, the findings also indicate that this increase is mainly attributable to the days closest after the stock split. When examining small and mid cap separately we found no significant difference in return volatility between the pre-split and post-split data. The stock splits conducted by firms in large cap on the other hand proved significant test results of an increase in the post-split period. The research question is concluded upon with yes, the findings indicate that a stock split is likely to increase the firm’s stock return volatility. Furthermore, that this increase is not continuous for a long period after the stock split but rather decreases or stabilizes close to its pre-split levels. The findings could possibly be argued to be explained by the liquidity hypothesis, agency theory, signaling theory, the optimal price/tick hypothesis and the procedure/structure hypothesis.
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Chapter 1 – Introduction

In this chapter we will first discuss the problem background as a way to introduce the reader to the research topic of this thesis. Secondly, we will present the research question and the research purpose. This will be followed by a discussion on the research gap within the research area and the research contribution as well as a presentation of the delimitations of the study.

1.1 - Problem Background

Each day we receive tons of information and much of the news centers around the world’s economy and its different stock markets. As an investor one receive constant information on the fluctuations of the stock market and sometimes the quotations vary significantly throughout the day. When the stock market is doing well usually the individual listed stocks follow the same development. After a period of high performance and unusually high returns for a stock a decision by management to conduct a stock split is often times the outcome. These stock splits are believed by most to be just a cosmetic accounting decision that has no direct cost or benefit attached to them (Grinblatt et al., 1984, p. 1). This is because a stock split is merely the division of outstanding shares and has no effect on the total value of the shares (Baker and Powell, 1993, p.20). For example, a stock split is often put in a scale such as 4:1 which means that every shareholder holding one stock before the split will be holding four stocks after the split. In other words, the stock will be four times cheaper after the stock split and the company will have four times more outstanding shares which imply that market capitalization, i.e. the value of the firm remains the same. Additionally, the firm’s future cash flow is not affected by the split.

According to Baker and Powell (1993) the motive behind a stock split has over time been strikingly consistent. It seems as the main motive is to increase the liquidity of the stock in order to better attract small investors. However, the notion that a stock split would increase its trading liquidity has been questioned as several studies indicate that trading liquidity actually decreases following a stock split. Other studies indicate that after a stock split the share price is more attractive for some investors and the pool of shareholders does increase, accordingly trading liquidity increases as there are more individuals buying and selling the stock (Baker and Powell, 1993, p.22). Baker and Powell gathered evidence from a survey of 136 managers in the US involved in the decision of stock splits and found that the main reason seemed to be to get the stock price into a better trading range. The second motive was to improve trading liquidity of the stock. Attracting investors and signaling optimism regarding the future were other important motives for conducting a stock split (Baker and Powell, 1993, p. 30).

Brennan and Copeland ask in their article from 1988 why then, if a stock split is merely a cosmetic accounting change, does it seem that both the declaration as well as the occurrence of a stock split actually are linked to real effects on returns? Many studies indicate that shareholder wealth is affected by a split and that abnormal returns are noted on the ex-date. Research also seems to indicate that stock splits are associated with stock risk (Brennan and Copeland, 1988a, p.83). One of the most prominent articles on this area is by Ohlson and Penman (1985) whom did a study on the effect of stock splits on return variances as a way to empirically examine the economic

1
irrelevance hypothesis. The economic irrelevance of shares outstanding basically entails that market value of the firm’s equity is not dependent upon how many shares a company has outstanding. Return variances before and after the ex-date of the split should theoretically, on average, show no differences. However, Penman and Ohlson (1985, p.251-252) find that return volatilities are significantly increased following the split and that this increase seems to be persistent over time. In a second article by Brennan and Copeland (1988b, p.1012) it was found that beta permanently increased following the ex-date. They also saw a temporary increase in the average beta both on the date of the announcement of a split as well as the actual split-date. These findings are consistent with Penman and Ohlsons’ findings.

If the market value of the firm’s equity is independent upon the total number of shares outstanding then we should expect to see no change in returns when the shares outstanding are decreased or increased. Accordingly, variances in those returns should on the average not have changed after a split. Thus, it is surprising that researchers seem to have a consensus that stock splits actually are associated to an increase in return volatility. Return volatility can be explained as ”...a measure of our uncertainty about the returns provided by the stock” (Hull, 2012a, p.303). Volatility can be measured in different ways but the most common one includes standard deviations of return and beta. Standard deviation measures how much of the change in the stock deviates from its mean on average whereas beta is measuring systematic risk. A beta of 1 implies that the stock is moving exactly in line with the market index, a beta of 2 will generate twice the returns as the index and a beta of 0,5 would generate half the returns of the index (Hull, 2012a, p.62).

When a firm’s stock price is rising the firm’s stock is performing well, thus resulting in higher stock returns. Large fluctuations in the stock prices indicate that the stock is volatile. Accordingly, investors are keen to be updated on the volatility of the different securities they own as, in the end, the value of the securities depend upon it. Therefore, what kind of information and events, such as a stock split, lead to volatility effects should be of interest to investors. Most research on this matter is however conducted mainly in the US with the exception of a few studies. Moreover, the studies examining the relationship between stock splits and a return volatility go a long way back, most studies are conducted in between 1980-1990. As far as we know, no similar study has been conducted on the Swedish market using updated data from the last 15 years.

1.2 – Research Question

Lots of previous research is focusing on stock splits. In theory, a stock split is not supposed to affect stock return, volatility or investor wealth in any way. It is only supposed to raise the amount of shares and lower the nominal value of each share an investor own. It has however been discussed whether this is true in practice, evidence seem to indicate that the economic theory of irrelevance is often violated. Thus, building on this contradiction, we developed this research question:

- Does a stock split affect stock return volatility of stocks listed on NASDAQ OMX Stockholm?

1.3 – Research Purpose

If we find that stock splits do affect volatility, this information is something that both
managers as well as investors will benefit from. If a stock split makes stock return more volatile, a manager might consider whether it is wise to do a stock split. An investor on the other hand, can deliberate whether it is worth holding a stock that is being splitted.

We aim to see if a stock split has an effect on stock return volatility. We will examine the Swedish market and will therefore use the companies listed on NASDAQ OMX Stockholm. The time span we will be using is the years 2002-2012. The purpose is to see if stock return volatility is significantly different after a stock split. Thus a pre-split period of return volatility will be compared with a post-split period of return volatility in order to discover if there is a significant difference. Since all research conducted in this field on the Swedish market is outdated, to our knowledge, we aim to see if old findings hold ground and if there has been a change in the effect a stock split has on volatility in later years. Market conditions are constantly changing and we are therefore curious to see if these changing conditions have had an effect in this matter as well.

Furthermore, we will also study whether there is any difference in stock return volatility following a stock split between small, medium and large companies on NASDAQ OMX Stockholm. The different sizes should have different trading activity and we are therefore suspecting that there might be differences in effect between these sizes. We especially expect higher trading activity in large cap than in small cap and therefore also a higher stock return volatility in large cap companies compared to small cap companies.

1.4 – Research Gap

In an efficient market, the stock return volatility should not change due to that a stock split has been conducted. However, in reality, the markets are not completely efficient. Because of this, we think it is interesting to know what happens to stock return volatility after a stock split. Studies like this have been conducted primarily on the U.S market. There are only a few studies similar to this that have been conducted on the Swedish market, however these are to our knowledge from the late 90s and hence rather old. The Swedish market differentiates from the U.S market in many ways. For example, trading liquidity may differ between the different markets as well as the size of investors and amount of institutional investors. The studies conducted in the U.S may not be very applicable on the Swedish market and our findings can therefore be highly interesting and of great use for investors and managers.

Moreover, most previous research dates back to the 80s and 90s. It is possible that things have changed since then and that findings that were true in the old days does no longer apply. Our study will generate more up to date results than most of the old studies on the issue that are existing today.

1.5 – Research Contribution

The contribution of our study is both practical and theoretical. We aim to provide a base for further theoretical research, since if we find that a stock split has an effect of stock return volatility, this is something that can be further explored. Practically, it will be of interest for managers and investors who should benefit from knowing whether stock return volatility is changing following a stock split.

Our research could be of use for managers when deciding whether to do a stock split or not. Our findings will inform them of what the consequences on volatility will be when
the stock split is conducted. With these facts at hand, it may be easier for management to make a decision of whether or not to go through with a stock split. Depending on what the company’s investors preferences are, management can make a decision using this study.

The study will also be of interest for investors since they often have preferences concerning the volatility of their stocks. If the findings show that stock splits possibly make stock return more volatile, investors who prefer to keep stocks with low volatility may sell off their stocks before a stock split is conducted or vice versa. If we find that a stock split does not affect stock return volatility it is still of interest for both managers and investors since they will then not have to be concerned with how volatility is affected when a stock split takes place. Our study has then eliminated a concern with stock splits.

Since we are only researching the Swedish market, this study will be applicable to the Swedish market. This particular research question has not previously been answered on the Swedish market, and is therefore of particular interest for us. The findings should then work as a base for researchers who want to explore this particular issue further in the future.

1.6 – Delimitations

This study is limited to the companies listed on NASDAQ OMX Stockholm since we are interested in finding out whether a stock split has an effect on stock return volatility on the Swedish market. Furthermore, this study will be limited to the years 2002-2012. Data from ten years will generate a sample that is large enough to see if there is an effect. It will also be trustworthy since the timeframe is long enough to exclude any misleading events. Moreover, since we found old studies from the 90s, we figured it would be a good idea to cover most of the 21st century. Only companies that have conducted a stock split will be included in the sample, since we are interested in what happens to return volatility following a stock split and not to compare to companies that have not done a stock split. Hence, companies that have not conducted a stock split during these years will be excluded from the sample.

We believe it is likely that the smaller the stock split factor is, the smaller the effect on volatility will be. In order to be able to see an effect, we will limit our study to companies that have conducted at the least 2:1 splits. Companies that have done smaller splits than that will be excluded from the sample.
1.7 – Disposition

Chapter 1: Introduction
In this chapter we will first discuss the problem background as a way to introduce the reader to the research topic of this thesis. Secondly, we will present the research question and the research purpose. This will be followed by a discussion on the research gap within the research area and the research contribution as well as a presentation of the delimitations of the study.

Chapter 2: Research methodology
This chapter will cover the research methodology of this study. First, it starts off with an introduction of how we decided upon the choice of subject followed by a short discussion on our preconceptions. Thereafter, we present our research philosophical positions, the research approach, the research method and the research design. By the end of the chapter we discuss the literature and data sources used and the reliability and validity of the research. The chapter concludes with a summary of the research methodology.

Chapter 3: Theoretical Framework
This chapter will introduce the theories and review the literature that are of relevance to answering the research question of the thesis. It starts with a short presentation of the stock exchange that is being examined in this study and then follows with an overview of the definition and meaning of a stock split. Thereafter, hypotheses that might explain the motivation behind stock splits are introduced including liquidity hypothesis, signaling hypothesis, optimal price/tick and procedure/structure hypothesis as well as a short section on information asymmetry. The chapter then continues with a presentation of important and relevant concepts such as return volatility, beta and standard deviation. The chapter concludes with a literature review on previous studies similar to this study.

Chapter 4: Practical Method
This chapter will present the practical method of this research. First we will describe the data collection process and thereafter the data frequency and time period will be explained. This is followed by an exploration of the sample data and the final sample size. Next, a section on the estimation process of the variables follows. Subsequently, the statistical analysis procedures are described and lastly, the hypotheses are presented.

Chapter 5: Empirical Findings
This chapter will first present descriptive statistics on the gathered data. This will be followed by a short section on the normality testing of the data. Then the empirical results from the paired samples t-test is presented, followed by the results from the Wilcoxon Signed Rank tests. The chapter continues with a presentation of the empirical results from the binomial Z tests performed. Finally, the chapter ends with a summary of the hypotheses testing.

Chapter 6: Discussion
This chapter will include a discussion of the empirical results in relation to previous research and the theoretical framework presented in chapter 3. The chapter starts off with an overall summary of the empirical results. It is then followed by an interpretation of the findings in relation to the signaling theory, the liquidity hypothesis, the optimal
price/tick, agency theory and the procedure/structure hypothesis. Lastly, the empirical results are discussed in light of the economic irrelevance theory.

Chapter 7: Conclusion
This chapter will go back to the research question and finally conclude upon it in light of the empirical findings. The chapter then continues with concluding comments on how the research purpose is achieved, the input to the research gap and the contribution of the research. The chapter ends with suggestions on how the study could be extended in further research.
Chapter 2 – Research Methodology

This chapter will cover the research methodology of this study. First, it starts off with an introduction of how we decided upon the choice of subject followed by a short discussion on our preconceptions. Thereafter, we present our research philosophical positions, the research approach, the research method and the research design. By the end of the chapter we discuss the literature and data sources used and the reliability and validity of the research. The chapter concludes with a summary of the research methodology.

2.1 – Choice of Subject

Both authors have studied the International Business Program at Umeå School of Business and Economics. Additionally, we have both chosen to study one more year to earn a Master’s degree in accounting. As such we have studied both finance and accounting at both bachelor’s and master’s level giving us an extensive academic knowledge base. Moreover, both authors have conducted internships abroad, in Brussels and San Francisco respectively, as well as studies abroad in France and in the US. Consequently, we have gained valuable academic as well as practical international experiences, within the field of business. Considering our backgrounds we have quite broad knowledge on the major financial and accounting theories and through our stays abroad we have also developed the necessary and appropriate language skills needed.

The choice of subject fell rather naturally for us. As both authors have the most knowledge, as well as interest, within the fields of finance and accounting we wanted to do something connected to those fields. Based on this, we decided upon a few criteria for our thesis. Firstly, we wanted to do a quantitative study. Secondly, we wanted to do it on a subject that we are interested in and feel quite confident about, but where we still have a lot to more to learn. We discussed a few other research subjects before finally deciding upon the subject of stock splits and its relationship with return volatility. As financial markets and corporate governance are both hot topics in today’s news coverage, especially after the recent turbulence in connection to the financial crisis, we felt intrigued to study what can have impact on volatility. We were further intrigued by the thought that something that is often known as a “simple accounting decision” could possible lead to financial consequences such as an increase in return volatility.

2.2 – Preconceptions

The way in which research is conducted can be influenced in many ways. Bryman and Bell discuss that issues on epistemological and ontological standpoints, which will be discussed further below, but also personal values, beliefs and experiences of the researcher can have an effect on the research. To keep a study entirely free of values is difficult, or impossible, but the researcher must try to be objective and minimize entering values into the research process (Bryman and Bell, 2011, p.30).

Thus, we want to proclaim our preconceptions. The underlying academic knowledge and theories that will be utilized in this study stems from our education on bachelor and master’s level within finance and accounting. We are also aware that the experience we have previously gained both academically and work-related might have an influence on our research. However, by staying aware of this fact we will limit that influence. Furthermore, the fact that our research is quantitative in nature and data is gathered
from reliable sources and analyzed with renowned statistical tools will aid us in remaining objective throughout the research process. Both authors also conducted quantitative studies for the first master’s thesis. As such, we have experience on the different pitfalls that may arise in the research process, which will be very valuable for us when conducting this study. Additionally, the conclusion of this research will be based upon empirical findings that should be generalizable, as such we minimize the risk of our preconceptions to influence the outcome of the research.

2.3 - Methodological Positions

There are two major methodological positions which are known as ontology and epistemology. It is essential for us as researchers to consider the research philosophical stances as it proclaims what we respect as knowledge as well as the way we perceive and look upon the world (Saunders et al., 2009, p.108). The stance we take on ontology and the stance we take on epistemology will affect our research process and thus they will be discussed in the following sections.

2.3.1 – Ontological Positions

According to Guba and Lincoln ontology asks the question of “what is the form and nature of reality and, therefore, what is there that can be known about it?” (Guba and Lincoln, 1994, p.108). In other words it should answer the question on how the researcher views reality and how he or she perceives the world to operate (Saunders et al., 2009, p.110). Ontology is concerned with whether social entities are made up of social actors and their actions, or if social entities in fact have a separate external reality beyond social actors (Bryman and Bell, 2011, p.20). Within ontology there are two main opposing stances, these are objectivism and constructionism.

Objectivism is the position within ontology that social entities exist apart from social actors and have an external reality (Saunders et al., 2009, p.110). Bryman and Bell (2011, p.21) give a good example on this. Think of a social entity such as a business organization. It can be viewed as a tangible object because it has rules and regulations, strategies and a mission statement and more. All these features also wield authority over the individuals within the organization as they need to comply with the rules, regulations, follow the strategy and strive toward the mission statement. If the employees do not comply they are at risk of losing their job. In that sense, the organization can be thought of to have a reality that is external to the individuals that populate it. Thus, because the organization has the characteristics of an object it also has an objective reality.

Opposite to the objectivistic view is subjectivism, which constructionism is part of. This view holds that “social phenomena” is the result of actions and perceptions of social actors and these phenomena are constantly evolving through social interaction (Saunders et al., 2009, p.111). This is an explicit contradiction to objectivism. Let us revisit the example of the business organization as a social entity given by Bryman and Bell. The view of constructionism would not acknowledge the organization as having an objective reality. Taking the constructionist stance would imply that the researcher would see the characteristics of the organization as dependent upon the individuals who work in it. Additionally, that these characteristics are constantly evolving due to the social interaction between these individuals (Bryman and Bell, 2011, p.22).
We, the authors of this study, have an ontological stance of objectivism. In order to answer our research question historical data and statistical analysis will be conducted. Thus, we will be able to base our conclusion upon objective empirical results. Clearly, we value objectivity as we believe it creates the most trustworthy research. The stance of constructionism would demand us to make subjective interpretations which we are not keen on doing as we feel it would bias the conclusion of the study.

2.3.2 - Epistemological Positions
What is considered or respected as acceptable knowledge, and how do we study the social reality (Saunders et al., 2009, p.113)? This is the question that epistemology tries to answer. Guba and Lincoln pose the question of epistemology as “what is the nature of the relationship between the knower or would-be knower and what can be known?” (Guba and Lincoln, 1994, p.108) and that the answer to it is dependent upon the answer given to the ontological question above. Bryman and Bell explain that as there are two opposing philosophy stances within ontology there are also two opposing stances within epistemology. These are known as interpretivism and positivism. These two positions of epistemology take on different opinions on how knowledge can and should be acquired, evaluated and accepted (Bryman and Bell, 2011, p.15-16).

Epistemology concerns what procedures and principles can and should be used when studying the social reality. Positivism is the stance within epistemology that proposes that the social world can be studied by using the procedures and principles of natural science. Bryman and Bell (2011, p.15) outline five principles of positivism. In short summary they include that phenomena need to be confirmed by the researcher’s senses to be knowledge. Moreover, that hypotheses should be developed from theories and tested in an empirical manner and that the foundation of new laws and new knowledge is created by the gathering of data. Additionally, following a positivistic stance imply that the research needs to be objective, that values should not affect the conduct of the research. Lastly, there is a distinction between normative and scientific statements.

In comparison, the opposing stance of interpretivism views natural sciences and social sciences as profoundly different. In other words, the researcher needs to go about and study the social world with different procedures and principles than the natural sciences’. Saunders et al. explain that “interpretivism advocates that it is necessary for the researcher to understand differences between humans in our role as social actors” (Saunders et al., 2009, p.116). In the interpretivistic view the researcher has to take on an empathetic attitude in order to fully understand the social world in which their research subjects live in and also try to see it from their point of view (Saunders et al., 2009, p.116).

We adopt the standpoint of positivism of epistemology in our research. We regard knowledge to be acceptable only when it can be confirmed. Furthermore, we will from theories develop hypotheses, collect data that we will empirically test by utilizing statistical tools in order to be able to accept or reject the hypotheses. Thus, our stance of epistemology is positivistic throughout the research process.

2.3.3 – Paradigms
The methodological positions of epistemology and ontology we have adopted can be better grasped by depicting them as four competing paradigms. According to Guba and Lincoln (1994, p. 105) a paradigm is the view or the belief system that guides the researcher in fundamental ways in epistemology and ontology as well as choices of
methods. The four paradigms are known as; functionalist, interpretative, radical structuralist and radical humanist.

Each of these paradigms reflects the different stances adopted on epistemology and ontology. In other words, they reflect the researchers view of the social reality and how the researchers will go about to study it (Bryman and Bell, 2011, p.24).

Each paradigm includes assumptions about objectivist versus subjectivist and assumptions about regulatory versus radical. Let us take an example of an organization to describe these assumptions given by Bryman and Bell (2011, p.24). Objectivist assumes that it is possible to have an external viewpoint of the organization whereas subjectivist assumes that an organization is only made up of the social actors inhabiting it and can thus only be understood by those actors. The assumption of either regulatory or radical answer to what the purpose of scientific research is. The regulatory assumption implies that the purpose of research is only to describe, or portrait, the organization. The radical assumption on the other hand implies that the researcher makes judgment of the organization and suggestions for improvement.

By plotting these assumptions on two axes we can identify the four competing paradigms. If the researcher makes the assumption of objectivist and regulatory the paradigm is functionalist. If the researcher instead is subjectivist and regulatory the paradigm is interpretative. The assumption of objectivist and radical make up the paradigm of radical structuralist, whereas subjectivist and radical is the paradigm of radical humanist.

<table>
<thead>
<tr>
<th>Assumptions:</th>
<th>Objectivist</th>
<th>Subjectivist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory</td>
<td>Functionalist</td>
<td>Interpretative</td>
</tr>
<tr>
<td>Radical</td>
<td>Radical Structuralist</td>
<td>Radical Humanist</td>
</tr>
</tbody>
</table>

Table 1 - The four competing paradigms

Source: By the Authors

As mentioned, we have a positivistic approach as well as an ontological stance of objectivism. This would imply that we are in the assumption of “objectivist” and “regulatory” as we only wish to describe the phenomenon of the possible effect a stock split can have on return volatility, we do not intend to make any judgment upon it. This implicitly means that this research process follows the functionalist paradigm. The functionalist is founded upon a problem-solving attitude which consequently leads to rational explanations (Bryman and Bell, 2011, p.24).

2.4 – Research Approach

When conducting a study, there are two research approaches to choose from: the deductive approach or the inductive approach (Bryman and Bell, 2011, p.11). While the deductive approach is mostly used together with a quantitative study, the inductive approach is most often used together with a qualitative research (Bryman and Bell, 2011, p.13). Which of these research approaches that is used depends on what type of study the researcher aim to conduct (Saunders et al., 2009, p.61). Saunders et al. further mention that a critical review of literature should be conducted in order to receive a base
to develop the research on. Why the literature is reviewed is however depending on which research approach is taken on (Saunders 2009, p.61).

A deductive research approach refers to when the researcher use theories that already exists to develop a hypothesis which then is tested using empirical findings (Bryman and Bell, 2011, p.11). When the hypothesis has been tested, it can either be rejected or accepted and finally the researcher will revive the theory (Bryman and Bell, 2011, p.11). More broadly speaking, it is reviewing literature and test theories found in this literature (Saunders, 2009, p.61) Ryan et al., (2002, p.147) mention that the deductive approach is what is most used in accounting and finance research. The last step of the process of the deductive theory actually includes a form of induction since the implications of the researchers own findings are inferred in this step (Bryman and Bell, 2011, p.13).

Bryman and Bell explain that the inductive approach is what is used when a researcher use their own findings to make up a theory. The theory is made up from a pattern of data that the researcher finds from the observations (Bryman and Bell, 2011, p.13). Saunders et al (2003, p.44-46) also mention that the framework is conceptual and that the theories are predetermined in the inductive approach. Saunders et al (2009, p.61) further explain that when literature is reviewed in the inductive approach, it is in order for the researchers to find something to connect their own theory to. Bryman and Bell (2011, p.13) mention that the inductive approach actually contains some elements of the deductive approach as well. They argue that a researcher might collect more data in order to see in which conditions theory holds.

In this research we will be using the deductive research approach since we are testing already existing theories that concerns stock splits and what happens to stock return volatility in the aftermath of a stock split. Rather than gathering data and observing whether we can find a pattern to develop our own theory, we are trying to see if an old theory is true or not. Hence, we can argue that we are using a deductive research approach.

**2.5 – Research Method**

There are two primary research methods to consider when developing a study: the quantitative and the qualitative research method. Barnham (2012, p.736) argues that the aim of these two methods are very different from one another and that both have
underlying approaches that are not alike. Lee (1992, p.87) states that these methods take different approaches and that those are based upon paradigms and philosophical assumptions. It is a common belief that the quantitative research method is the opposite of the qualitative research method (Bryman and Bell, 2011, p.387). These two research methods are quite distinguished from each other in many ways and this is probably what has led to this faulty assumption (Bryman and Bell, 2011, p.387). Although, it is interesting to know what the fundamentals of each research method are and this will be described below:

The qualitative research is more focused on words than on numbers (Strauss and Corbin,1998, p.11) Moreover, the qualitative research method often takes the epistemological position of interpretivism (Bryman and Bell, 2011, p.386). An ontological position of constructionism is also very commonly used in the qualitative research (Bryman and Bell, 2011, p.386). Hyde (2000, p.84) mentions that qualitative research tend to be more detail focused. That is, in qualitative research a sample that is rather small but detailed. One should be careful not to assume that qualitative research solely is generating theories, since there are researches where a qualitative study has been used to test theories as well (Bryman and Bell, 2011, p.27).

Quantitative research can be thought of as: “...a research strategy that emphasizes quantification in the collection and analysis of data...” (Bryman and Bell, 2011, p.26). The quantitative research method is rather taking a natural science model of the epistemological position, especially the epistemological position of positivism (Bryman and Bell, 2011, p.386). The quantitative method also most often takes a more ontological position of objectivism (Bryman and Bell, 2011, p.27). Bryman and Bell further mention that when the research is focusing on generating new theories (inductive approach) it is most often a qualitative research method that is used. When existing theories are tested (deductive approach) the researcher is most often taking a quantitative research method. Bryman and Bell (2011, p.150) point out that what distinguishes quantitative research from qualitative is not only that it quantifies aspects of social life. They mention that since they have a different epistemological and ontological positions, the quantitative research is concerned with more than only numbers.

It is, as mentioned, a common mistake to believe that the quantitative and the qualitative data are each other’s opposites. However, since they differ from each other in many ways it can be interesting to see how they contradict. The below table shows the most important features with each method and it also gives a clear view of how they differ from each other.

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>Words</td>
</tr>
<tr>
<td>Point of view of researchers</td>
<td>Point of view of participants</td>
</tr>
<tr>
<td>Researcher distant</td>
<td>Researcher close</td>
</tr>
<tr>
<td>Theory testing</td>
<td>Theory emergent</td>
</tr>
<tr>
<td>Static</td>
<td>Process</td>
</tr>
<tr>
<td>Structured</td>
<td>Unstructured</td>
</tr>
<tr>
<td>Generalization</td>
<td>Context understanding</td>
</tr>
<tr>
<td>Hard, reliable data</td>
<td>Rich, deep data</td>
</tr>
<tr>
<td>Macro</td>
<td>Micro</td>
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<tr>
<td>Behavior</td>
<td>Meaning</td>
</tr>
<tr>
<td>Artificial setting</td>
<td>Natural setting</td>
</tr>
</tbody>
</table>
As our research focuses on trying to find out whether a stock split could have an impact on stock return volatility to change, we are mainly concerned with numbers. As already mentioned, a deductive research approach will be used since our hypotheses are developed from already existing theories. The ontological position of objectivism will be taken in this research and so will the epistemological position of positivism. Furthermore, the study will be more general than focused on minor details. Building on this we can conclude the quantitative research method will be used in this study. The research method that will be used in our study is best described as a quantitative research method considering the above standing characteristics. Also, answering our research question using a qualitative research method would be rather problematic.

2.6 - Research Design

The research design explains how the researcher is going to answer the research question (Saunders, 2009, p.136). The research design describes how a researcher will prioritize in the research process, but also how the researcher will collect and analyze data (Bryman and Bell, 2011, p.40). There are five types of research designs that are most common. These are (Bryman and Bell, 2011, p.45-63):

- **Experimental Design**
  When this design is used, an experiment is included in the research. This kind of research design is not often found in business research. However, when it is being used, it generates very trustworthy results.

- **Cross-Sectional Design**
  In a cross-sectional design, a specific point in time is looked at and the researcher is trying to find a pattern among the data that is gathered. This data consists of two or more variables and can be either qualitative or quantitative.

- **Longitudinal Design(s)**
  Changes over time are best studied using the longitudinal design (Saunders et al., 2009, p.155). Bryman and Bell (2011, p.57-58) also mention that the longitudinal design is what is used in management and business research in order to see changes over time.

- **Case Study Design**
  The case study design refers to when the researcher studies one case in detail. This design is often used in business research and examples of this kind of research are a study of a single event or a single organization.

- **Comparative Design**
  Comparative design refers to when similar methods are used to observe two or more cases that oppose each other. “This design is used to understand a social phenomenon better as its relation to contrasting cases is compared” (Bryman and Bell, 2011, p.63).
For our research we will foremost use the longitudinal design since we are looking at more than one point in time. It will also include some elements of the cross-sectional design as well since we are examining a relationship between two variables, but because we are looking at changes over time we cannot say that this study is purely cross-sectional. We will collect data throughout the years 2002-2012 and see if there is a change in stock return volatility as a stock split has taken place. When we examine if there is a difference between small, medium and large cap companies we are using solely the cross-sectional design since we are then comparing the different sizes at one point in time.

2.7 - Literature and Data Sources

In this study mostly secondary data and literature sources will be utilized, however mostly accessed through tertiary sources. Secondary literature refers to for example books and journals, whereas what constitutes primary literature is when the piece of work first originated, for example a thesis or a report (Saunders et al., 2009, p.69). Furthermore, Saunders et al. explain that there are also tertiary sources which are sometimes called “search tools” and can assist in finding information on a topic or to gather primary and secondary literature, for example an encyclopedia or an index.

The secondary sources and literature used for this research is mainly published articles in academic journals relevant to our research area. Additionally, textbooks on concepts and definitions will also be used. Furthermore, official data on stock splits and stock returns will be gathered from databases. Through Umeå University’s library we have access to a Business Source Premier, a tertiary source, through which we have been able to collect published academic articles of interest. A few articles have also been accessed through Google Scholar that were not accessible through Business Source Premier. To find the relevant articles for this study the main keywords included but not limited to were: stock split, volatility, return variance, return volatility, economic irrelevance, signaling hypothesis, liquidity, beta, information asymmetry.

Additionally, we have gathered the necessary information and data on stock splits and stock returns from Thomson Reuters DataStream which we have access to through Umeå University’s library.

By utilizing secondary literature and tertiary sources for our research we gain many benefits. Bryman and Bell (2011, p.313-320) discuss some of these. Firstly, secondary data is less costly and less time-consuming to. We can access secondary data of high quality directly through various databases whereas gathering first-hand information and data as a primary source would be extremely resources demanding. Secondly, by using secondary sources much time is freed up which could be used for more thorough data analysis. Thirdly, by the use of secondary literature such as official data the reliability of the data is usually high, which subsequently increases the reliability of the research.

However, there can also be limitations with using secondary literature as explained by Bryman and Bell (2011, p.320-321). For example, it can be difficult to familiarize with the data as it sometimes can include a very high volume of data and thus be highly complex. To manage a vast amount of complex information can therefore be a challenging task. Additionally, just as the quality of the information can be a benefit
when using secondary sources it could possibly also be a drawback in the cases where data is not gathered from regulated or otherwise trustworthy sources.

In our opinion we find the benefits to outweigh the drawbacks as we argue that they can quite easily be overcome. We do this by critically reviewing the sources we use in this study. We evaluate them on relevance and look for possible bias, also important is that the articles we use are published in academic journals. Moreover, the data we need to conduct this research, information on stock splits and stock returns of firms listed on NASDAQ OMX Stockholm, will be collected through Thomson Reuters DataStream. We deem Thomson Reuters DataStream to be a highly trustworthy source as it is a very acknowledged and acclaimed database.

From the above discussion we find that the possible limitations that come with using secondary sources are not a problem for this research. Rather, we find only benefits to utilizing secondary sources as it is the most suitable for answering our specific research question.

2.8 – Validity and Reliability

Validity and reliability are important in research. If a research would have neither reliability nor validity, the results of the study would not be usable. Lacking these two fundamental elements would make the research worthless since it does not provide the reader with trustworthy results.

2.8.1 – Reliability and Replicability

When talking about reliability, it is referred to whether a researcher could do the same study all over again and obtain the same results (Bryman and Bell, 2011, p.41). Bryman and Bell (2011, p.41) mention that a researcher that is conducting a quantitative research should be concerned with the stability of a measure. They take as an example an IQ test that has been conducted. The result of this IQ test differs on different occasions for the same person. Hence that IQ test cannot be considered reliable.

Stability, internal reliability and inter-observer consistency are the three factors that are of particular interest when deciding if a research is reliable (Bryman and Bell, 2011, p.158). Stability refers to whether the same results would appear if the study was remade another time (Bryman and Bell, 2011, p.158). Internal reliability refers to whether the scale indicators are consistent and the inter-observer consistency refers to how consistent the observer’s decision is (Bryman and Bell, 2011, p.158). Reliability has been found very important in business research (Bryman and Bell, 2011, p.41).

Another issue that is important to consider when conducting a research is replicability. It is crucial that a researcher describes how the study has been conducted in detail, that in order for the study to be replicable (Bryman and Bell, 2011, p.41).

2.8.2 - Validity

Validity can be thought of as whether the integrity of the conclusions that appears in the research (Bryman and Bell, 2011, p.42). Saunders (2009, p.157) mentions that there is validity when the results are what they are believed to be. Validity can also be referred to whether the researcher has chosen the right indicator to measure a concept (Bryman and Bell, 2011, p.159). Two kinds of validity should be taken into account when conducting a research. It is the internal validity which refers to the fact that the results are caused by the variable that is being researched and not by some other variable (Bryman and Bell, 2011, p.42-43). For example, if we think A is causing B, are we
really sure that it is $A$ that causes $B$ and that it is not some external variables that makes it seem that $B$ is caused by $A$? (Bryman and Bell, 2011, p.42-43). External validity refers to whether the findings are generalizable. That is, if they can be used in another context as well. (Bryman and Bell, 2011, p.42-43). Bryman and Bell (2011, p.43) mention that it is because of the issue of generalizability important for the research how organizations or people are chosen for the study. They further mention that researchers that are conducting a quantitative research strive for a representative sample, and the reason for that is the external validity.

The indicators we have used in this study will not change and is consistent over time. Hence, if the study should be repeated, the same results would appear. The indicators, stock splits and stock return volatility from 2002 through 2012 will not change in the future and we can therefore conclude that the results will be consistent if the study were to be conducted again. We are also focusing on not letting our assumptions getting in the way and rather being objective. To gather data, we are using the well known and reliable Thomson Reuters Datastream and the statistical tests are conducted in SPSS, a trustworthy statistics program.

If we find evidence that indicate that stock splits leads to a change in return volatility we cannot be completely sure that the research holds internal volatility. Thus, one should be careful when interpreting the results. We cannot for sure say that stock splits cause changes in volatility as there may be other factors at play. When it comes to the issue of whether our research is generalizable, we argue that we are studying the Swedish stock market and thus mainly generalizable to that market. Although, this might study might also apply on markets that are similar to the Swedish.

### 2.9 - Ethical & Societal Issues

In this section the potential and relevant ethical and/or social issues will be discussed as these might have an effect on research integrity (Bryman and Bell, 2011, p.122). According to Diener and Crandall (1978, p.3) ethics is not just prohibiting researchers in their research process, rather ethics supports them to uphold responsibilities. Moreover, ethics are those guidelines that support the researcher in adhering to values and making the research conforming to those values as well. Four particular areas of concern have been identified by Diener and Crandall (1978, p.17-96) regarding ethical issues. They are; harm to participants, invasion of privacy, informed consent and deception. We find these to be more related to qualitative research, and especially if there is a relationship between the researcher and research participants. As we do not have any research participants these main concerns of ethical issues are not relevant to this study.

Aside from these issues there is also a need for honesty and accuracy. At times a researcher might feel compelled to fake or in any other way alter the data because they feel pressed to “produce” significant results (Diener and Crandall, 1978, p.151-152). We have no motivation to alter or fake the data, nor to report only certain results, in this research as we are aware of the demoralizing consequences that could have on the reliability of the research, and on science overall. Moreover, the collected data that is utilized in this study as well as the different results of the statistical tests performed is upon request, available for the public.
There is also a potential ethical issue concerning data management and copyrights. According to Bryman and Bell (2011, p.139) the main concern with data management is whether the collected data is actually used for the research purpose or if there is some hidden agenda that it will be used for. As we are conducting a quantitative study with hard, numerical data stemming from official databases this issue is not a concern. Regarding copyright this should not be an issue either. We are collecting the information needed for this study through official databases and academic journals. That is, only from sources that are available to the public. Moreover, we are aware of the importance of referencing our sources.

Another ethical as well as social issue could be affiliation, which could surely wreck the credibility of any research. This study is completely independent, we have no affiliation with any organization nor do we receive any funding to conduct this research.

We would also like argue that this study can contribute in a societal way. This because we aim to add new knowledge to the research area that should be of interests for social actors such as company management and investors. New information on the relation between stock splits and return volatility on the Swedish stock market could be of high relevance for these actors. By increase the knowledge pool for investors they have more information when making investment decisions and management will have more information to aid them in the decision of accounting changes such as a stock split. Thus, society can benefit by being aware of the relation between stock splits and its possible impact on return volatility.

Finally, we would like to stress the fact that both authors of this study have studied many courses that included ethical considerations and elements of research. As such, we deem that we have sufficient and appropriate knowledge to be able to conduct research in an ethical manner.
2.10 - Summary of Research Methodology

In order to get a better comprehension on the research methodology of this thesis we have included a figure which should also give a better overview.

Figure 2 - Summary of Research Methodology
Source: By the Authors

First, we have the fundamental methodological stances of research philosophies. Our ontological position is objectivism and our epistemological position is positivism. As such, we perceive that there exist an external reality of the social reality that is not dependent upon social actors. The research have a deductive approach since we are building hypothesis from already existing theories in order to test them and revive theories. Furthermore, the study follows a quantitative method as this is best suitable to answer the research question. Additionally, the research design is longitudinal but also includes a hint of cross-sectional design.
Chapter 3 – Theoretical Framework

This chapter will introduce the theories and review the literature that are of relevance to answering the research question of the thesis. It starts with a short presentation of the stock exchange that is being examined in this study and then follows with an overview of the definition and meaning of a stock split. Thereafter, hypotheses that might explain the motivation behind stock splits are introduced including liquidity hypothesis, signaling hypothesis, optimal price/tick and procedure/structure hypothesis as well as a short section on information asymmetry. The chapter then continues with a presentation of important and relevant concepts such as return volatility, beta and standard deviation. The chapter concludes with a literature review on previous studies similar to this study.

3.1 - NASDAQ OMX Stockholm

The official name of what is maybe most known as the Stockholm Stock Exchange is NASDAQ OMX Stockholm. This is the primary stock exchange in Sweden where most trade of securities occur. NASDAQ OMX Stockholm is part of NASDAQ OMX Nordic which also includes the stock exchange of Copenhagen, Helsinki and Iceland (NASDAQ OMXa, 2014).

The stocks listed on NASDAQ OMX Stockholm are divided into three segments depending upon market capitalization of the firm. The segments are small cap where firms with market capitalization of less than 150 million euro are listed, firms with market capitalization between 150 million to 1 billion euro are listed in the mid cap segment and finally firms with a market capitalization above 1 billion euro are in the large cap segment (NASDAQ OMX, 2014b). The number of stocks listed on the NASDAQ OMX Stockholm fluctuates and there is often more stocks than firms listed due to some firms having both A and B stocks.

There are a few other, much smaller stock exchanges in Sweden but the main market for trading is NASDAQ OMX Stockholm. Thus, it is natural to investigate the Stockholm Stock Exchange as most listed firms are in that exchange. Moreover, important for us is to have a valid and large enough index as to be able to compare return volatility against. NASDAQ OMX Stockholm provides this, namely OMX Stockholm PI (OMXSPI). This is an index also called “Stockholm all-share” as it weighs together the common value of all stocks listed on the exchange, which gives a good overview of the development of the Stockholm Stock Exchange (Avanza, 2014).

3.2 - Stock Splits

A stock split is basically equivalent to a stock dividend and is most often preceded by a period of high increase in stock price and earnings (Cheng, 2008, p.89). Berk and DeMarzo explain that a stock split is essentially a stock dividend of 50% or higher, and below 50% it is considered a stock dividend. Usually a stock split is not referred to with a percentage but rather a split factor. For example, if management declares that a 3:2 stock split (which equals 50%) will be conducted it means that for each two shares owned a third share will be received (Berk and DeMarzo, 2013, p.612).
Since a stock split does not generate any cash in or out of the firm, the market value of the firm’s equity should stay constant. What changes is the number of outstanding shares which increases and the value per share will decrease due to the increase in shares (Berk and DeMarzo, 2013, p.614). Moreover, this also implies that the investor’s fractional ownership of the firm’s equity and votes is constant after the split as before (Conroy and Harris, 1999, p.28).

There are a few different dates that are attached to stock splits and the research regarding it. First is the announcement date which is typically around 45-75 days before the split actually takes place (Cheng, 2008, p.95). The ex-split date is the day the actual split occurs. In between the announcement date and the ex-split date is also the record day. These dates can have an effect on the trading conditions and can cause inconveniences. For example buying shares between the record day and the ex-split date causes an obligation, known as a due bill, upon the seller to remit new shares to the buyer when received (He and Wang, 2012, p.137).

Grinblatt et al. (1984, p.1) explain that the common view on stock splits are that they are just an accounting change that have no direct effect, no direct cost and no direct benefit. Also Berk and DeMarzo (2013, p.614) highlight that there is no real consequence to a stock split, neither from the firm’s perspective nor from the shareholder’s. However, as mentioned in the problem background, research seem to indicate that this “basic accounting change” actually do have an effect both on shareholder wealth as well as return variances (Brennan and Copeland, 1988, p.83-84).

3.3 - Motivation behind Stock Splits

Why would a firm choose to do a stock split if the firm value does not, in theory, change? There could be many reasons for this including to send a positive signal, to increase liquidity, to increase trading activity, to reach the optimal tick size and more. These concepts will be explained further here below.

3.3.1 – Signaling Theory

He and Wang (2012, p.132) explain that the signaling hypothesis says that an announcement of a split carries inside information about future performance to investors on the outside. They further mention that a split is thought of as a positive indication for the future whereas a reverse split is a negative indicator. Grinblatt et al., (1984, p.461-462) refers to a stock split as a “cosmetic accounting change”. That is, in theory the cash flow of the firm should not change due to a stock split itself.

He and Wang (2012, p.132) argues that in order for a signal to be credible to investors, it has to be connected to a cost of some kind. They say that if the signal is not connected to a cost, any company, no matter their expectations for the future, would be able to conduct a stock split and send a signal of a positive outlook to the market at any time. Bechmann and Raaballe (2007, p.576) found that if a stock split announcement is combined with an announcement of an increase in dividends, the announcement effect is much higher than if there is only an announcement of stock splits. That is, the announcement effect is significantly lower when it is not associated with a cost in retained earnings (dividends).
Grinblatt et al., (1984, p.461) found that stock split announcements affects stock prices positively. They mention that around the ex-date of a stock split, the excess return was significantly more positive.

Grinblatt et al., (1984, p.463) mention that a stock split should carry no information regarding future earnings since no costs can be associated with the event. Although, Grinblatt et al., (1984, p.464) argues that there are more than one possible outcome associated with the signaling effect following a stock split. They say that if investors face a false signal, the company’s reputation might be damaged which may lead to indirect costs. They also mention that it is possible that another outcome may be that a stock split draws a lot of attention which makes market analysts reassess the firm’s future cash flow. For companies that are underpriced, this is of course great while companies that are overpriced would rather want to avoid it (Grinblatt et al., 1984, p.464). One of the reasons as to why a company would choose to convey information using a stock split rather than having an ordinary press release might be that they want to keep information away from competitors (Grinblatt et al., 1984, p.464). Grinblatt et al. further mention that it might also be that management risks getting the blame if this directly communicated information is faulty. Moreover, it might also be that management does not intend to signal anything to the market but rather split in order to have stocks that are priced within the customary trading range.

McNichols and Dravid (1990, p.857) hypothesized that managers might signal their private information through stock splits. They conducted three different tests in order to test this hypothesis. In their study they also assumed that their managers wanted their shares to be traded in a special price range. First, they tested whether the choice of split factor was based upon inside information. They found that this is indeed true. Managers do use inside information when choosing the split factor (McNichols and Dravid 1990, p.857). The second test McNichols and Dravid conducted was in order to examine the announcement returns and split factor signal association. They found that the association between these two was strong. This indicates management’s belief about the value of the firm can be associated with the split factor choice. In their third test, McNichols and Dravid find that investors do view announcements of a stock split as a signal of how profitable the firm will be in the future. This is found due to the correlation between announcement returns and earnings forecast errors (McNichols and Dravid 1990, p.857).

Ariff (2004, p.176) examined the Singapore market for evidence of the signaling theory. He found, as many other previous researches, that there is a positive and notable response to stock split announcements. Moreover, he found that there was a difference between the companies that had increased dividends or earnings in the year following the announcement of a stock split compared to those that had not. With these findings in hand, he concluded that a signaling effect exists (Ariff 2004, p.176).

3.3.2 - Liquidity Hypothesis
Baker et al. (1995) write that the liquidity hypothesis proposes that by increasing the number of shares traded whilst proportionally decreasing the bid-ask spread will increase liquidity. According to this hypothesis, by conducting a stock split the share becomes more attractive to investors due to the lowered share price. Consequently, enhanced liquidity then arises due to either increased trading or an increased number of shareholders (Baker et al., 1995, p.29).
There are however studies that have found that market liquidity increases following a stock split, but some studies have also found that market liquidity decreases (He and Wang, 2012, p.131). The liquidity improvement argument says that splits lowers share prices, increases the base of ownership, increase the amount of trades and makes the market more liquid (Baker and Gallanger, 1980 cited in He and Wang, 2012, p.131).

Han (1995, p.159) found that when a reverse split was conducted, the bid-ask spread would decrease and trading volume would increase. He also found that the amount of non-trading days declined notably. This was however not found among the control firms. On the contrary, the liquidity reduction argument says that an increase in transaction costs and the bid-ask spread and a decrease in trading volume appear after a stock split (He and Wang, 2012, p.131).

As stated, the evidence provided by empirical research on the liquidity effects diverges. It is still unclear whether or not a stock split actually do increase or decrease market liquidity (He and Wang, 2012, p.131) Copeland (1979) and Lamoreux and Poon (1987) found that stock splits can reduce shareholder liquidity. Lakonishok and Lev (1987) on the other hand found an increase in trading volume in the time nearby the stock split. Also, Maloney and Mulherin (1992) provided evidence of higher number of shareholders and an increase in trading following stock splits.

If liquidity actually changes due to a stock split it could be argued to indirectly contradict the economic irrelevance a stock split is assumed to have. If a stock split is an event that is only cosmetic no real effects should be detected.

3.3.3 – Optimal Price/Tick Hypothesis
The optimal price/tick hypothesis says that “...for a given stock both the price and the relative tick size have an optimal range” (He and Wang 2012, p.125). He and Wang further explain that the tick size is the minimum movement in price divided by the price of the stock. Moreover, He and Wang further discuss that a company which is experiencing a stock price that is too high and a tick size that is too low, should benefit from conducting a stock split since that could bring the stock price and the tick size back to what is optimal. Companies that have a stock price that is too low and a tick size that is too high could instead conduct a reverse stock split to bring back these two to their optimal level (He and Wang 2012, p.125). Koski (2007, p.219-220) mentioned that for companies that do a reverse stock split, the average price before the split is $1.21. Koski (1998, p.147) argues that for companies that conducts a regular stock split, the stock price before the split is on average $50 and after the split, the price on average lies around $28. Angel (1997, p.655) mentioned that on average, the price of a stock in the US sells for $40, in London, the average stock sells for £5 and in Hong Kong for about $2. Hence, he argued there is an average price covering all stocks in a market. Thus, an optimal trading price seems to exist (He and Wang 2012, p.125).

Lakonishok and Lev (1987, p.925) found that four years before a split, splitting companies have much higher stock prices than the non-splitting companies. They argue that this price gap between the splitting company and the non-splitting company continues to increase until the splitting company conducts its stock split. Thereafter, the price gap decreases and is completely eliminated four months after the stock split (Lakonishok and Lev, 1987, p.925). It can therefore be assumed that the split is conducted in order to make prices decrease to an acceptable level so that they are more in line with average prices at a more normal level (Lakonishok and Lev, 1987, p.925).
It has for a long time been assumed that a company that conducts a stock split gains a broader base of shareholders since the number of investors increases (He and Wang, 2012, p.129). He and Wang further mention that it is possible that a company is trying to move itself within a trading range that generates more investors. They also hypothesize that it is possible that analysts become more interested in a company that has a larger base of investors and hence the awareness increases the firm value (He and Wang, 2012, p.129). Brennan and Hughes (1991, p.1685) mentioned in their study that the amount of information from analysts following the ex-date would increase. They further mentioned that due to the fact that the amount of information that is streaming from analysts increases, volatility might increase as well as the bid-ask spread and the amount of shareholders.

3.3.4 - The Procedure/Structure Hypothesis

The procedure/structure hypothesis examines features of stock split procedures, the regulations affecting stock splits as well as the market structure of trading in relation to splits (He and Wang, 2012, p.136). Furthermore, they argue that the procedure/structure hypothesis is important because it explain the following (He and Wang, 2012, p.136-139):

1. Why, between the announcement day and the ex-split day, the return is positive  
2. Why, on the record day, the return is negative  
3. Why, on the ex-split day, the return is positive  
4. Why, after a split, the bid-ask spread percentage is larger  
5. Why, after the ex-split day, volatility is higher  
6. Deregulating prices through a split

1. A stock split works as a positive signal of future returns for the company. Investors are however rather slow to incorporate this positive signal and it is not until between the announcement day and the ex-split day that a positive abnormal return is discovered. The procedure/structure hypothesis ascribes this slow incorporation of new information to market frictions.

2. The negative return that investors experience on the record day is due to inconveniences that are connected to trading. These inconveniences are consistent with the procedure/structure hypothesis. These inconveniences emerge because of the procedure of the trading of the old stock (un-split shares) between the record day and the ex-split date which have attached due bills to them. Thus, this procedure leads to negative returns on the record day.

3. If the market was efficient there should be no price effect on the ex-split date as there is no new information, although this is not the case as empirical evidence indicate abnormal returns on this date exist. The procedure/structure hypothesis assumes that this is the result of a tax effect, microstructure of the market, and an effect of the inconveniences on the record day.

4. A stock split result in a lower share price, thus at the same time increasing the relative tick size and percentage bid-ask spread. Consequently, the higher percentage in bid-ask spread can be explained by the “spread setting function of market makers”. Huang and Weingartner (2000, p.124) found that the spread setting behavior does not change due to that a company splits their stocks to the optimal price. Thus, the higher percentage bid-ask spread is just the consistent outcome of what would be expected in the new, lower price range.
5. When-issued trading is a feature of a split, and the procedure/structure hypothesis bases its explanation for higher volatility after the ex-split day on this feature. There seem to be a period of lower volatility due to when-issued trading (trading after the record day but before ex-split day) before the ex-split day. Basically, two markets of shares is then available; when-issued shares which trades at post-split level and un-split shares at pre-split level. When-issued shares typically attracts small-volume investors. Comparing a firm who trades with both un-split and when-issued shares with a firm which does not, volatility is lower (for both kind of shares) in the former firm. Volatility then increases because after the split the small-volume traders revert to trading in “the regular way”, subsequently volatility increases.

6. Market structure changes, such as a reduction in regulation of the minimum par value of a share, is found by empirical evidence to often be followed by a stock split. The split in such a situation seems to be a means to attract smaller investors and reach a new optimal price range as a consequence of the deregulation. This supports the procedure/structure hypothesis.

3.3.5 - Agency Theory and Information Asymmetry
According to the agency theory, managers are the agents hired by shareholders who are seen as principals to maximize shareholder value. Agency costs might arise because there is a divergence between managements’ interests and shareholders’ interests, and the shareholders feel the need to monitor management (Jensen and Meckling, 1976, p.308). Agency costs are closely related to information asymmetry, which means that managers might have more information on the future outlook of the firm than shareholders do (Berk and DeMarzo, 2013, p.564). The more information asymmetry the shareholders feel there is, the higher the need for monitoring the behavior of management and thus the higher the agency costs becomes.

Cheng (2008, p.108) present results from 30 years of Canadian data which suggest that managers can effectively announce positive inside information and their expectations to the outside shareholders by declaring a stock split. Thus, reducing the gap of asymmetric information and increasing the value of the firm in the long term (Cheng, 2008, p.108).

If empirical results show a change in risk following a stock split it could be explained by the informational effect. It could be that shareholders believe that managers know more than themselves, subsequently causing the stock return to become more volatile.

3.4 - Economic Irrelevance Theory
As already mentioned, stock splits are thought only to have a cosmetic effect on accounting (Grinblatt et al., 1984, p.461-462). Miller and Modigliani’s irrelevance theory goes hand in hand with this view and is therefore of particular interest for our research.

DeAngelo and DeAngelo explain that Miller and Modigliani’s irrelevance theorems refers to that “…in frictionless markets with investment policy fixed, all feasible capital structure and dividend policies are optimal because all imply identical stockholder wealth and so the choice among them is irrelevant” (DeAngelo and DeAngelo, 2006, p.294). That is, they mean that it is only the investment policy that is relevant for the wealth of the stockholder, if the market is frictionless. Payout decisions and leverage does not affect the value of the firm in any way.
Millar and Fielitz (1973, p.35) mention that, although there are contrary opinions, some believe that stock distributions only convey information about variables such as dividends or earnings. When a stock split is conducted, the par value decreases and the amount of shares outstanding increases, but that is the only change a stock split causes. Millar and Fielitz (1973, p.35) argues that assets are not affected and therefore neither is production efficiency. Also, they say that long-term debt, interest charge, preferred stocks and its dividend stays unaffected as well. Thus, financial leverage, total equity and pro rata ownership is neither changed. With this in mind, stock splits or dividends should not influence market value (Millar and Fielitz 1973, p.35).

Dowen (1990, p.927) mentions that stock splits or dividends are shifting the demand curve and a new price level is reached. He also mentions that this new price level is proportional to the old one. The company that is conducting a stock split or distributing dividends cannot change its market value just by changing the amount of shares outstanding (Dowen, 1990, p.927).

3.5 - Volatility Measures

3.5.1 – Volatility
As one of our key variables in this study is volatility, we will examine this variable further and introduce different ways to calculate volatility. If an investor had the choice either to hold a stock with low volatility and high possible return or a stock with high volatility and high possible return, the investor would in all cases choose the stock that has low volatility and high possible return. The rule is however that the more volatile a stock is, the higher is the possible return and vice versa.

As mentioned earlier, volatility is a measure of risk. A lot of studies have been concerned with risk in connection to stock return. It is widely known that stocks with higher risk can generate greater return. Ghysels et al., (2005, p.510) even describes this risk-return trade-off as the “first fundamental law of finance”.

French et al., (1987, p.3) found that there is a positive relationship between the expected market risk premium and the predictable volatility of returns. They further found that evidence of a negative relationship between unexpected stock returns and unexpected changes in stock return volatility. They argue that this negative relationship is an indication of a positive relationship between volatility and expected risk premiums.

Braun et al., (1995, p.1575) mention that it has been widely documented that when good or bad news enters the market, stock return volatility rises. This is true for both individual stocks and market indices (Braun et al., 1995, p.1575). Schwert (1990, p.30) mentions that it has not yet been proven what causes the profound relationship between stock return volatility and trading activity, it could be trading itself that is causing volatility, or new information entering the market. He hypothesizes that when investors receive new information, they may revalue their investments and start trading. When many investors receive this information and start trading, volatility rises due to higher trading activity. Schwert also mentions that it might be that when price changes, investors starts to reevaluate their investments when prices changes, and therefore starts trading (Schwert, 1990, p.30).

It is interesting to know how volatility was behaving throughout the financial crisis, especially since our sample covers more than one turbulent period. Schwert (2011, p.790) mentioned that stock return volatility was very high throughout the latest
financial crisis. Schwert 2011 (p. 804-805) also found that the sector that was most volatile throughout the financial crisis was the financial sector. Volatility was high in many countries through this crisis but settled when people started to understand that volatility would decrease again (Schwert 2011 p.804-805).

There is more than one type of volatility and these will be covered below.

3.5.2 - Implied Volatility
The implied volatility is commonly known as a prediction of the future volatility. Giot (2005, p. 92) mention that implied volatility is the only variable in Black and Scholes formula that is unknown. The implied volatility is most often discussed in an option pricing setting because of this. In option pricing, the implied volatility can be thought of as “the volatility that gives the market price of the option when it is substituted into the pricing model” (Hull, 2012b, p.208). Wang et al., (2012, 94) also mention that implied volatility is thought of as an options stock return volatility (throughout the life it has left) according to market expectations.

3.5.3 - Historical Volatility
By looking at historical data and calculate the standard deviation, one can try to predict the life of a security (Dubofsky and Miller, 2003 p.532). Engle (2004 p.405) also mention that historical volatility can be found by looking at a sample standard deviation over a short period of time. Ferulano (2008, p. 124) describe volatility as random and unobservable. They mention that data must hence be inferred in order to foresee volatility. Many models have become known for their estimations of volatility. These models most often use historical or implied volatility.

3.5.4 - Asymmetric Volatility
Dennis et al. (2006, p.381) describes the asymmetric volatility phenomenon as when higher volatility results from negative return shocks than it does from positive return shocks that are of the same size. They further mention that a negative correlation between expected volatility innovations and stock return exists and this has also been used to describe this phenomenon (Dennis et al. 2006, p.381-382).

3.5.5 – Beta
Beta (β) is one of the two measures that will be used in this study to see if volatility changes following a stock split. Hull describes beta as “A measure of the systematic risk of an asset” (Hull 2013a, p.798). A portfolio with a beta of 1.0 has the exact same return as the index (Hull 2013a, p.62). When beta is 2.0 however, the portfolio has twice as much in return as the index and if beta is 0.5, the portfolio generates half as much as the index (Hull 2013a, p.62). Trainor Jr (2012, p.2) mentions that the more the beta differ from 1.0, the more volatility is present. Beta can also be a negative value, such as -1 which implies that the stock moves in the exact opposite direction as the index. Moreover, stocks with high volatility should also generate a greater return.

Estrada and Vargas (2012, p.77) examined whether risk can be legitimately measured using beta but also whether beta is useful when developing a portfolio. Their findings indicate that beta is indeed a good measure of risk and that it is also useful when a portfolio is selected (Estrada and Vargas, 2012, p.86).

Trainor Jr (2012, p.1) argues that in low volatility markets, portfolios with a high beta outperform whereas in high volatility markets these portfolios underperform. He found that portfolios with a high beta perform 0.42% better than a portfolio with low beta in a
market with low volatility. Portfolios with a high beta do also underperform a portfolio with low beta with 0.51% in a market with high volatility (Trainor Jr., 2012, p.1). When he combined high and low volatility markets, no relationship between return and beta was found.

3.5.6 – Standard deviation
Standard deviation is the second measure we will be using in this study to see if volatility changes due to a stock split. Moore et al. (2009, p.40) describes standard deviation as something that measures how far away from the mean the observations are. That is, how spread out the observations are. He further argues that if the return of a stock has a large spread, then it is harder to predict the return an investor will gain and therefore a stock with a large spread becomes riskier than a stock that has a smaller spread of the return (Moore, 2009, p.42).

3.6 - Previous Similar Studies

There are quite many studies centering on stock splits and post-split effects. Mostly these studies focus on post-split liquidity, excess returns or abnormal returns. Penman and Ohlson (1985) have conducted maybe the most notable study in the area of stock splits’ effects on return volatility. They analyzed a sample of 1257 stock splits, by 910 firms on NYSE (New York Stock Exchange) with a split factor of 2:1 or higher (Ohlson and Penman, 1985, p.253). Furthermore, they used binomial Z test to analyze the data set (Ohlson and Penman, 1985, p.254-255). According to the economic irrelevance theory the return variances following a split should on average stay the same but Ohlson and Penman’s empirical analysis provides indications that return volatilities are significantly greater after the ex-split date. The increase in return standard deviation is 28-35 % when looking at daily returns, and marginally less with weekly return data. The empirical results also suggest that the increase in volatility is not a gradual adjustment, but rather the change in volatility happens at the ex-split date. Additionally, the authors consciously tries to avoid the announcement effects in the analysis by comparing return variances following the announcement but before the split date, with return variances following the ex-split date. Thus, the empirical results also rules out the possibility of it being the announcement of the stock split that has an effect on return volatility (Ohlson and Penman, 1985, p.251-252).

Dubofsky (1991) expands Ohlson and Penman’s study and encompasses not only NYSE stocks but also AMEX (then American Stock Exchange which was later acquired by NYSE) stocks during the same time period. Dubofsky argues that there are some quite substantial differences between NYSE and AMEX stocks especially in terms of owner characteristics and “market making mechanics” and that it therefore would be of interest to compare the two exchanges (1991, p.423). Moreover, if the empirical results showed that the increase in return variances following a split differed between the two exchanges that could indicate that it is the differences between the exchanges that contributed to the difference in return variances. The differences between NYSE and AMEX that Dubofsky lists are as follows (1991, p.421-422):

a) Amex stocks were usually smaller and had a lower share price. Low priced shares typically have wider bid-ask spread which can lead to more “noise-induced variance”.

b) How specialists behave and specifically what their pricing process is. Also, different rules on the exchanges that govern the specialists’ actions.
c) Higher degree of institutional owners and trading of NYSE stocks than AMEX stocks. Individuals have higher per share transaction costs than institutions do which might affect their trading decisions.

The results for NYSE stocks confirmed Ohlson and Penman’s (1985) and also AMEX stocks showed an increase in return variances following the ex-split date. Although, the results showed that the increase in volatility was greater for the stocks on NYSE than AMEX stocks. Dubofsky clarified that being listed on NYSE or AMEX proxy other real variables, such as those listed in a through c, which could explain the findings (Dubofsky, 1991, p. 430).

Sheikh (1989) uses Black-Scholes and Roll option pricing formula to solve for implied standard deviations (ISD) of returns. The ISD behavior on call options of stocks that split in between 1976-1983 is examined. The main objective of the study is to answer whether ISD of stock that conduct a split increase relative to ISD of stock that do not perform a split (Sheikh, 1989, p. 1362).

Sheik’s findings were that ISDs did increase at both the announcement date as well as the split date for stocks that split. However, the increase in ISDs at the announcement date was not significantly different from the change in the control group of non-splitting firms. The change in ISD at the ex-split date was however significantly larger in the group of the firms who split than in the control group, which is also significantly correlated to the increase in return variances at the ex-split date (Sheikh, 1989, p.1371).

In addition to examining the impact of stock splits on return variances there are a few studies that focus on the impact of stock splits on the systematic risk, beta, of the firm. Beta, in comparison to return variances measures such as standard deviation which only measures variance during a period of time, measures the volatility of the return in comparison to an index. Thus, depending upon investors’ preferences beta can be very useful when diversifying one’s portfolio.

Brennan and Copeland (1988b, p.1009) provided evidence that the anomaly of an increase in return variance following a stock split also seemed to extend to an increase in beta as well. By using time-series estimates and cross-series estimates of beta from a sample of 1034 splits. The results were that a temporary increase in average beta arises on the announcement date (about 20%) and at the time the split is effective (about 30%). Additionally, a permanent increase in beta was found following the ex-date of the split, about 18% above its level before the split (Brennan and Copeland, 1988b, p.1012).

Also Lamoureux and Poon (1987p, 1362) in their study on the US market found evidence that beta increases following a stock split. Wiggins (1992) on the other hand found no difference between pre- and post-split betas when using weekly or monthly return data. Furthermore, Wiggins conclude that the results of Brennan and Copeland and Lamoureux and Poon was biased because they used a too short time interval (daily returns) when estimating beta (Wiggins, 1992, p.638-639).

By reviewing the literature in this field it becomes quite obvious that the common belief that a stock split is merely a cosmetic accounting change is challenged by the empirical evidence. Return variances and beta estimates should in theory be on average the same before the split as after the split, however evidence seem to indicate that this might not be the case.
3.7 - Summary of Theoretical Framework

To sum up the theoretical framework that provides the base for this study we have included a figure below. The aim is to graphically enhance the understanding of how the research question is connected to the presented theories.

Figure 3- Theoretical Framework

Source: By the Authors

The event of a stock a split is what we will examine and its possible relationship with return volatility. If a firm conducts a stock split but the statistical analysis indicate no relationship with return volatility it can be argued to show support for the economic irrelevance theory. On the contrary, if the statistical analysis show a relationship between the event of a stock split and return volatility, the common thought of viewing a stock split as a cosmetic event must be questioned.

If an effect on return volatility following a stock split is found, there can be several explanations for either the increase or decrease in volatility. It might be explained by the signaling hypothesis, the optimal price/tick hypothesis, liquidity hypothesis or the procedure/structure hypothesis.

The signaling hypothesis is closely related to agency costs and information asymmetry. When a stock split is announced it could possibly be perceived as a positive, or negative, signal which decreases, or increases, agency costs and information asymmetry.
between shareholders and management. Consequently, shareholders can be either attracted to or concerned with the stock and decided to buy/sell which affects return volatility. Return volatility changes could also arise due to the changes in liquidity following a stock split. Evidence indicate that trading volume, shareholder compositions and bid-ask spreads are all factors that change due to a stock split, subsequently leading to changes in return volatility.

Furthermore, the event of a stock split is often motivated by a wish to reach the optimal price or tick size. If the optimal price/tick is reached it might attract investors which then in turn, have an effect on return volatility. Finally, the procedure/structure hypothesis might help explain changes in return volatility following a stock split. As a stock split set off many different procedures and new structures it could affect return volatility, either increasingly or decreasingly. Specifically related to greater volatility on the ex-split day could be when-issued trading (He and Wang, 2012, p. 138).
Chapter 4 – Practical Method

This chapter will present the practical method of this research. First we will describe the data collection process and thereafter the data frequency and time period will be explained. This is followed by an exploration of the sample data and the final sample size. Next, a section on the estimation process of the variables follows. Subsequently, the statistical analysis procedures are described and lastly, the hypotheses are presented.

4.1 – Data Collection

Thomson Reuters Datastream was used to collect the relevant data for this study. Datastream is provided by Umeå University’s library. We feel confident in using data provided by Datastream as this is a highly regarded and a widely used source by academics and analysts. The data gathered from the mentioned database were adjusted closing share prices, price index for OMXSPI and stock split dates and split factors for all companies listed on NASDAQ OMX Stockholm.

![Data Collection Process Diagram]

Figure 4 - Data Collection Process

Source: By the Authors

The above figure depicts the data collection process. The collected data was not possible to use directly as the main variables. Rather, from the adjusted closing price and the price index we calculated the log returns, which in turn, were used to estimate standard deviation and beta of the shares. Stock split dates and stock split factors of stock splits that occurred between 2002-01-01 and 2013-01-01 were collected. From these we got a sample of stock splits that fulfilled our criteria, which will be explained further below.
4.2 - Data Frequency

In order to see when the stock split is conducted and what the split factor is, we have gathered data of the split dates on a daily basis as well as the split factor on a daily basis. From this, we can see when the stock split has been conducted and how big the split factor is.

For the volatility measures, we have gathered data of the adjusted share prices on a daily basis throughout the years 2002-2012. The adjusted share prices will thereafter be used to estimate standard deviation and beta. The reason as to why we choose to gather these share prices on a daily basis is because they generate more accurate volatility measures. Additionally, previous similar studies mainly use daily prices, as such using daily prices makes this study’s results more comparable with previous findings.

Stock splits can be conducted whenever it seems right for management. We have, as mentioned, gathered data on each day over a period of ten years. That is in order to see on which day the stock split has been conducted and then be able to measure the volatility during the days before and after the split. Regularly, a stock split is not conducted on a frequent basis, but rather, it can occur whenever suitable for management and the company. We can therefore most likely not expect to find pattern of when the companies conducts stock splits, we instead expect to see companies conducting stock splits on random dates. However, a stock split is usually preceded by a period of high growth in earnings.

4.3 - Time Period

We will be examining the years 2002-2012, since we believe that using a time span of ten years will give us a large enough sample. The time period should also be long enough to exclude misleading events. Furthermore, since we want to contribute with an up to date result, we chose a time period dating up until around the latest date we will be able to examine, that is, we have gathered data until 2013-01-01.

Throughout the time period we are examining, there have been times of financial distress. For example, in 2008, the when the financial crisis took place, we expect volatility to be greater than during times without financial distress.

Figure 5 - OMXSPI Graph

Source: NASDAQ OMX Stockholm
The above graph shows the NASDAQ OMX Stockholm Benchmark Price Index from January 1\textsuperscript{st} 2002 through December 31\textsuperscript{st} 2012. As noticed, there are several bumps in the index. These bumps are evidence of financial turmoil. The first bump is showing in 2003, and then there is the financial crisis in late 2008 followed by the economic downturn in 2011. For all of these time periods, we expect volatility to be higher than usual.

4.4 – Sample Data

The sample in this study includes all companies on NASDAQ OMX Stockholm that fulfill the following requirements:

- Has conducted a stock split throughout the years 2002-2012
- Has conducted a stock split with a split factor over 2:1

The table below shows how many stock splits that have been conducted in each segment and how many is left (final sample) after all stock splits that does not fit our research has been excluded. Since we are using a rather long time period, many companies have conducted more than one stock split throughout these ten years.

<table>
<thead>
<tr>
<th>Amounts of Stock Splits</th>
<th>Final Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Cap</td>
<td>60</td>
</tr>
<tr>
<td>Mid Cap</td>
<td>64</td>
</tr>
<tr>
<td>Small Cap</td>
<td>72</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
</tr>
</tbody>
</table>

Table 3 – Sample

Source: By the Authors

The amount of stock splits that has been conducted by companies listed on NASDAQ OMX Stockholm totals to 196. Out of these 196, 90 stock splits fulfilled our requirements. 31 stock splits will be included from the large cap segment, 31 from the mid cap segment and 28 from the small cap segment. This means that more than 100 of the observed stock splits during this time period were either unobservable due to lack of data or had a stock split factor that was less than 2:1. The majority of the disregarded observations for the sample have split factors that were close to 1:1.

4.5 – Sample Size

Using a small sample when conducting the statistical tests leads to insensitivity in the test (Saunders et al., 2009, p.450). Because of the fact that it is better to have a large sample size, we have decided to include as many stock split observations as possible. Although we suspect that the bigger the split factor, the greater the effect on volatility, we decided to limit our exclusions at splits smaller than 2:1 in order to have as large of a sample as possible.

Our sample is, as mentioned, rather large. This means that if a stock split has an effect on volatility, our statistical tests will detect it. That is because a large sample can detect smaller changes in volatility than a small sample can.
4.6 - Estimation of Variables

4.6.1 - Log Returns
As mentioned, we have collected the daily adjusted closing prices for stocks listed on NASDAQ OMX Stockholm and thus we need to compute the stock returns manually. Specifically, we will calculate natural log returns, also known as continuously compounded returns. Ruppert (2004, p. 76) present the mathematical formula to do this as:

\[ r_t = \ln(1 + r_t) = \ln(p_t) - \ln(p_{t-1}) = \ln\left(\frac{p_t}{p_{t-1}}\right) \]  

\( r_t \) is equal to the log return, \( p_t \) is the stock price at time \( t \) and \( p_{t-1} \) is the stock price one period before time \( t \). The log return is thus a natural logarithm of the ratio between the stock price at time \( t \) and the stock price time \( t-1 \).

We use natural log returns as they are better suited for statistical inference than net-returns are. Specifically an increase or decrease in returns will be the same in percentages, only the positive or negative sign is different (Ruppert, 2004, p.77). Moreover, Ruppert further explains that log returns are time-consistent, which offers simplicity when calculating multiperiod returns.

4.6.2 - Standard Deviation
We will use both standard deviation and beta as measures of return volatility. Subsequent to calculating the log returns we will estimate standard deviation and beta a period before and a period after every stock split observation in the sample. Standard deviation is calculated as:

\[ s = \sqrt{\frac{1}{n-1}\sum(x_t - \bar{x})^2} \]

Moore et al., explain that standard deviation is thus the square root of the spread of the observations from the mean (2009, p. 40-41). The further away the returns (observations) are from the average return (mean) the greater the standard deviation will be. Subsequently, the greater the standard deviation, the greater is the return volatility.

4.6.3 - Beta
As mentioned, beta is a measure of systematic risk. Beta will be calculated using the log returns with the following formula as presented by Bodie et al., (2009, p.281):

\[ \beta = \frac{\text{Cov}(r_i, r_m)}{\text{Var}(r_m)} \]

\( \text{Cov}(r_i, r_m) \) is the covariance between the market index return \( r_m \) and the individual stock’s return \( r_i \). \( \text{Var}(r_m) \) is the variance of the market index return. Thus, as becomes clear from this formula is that beta measures how the individual stock’s return moves in comparison to how the market index return evolves. As such, beta measures the individual stock’s sensitivity to the market, or its benchmark. In this study we have used OMXSPI as benchmark index.
By testing both standard deviation and beta as measures as return volatility following a stock split we anticipate to add more depth to the empirical results. As such, contribute to a greater understanding of the relationship between stock splits and return volatility.

**4.6.4 - Market Index Return**
For our calculation of beta, we have used the OMX Stockholm PI (OMXSPI) as a market index. We choose to use the OMXSPI since it provides a good overview of all stocks traded on NASDAQ OMX Stockholm and their movements throughout our sample period.

**4.6.5 - Time Periods for Beta and Standard Deviation**
Following Brennan and Copeland (1988b) and Ohlson and Penman (1986) we will use a 75 day period before the split date and a period of 75 days after the split date to calculate two different values each of beta and standard deviation. Thus, a pre-split standard deviation based on 75 days prior to the split date and a post-split standard deviation based on 75 days after the split date will be computed. A pre-split beta and a post-split beta will be calculated in the same manner.

Additionally, an extra set of pre-split and post-split standard deviations and betas will also be calculated. In this set we will exclude the 10 days before and the 10 days after the split date, and base the pre-split variables thus on day -75 to -10 and the post-split variables on day +10 to +75, day 0 being the split date. By doing so we hope to see, if there is an increase in return volatility, whether this increase is mainly attributable to the days closest to the split-date or to a longer period before and after the split.

To sum up, first we will calculate two sets of pre- and post-split data based on day -75 to day +75, excluding the split date.

![Figure 6 - Days measured](source: By the Authors)

Then we will calculate two more sets of pre- and post-split data where we exclude the 10 days closest before and the 10 days closest after the split.

![Figure 7 - Days measured](source: By the Authors)
4.7 - Statistical Analysis

4.7.1 - Exploratory Data Analysis
The gathered data and variables will be analyzed with descriptive statistics before being tested with statistical significance tests. This in order to give a good overview of the data and describe its main characteristics. Moreover, the variables will be tested for normal distribution as the parametric t-test to some extent includes this assumption. Normality tests will thus be conducted in SPSS and they are the Kolmogorov-Smirnov and the Shapiro-Wilk tests, which test the null hypothesis of the data being normally distributed.

4.7.2 - Paired Samples T-test
The pre-split variables will be compared against the post-split variables to see if there is a significant change in average means of the volatility measures. The first test to be conducted is a paired samples t-test. A paired samples t-test is a parametric test which estimates the mean of the two variables one wants to compare and investigates whether the difference in means between the two samples of variables are different from 0. In other words, it measures whether there is a significant difference in means in the two groups. For example, this study will test the pre-split standard deviation mean against the post-split standard deviation mean as well as the pre-split beta mean with the post-split beta mean. Thus, we measure if there has been a significant change in means in the return volatility variables following the split.

The significance test for the null hypothesis that the mean is not different between the two samples is based upon the two sample t-test statistic (Moore et al., 2011, p.434):

$$ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} $$

(4.4)

Where $\bar{x}_1$ is the pre-split mean of standard deviation/beta and $\bar{x}_2$ is the post-split mean of standard deviation/beta. $s_1^2$ is the sample variance for the post-split volatility measures, and $s_2^2$ is the post-split sample variance. $n_1$ is the sample size for the pre-split sample and $n_2$ for the post-split sample.

According to Moore et al., (2011, p. 424) the two sample t-test have a higher robustness than one sample t-procedures. If the sizes of the samples compared are similar and the two populations have similar distributions the probability values for the t-test are rather accurate for a broad range of different distributions, even for small samples. The two sample t-test is thus more robust against non-normality distributions and mostly gives reliable p-values.

4.7.3 - Wilcoxon Signed Rank Test
In order to strengthen the statistical analysis and provide the most reliable results we will also conduct the Wilcoxon Signed Rank Test. This is a non-parametric test and such tests do not require any assumptions about certain distributions of the variables. Instead of testing the mean, which can be heavily influenced by just a few outliers, the Wilcoxon Tests measure and test the median instead (Moore et al., 2011, ch.16, p 2).

There are different kinds of Wilcoxon Tests and the one we will perform is the Wilcoxon Signed Rank Test. A rank test is based on, as the name suggests, ranking the observations from smallest to the largest (Moore et al., 2011, ch.16, p.13). The two-related sample Wilcoxon Signed Rank Test performed in SPSS will allow us to test
whether there is a systematic difference (increase) in the return volatility measures in the pre-split group and the post-split group, even when there are skewed distributions.

4.7.4 - Binomial Z-Test
In addition to the paired samples t-test and the Wilcoxon Signed Rank Test we will also perform a binomial Z test. Instead of having quantitative variables the binomial Z test evaluate categorical variables. The binomial Z test have been utilized by Ohlson and Penman (1985) and Dravid (1987) among others when testing the stock split effect on return variances. The binomial z-test is also a non-parametric test and thus does not rely on assumptions of the distribution of variables.

Following Ohlson and Penman the pre-split measure is matched with the post-split measure for each stock split, counting the number of cases where the post-split measure (of standard deviation/beta) is higher than the pre-split (Ohlson and Penman, 1985, p.254). When the difference between post-split and pre-split volatility measure is positive, it means an increase has occurred and if the difference is negative a decrease. As such, we exclude all scale information when we transform the quantitative variables into categorical variables (increase or decrease) but the tests become extremely robust.

The hypotheses for this test examine the proportion of increases and decreases. If there is no effect of a stock split the expected result is that the proportion is 50 % of each an increase and a decrease. In other words, there is an equal chance to have an increase or decrease in standard deviation/beta following a stock split. The hypotheses will be introduced in a subsequent section in this chapter.

4.7.5 - P-Value
The significance of all statistical tests performed will be evaluated with the probability value, often called the p-value. The p-value measures the probability that the null hypothesis tested is actually true, or if we see it the other way around it tells us the statistical support for the alternative hypothesis. The smaller the p-value, the greater is the evidence against the null hypothesis and can thus be inferred as statistical support for the alternative hypothesis (Moore et al., 2011, p. 356)

Common significance levels used are between 0,01 up to 0,1 (Moore et al., 2011, p.358). In this study we will not set a solid p-value and examine the statistical significance upon that. From our point of view, the p-value tells us just how likely it is that the null hypothesis is true. For example, if we would set a solid significance level to 0,05 and then conduct a test where the p-value yielded was 0,06 we could not reject the null hypothesis. In practice, there is no exact number at which a test becomes significant or not. Accordingly, we will examine the p-values for each test and evaluate whether we shall reject or accept the null hypothesis.

4.8 - Hypotheses
This section will introduce the hypotheses that will be tested by the different statistical tests in order to answer the study’s research question. The hypotheses are founded upon the statistical tests we use and are such formulated in different manners for the paired samples t-test, the Wilcoxon Signed Rank Test and for the binomial Z test.
4.8.1 - Hypotheses for the Paired Samples T-Test

\[ H_0 = \bar{x}_2 - \bar{x}_1 = 0 \]
\[ H_a = \bar{x}_2 - \bar{x}_1 > 0 \]

Where \( \bar{x}_2 \) stands for the post-split mean of the variable, in this study standard deviation and beta, and \( \bar{x}_1 \) stands for the pre-split mean. Thus, the null hypothesis states that there is no difference in means between the pre-split sample and the post-split sample. Contrary, the alternative hypothesis states that there is a difference in means and that this difference is positive, in other words, an increase in means of return volatility.

Thus, first we will test whether there is a significant difference in means between the pre-split and post-split standard deviation. Secondly, we will test if there is a significant difference in means between pre- and post-split beta. As such:

\[ \bar{x} = \bar{\sigma} \]
\[ \bar{x} = \bar{\beta} \]

In addition to testing all 90 stock splits covering all size segments of NASDAQ OMX Stockholm we will also perform paired samples t-test in the three different size segment. Accordingly, t-tests will be performed for the stock splits that occurred in the large cap segment, another set of t-tests for the mid cap segment and lastly, for the small cap segment.

4.8.2 - Hypotheses for the Wilcoxon Signed Ranks Test (Paired Samples)

\[ H_0 = M\sigma_2 - M\sigma_1 = 0 \]
\[ H_a = M\sigma_2 - M\sigma_1 > 0 \]
\[ H_0 = M\beta_2 - M\beta_1 = 0 \]
\[ H_a = M\beta_2 - M\beta_1 > 0 \]

Where the M stands for median. Accordingly, the null hypothesis states that there has been no significant change in median of standard deviation/beta in the pre- and post-split samples. The alternative hypothesis is that there is a significant increase in the median standard deviation/beta in the post-split sample. As for the t-test we will also perform Wilcoxon Signed Ranks Test within the different size segment to see whether there is a difference between firm sizes.

4.8.3 - Hypotheses for the Binomial Z Test

\[ H_0 = Pr (\sigma_2 > \sigma_1) = 0.5 \]
\[ H_a = Pr (\sigma_2 > \sigma_1) > 0.5 \]
\[ H_0 = Pr (\beta_2 > \beta_1) = 0.5 \]
\[ H_a = Pr (\beta_2 > \beta_1) > 0.5 \]

The null hypothesis is thus that the proportion of an increase in standard deviation in the post-split period is equal to 50 % and the proportion of a decrease in standard deviation is also equal to 50 %. In other words, it is the exact same chance to have either an increase or decrease in standard deviation following a stock split. The alternative hypothesis is that the proportion of increase in standard deviation is greater than the expected proportion of 50 % and decreases thus less than 50 %. The same hypotheses are used for testing return volatility variable of beta and the principals are the same as for the hypothesis just described for standard deviation.
Additionally, to test if there is any size effect we will perform binomial Z tests for the three different size segment of NASDAQ OMX Stockholm.

4.9 - Scrutiny of Practical Method

This is a quantitative research study with a focus on a research question which nature entails that a significant amount of data is collected in order to answer it. As the data utilized for the study has been collected from official databases it is of importance to review the reliability of those and be critical towards it. Since Thomson Reuters Datastream is widely used by academics, professional analysts and investors which indicates that the information provided is of high quality and highly reliable.

As mentioned, the collected data needed manual processing, such as calculating log returns, standard deviation and betas, before being statistically analyzed. Thus, due to manual processing the risk of a human error increases. Being aware of this risk we have taken steps to secure the accuracy of the final processed numerical data. All manual processing before the statistical analysis has been processed in Microsoft Excel a program very well suited for handling and mathematically process significant amounts of numerical data. In addition, we have performed control computations on a regular basis as well as random spot-checks to assure the accuracy of the calculations.
Chapter 5 – Empirical Findings

This chapter will first present descriptive statistics on the gathered data. This will be followed by a short section on the normality testing of the data. Then the empirical results from the paired samples t-test is presented, followed by the results from the Wilcoxon Signed Rank tests. The chapter continues with a presentation of the empirical results from the binomial Z tests performed. Finally, the chapter ends with a summary of the hypotheses testing.

5.1 – Descriptive Statistics
The descriptive statistics will provide a helpful overview of the data that is used when the statistical tests are conducted. Explaining graphs and figures will be included to compliment the text.

5.1.1- Stock Split Conductions

Examining the years that are included in our sample period, we find that most of the splits have been conducted between 2005 and 2007. Fewest stock splits have occurred in 2002-2003, 2008-2009 and 2012. Not surprisingly, are these the years when the Swedish market has faced financial distress. The stock splits are not equally divided throughout the 10 years we are examining. Rather, it is clear that it has, during some of the years, been more appealing to managers to conduct stock splits.

May is the month in which most stock splits occurred. Thereafter, June and April were popular months for stock splits to be conducted. Apart from these popular months, the stock splits are fairly equally divided throughout the year. January is the only month in our sample when no stock split was conducted.
5.1.2 – Changes in Return Volatility Measures

As can be seen from the graph, 60% of the changes in standard deviation in the post period of a stock split are increases. This means that only 40% of the changes in standard deviation are decreases. Thus, more stocks faced an increase in standard deviation in the post-split period than decreases.

Like standard deviation there were 60% increases and 40% decreases in beta in the post period of a stock split among our observations.

Examining how many increases and decreases in standard deviation has occurred in the post split period when the 10 days closest before and after a stock split has been removed, we find that 57.8% of the changes are increases in standard deviation whereas 42.2% are decreases.

When looking at beta with -10 to -75 and +10 to +75 days around the stock split, we find that increases stands for 57.7% of the changes in beta and 43.3% of the changes are decreases. Thus, the percentage changes are very similar when measuring standard deviation and beta on the two different time periods.
5.2 – Normality

In order to test for normality, we used the Kolmogorov-Smirnov and Shapiro-Wilk test, which test the null hypothesis that the data comes from a normal distribution. We found that all but one of our tests were non-normal. Testing for pre and post standard deviation, we found that the significance value is 0.000 for both Kolmogorov-Smirnov and Shapiro-Wilk test, which is greatly indicating the data is not normally distributed. For the pre and post beta, both the Kolmogorov-Smirnov and Shapiro-Wilk tests generated a significance value of 0.000 which again is an indication of non-normally distributed data. The pre and post standard deviation 10 days also showed a significance value of 0.000 for both normality tests, meaning that this data is non-normally distributed. The pre beta 10 days data can also be concluded non-normally distributed since the significance value for both normality tests are 0.000. For the post beta -75 to -10 and +10 to +75 days data however, the significance value is well over the confidence interval, meaning that the data is normally distributed.

<table>
<thead>
<tr>
<th>Tests of Normality</th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td>Postbeta10day</td>
<td>0.057</td>
<td>90</td>
</tr>
</tbody>
</table>

* This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4 - Normality test

As seen from the table above, the post beta is the data that proved to be normally distributed. We found that the Kolmogorov-Smirnov reached a significance value of 0.200 and the Shapiro-Wilk test a significance value of 0.846. Both of these are above a confidence interval 95% and we can therefore conclude that the post beta beta -75 to -10 and +10 to +75 data is normally distributed.

5.3 - Paired Samples T-Test

As mentioned, the paired samples t-test examines if there is a difference in means in two samples. In the two tables on the next page are the result of the t-test of pre-split standard deviation and post-split standard deviation for all 90 stock splits observations.
The standard deviation (measured as -75 and +75 days before and after the stock split date) mean is 0.0298 before the stock split and 0.03 after the stock split. The mean of paired differences is 0.00027. We obtain a t-value of -0.145 and the p-value is very high at 0.885. Accordingly, we cannot reject the null hypothesis of there being no difference in means of standard deviation before and after the stock split.

Next we performed the same test but with beta as the volatility measure instead. The pre-split beta mean of the 90 observations was 0.79 and the post-split beta mean was 0.88 as can be seen in the table below.

Table 5 - T-test standard deviation

Table 6 - T-test standard deviation

The standard deviation (measured as -75 and +75 days before and after the stock split date) mean is 0.0298 before the stock split and 0.03 after the stock split. The mean of paired differences is 0.00027. We obtain a t-value of -0.145 and the p-value is very high at 0.885. Accordingly, we cannot reject the null hypothesis of there being no difference in means of standard deviation before and after the stock split.

Next we performed the same test but with beta as the volatility measure instead. The pre-split beta mean of the 90 observations was 0.79 and the post-split beta mean was 0.88 as can be seen in the table below.

Table 7 - T-test beta

Table 8 - T-test beta
The mean of the paired differences between pre- and post-split beta is -0.09. The t-statistic is -1.076 and the p-value is 0.285. Thus, we cannot reject the null hypothesis of there being no difference in means in the pre- and post-split beta.

Additionally, we performed paired samples t-test on the standard deviation calculated on -75 days to -10 before the stock split date and +10 days to +75 days after the stock split date. Below is the result.

### Table 9 - T-test standard deviation 10 days

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prestd10days</td>
<td>0.029591043511912</td>
<td>90</td>
<td>0.026440728646851</td>
<td>0.002787097517373</td>
</tr>
<tr>
<td>Poststd10day</td>
<td>0.027506661812034</td>
<td>90</td>
<td>0.014260565133287</td>
<td>0.001503195551502</td>
</tr>
</tbody>
</table>

### Paired Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prestd10days -</td>
<td>0.00208438</td>
<td>0.01952133</td>
<td>0.00205772</td>
<td>-</td>
<td>1.013</td>
<td>89</td>
<td>0.314</td>
</tr>
<tr>
<td>Poststd10day</td>
<td></td>
<td></td>
<td></td>
<td>.00617304</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10 - T-test standard deviation 10 days

Again, we found no significant differences in means of standard deviation before and after the stock split as is evident from the table above. The p-value is 0.314, which is quite high and as such we cannot reject the null hypothesis.

Below the results for the test with beta calculated on the same time-period as previously described for standard deviation above are presented.

### Table 11 - T-test beta 10 days

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prebeta10day</td>
<td>0.804650484217986</td>
<td>90</td>
<td>0.663962192704632</td>
<td>0.069987760306298</td>
</tr>
<tr>
<td>Postbeta10day</td>
<td>0.793062962494497</td>
<td>90</td>
<td>0.522159867764414</td>
<td>0.055040482829019</td>
</tr>
</tbody>
</table>
The mean of pre- and post-split beta is very similar, 0.8 before the stock split and 0.79 after the stock split of the 90 observations. However, the p-value is very high at 0.86 and hence we cannot reject the null hypothesis of no difference in means pre- and post-split.

As all paired samples t-test resulted in high significance values we decided to not perform additional t-test in the different segments as these result would be of no interest. Especially having in mind that each segment only contain around 30 observations and have very non-normal distribution, thus making the t-tests unreliable.

5.4 – Wilcoxon Signed Ranks Test

As mentioned in chapter 4, the Wilcoxon Signed Ranks Test examine the median of the observations (Moore et al., 2011, ch.16, p 2). Thus, this test will show us if there is any changes in the median of the return volatility measure before and after a stock split has been conducted.

### Table 12 - T-test beta 10 days

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>Paired Differences</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Std. Error</td>
<td>Mean</td>
<td>95% Confidence Interval of the Difference</td>
</tr>
<tr>
<td>Prebeta10day - Postbeta10day</td>
<td>.01158752</td>
<td>.62326402</td>
<td>.06569779</td>
<td>.11895260</td>
</tr>
</tbody>
</table>

### Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th>Negative Ranks</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>36a</td>
<td>43.19</td>
<td>1555.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Positive Ranks</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>54b</td>
<td>47.04</td>
<td>2540.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ties</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0c</td>
<td>90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ranks</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PostStd - PreStd</td>
<td>36a</td>
<td>43.19</td>
<td>1555.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>54b</td>
<td>47.04</td>
<td>2540.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. PostStd < PreStd
b. PostStd > PreStd
c. PostStd = PreStd

test Statistics:

<table>
<thead>
<tr>
<th>Test Statistics</th>
<th>PostStd - PreStd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-1.982b</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.048</td>
</tr>
</tbody>
</table>
a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 13 - Wilcoxon standard deviation

Through the Wilcoxon Signed Rank Test, we see that for 36 of the stock splits we examined, the conduction of a stock split had a negative effect on standard deviation. Hence, the standard deviation decreased following a stock split. For 54 of the split, the rank was positive, meaning that standard deviation increased following a stock split. Thus, there are significantly more positive ranks than negative ranks. This generated a significance value of 0.048, which indicates that we should reject the null hypothesis in favor of the alternative hypothesis. The results indicate that the median in the post-split group is higher than in the pre-split group.

<table>
<thead>
<tr>
<th>Ranks</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Ranks</td>
<td>35</td>
<td>44.74</td>
<td>1566.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>55</td>
<td>45.98</td>
<td>2529.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Postbeta < Prebeta
b. Postbeta > Prebeta
c. Postbeta = Prebeta

Test Statistics

<table>
<thead>
<tr>
<th>Test Statistics</th>
<th>Postbeta - Prebeta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-1.937^a</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.053</td>
</tr>
</tbody>
</table>

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 14 - Wilcoxon beta

For the volatility measure beta, the Wilcoxon Signed Ranks Test showed that 35 of the ranks were negative, meaning that for 35 of our observations, beta decreased following a stock split. For 55, the rank was positive, indicating that beta increases after a stock has been conducted. The significance value reaches 0.053 for beta, which is very close to the confidence level of 95%. We can therefore reject the null hypothesis and assume that there is a significant difference (increase) in beta after compared to before a stock split.
### Table 15 - Wilcoxon standard deviation 10 days

When 10 days right before and after the stock split has been eliminated when estimating the volatility measures, the Wilcoxon Test shows that the amount of negative ranks amounts to 39, whereas the positive ranks amounts to 51. This means that 39 of the stock splits generated a decrease in standard deviation whereas 51 generated an increase. The significance value is 0.446 and well above the confidence level, which indicate that the null hypothesis cannot be rejected.

#### Ranks

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Ranks</td>
<td>39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.64</td>
<td>1858.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>51&lt;sup&gt;b&lt;/sup&gt;</td>
<td>43.86</td>
<td>2237.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Poststd10day < Prestd10days  
b. Poststd10day > Prestd10days  
c. Poststd10day = Prestd10days

#### Test Statistics<sup>a</sup>

<table>
<thead>
<tr>
<th></th>
<th>Poststd10day - Prestd10days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-0.762&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.446</td>
</tr>
</tbody>
</table>

a. Wilcoxon Signed Ranks Test  
b. Based on negative ranks.

#### Ranks

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Ranks</td>
<td>37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.65</td>
<td>1837.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>42.60</td>
<td>2258.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Postbeta10day < Prebeta10day  
b. Postbeta10day > Prebeta10day  
c. Postbeta10day = Prebeta10day

#### Test Statistics<sup>a</sup>

<table>
<thead>
<tr>
<th></th>
<th>Postbeta10day - Prebeta10day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-0.847&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.397</td>
</tr>
</tbody>
</table>

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 16 - Wilcoxon beta 10 days

For beta with the 10 days closest before and 10 days closest after the split date is excluded, the Wilcoxon Signed Ranks Test shows that there were 37 negative ranks and 53 positive ranks. This means that for 37 of the stock splits, beta has decreased following the stock split, whereas for 53 of the stock splits, beta has increased. The significance value is 0.397 and well above the confidence level. Therefore, we cannot reject the null hypothesis.

5.4.1 - Wilcoxon Test for Different Size Segments

For both the small and mid cap segments, all Wilcoxon Signed Rank Tests indicated that the null hypothesis could not be rejected. The significance value was well above the confidence level of 95% in all tests conducted in these segments. For the large cap segment however, all of the tests generated significant results and will therefore be further discussed below.

<table>
<thead>
<tr>
<th>Ranks</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PostStd - PreStd</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>10³</td>
<td>14.90</td>
<td>149.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>21²</td>
<td>16.52</td>
<td>347.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. PostStd < PreStd  
b. PostStd > PreStd  
c. PostStd = PreStd

Test Statistics

<table>
<thead>
<tr>
<th>Z</th>
<th>PostStd - PreStd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1.940²</td>
</tr>
</tbody>
</table>

a. Wilcoxon Signed Ranks Test  
b. Based on negative ranks.

Table 17 - Wilcoxon standard deviation large cap

Examining the standard deviation in the large cap segment alone, we find that 10 of the stock splits in our large cap segment have a negative rank, whereas 21 of the stock splits have a positive rank. From this, we can conclude that for 10 of the stock splits, the standard deviation decreased in the post period whereas 21 of the stock splits experienced an increase in standard deviation in the post period. The significance value is 0.052, which is within the confidence interval of 95%. Therefore, we can reject the null hypothesis in favor of the alternative hypothesis.
For beta, only 9 of the stock splits had negative ranks, while 22 had positive ranks. This means that 9 out of 31 stock splits in the large cap segment faced decreases in beta in the post-split period. 22 of the stock splits did however face increases in beta after the stock split was conducted. The significance value is only 0.005, meaning that the null hypothesis can be rejected in favor of the alternative hypothesis with strong evidence.
a. Wilcoxon Signed Ranks Test  
b. Based on negative ranks.  

Table 19 - Wilcoxon standard deviation large cap 10 days  
For the -75 to -10 days, +10 to +75 days standard deviation is tested, the Wilcoxon Signed Ranks Test shows that 10 of the stock splits examined in the large cap segment came out negatively ranked whereas 21 were positively ranked. Thus, for 10 of the stock splits in the large cap segment, standard deviation decreased following a stock split and for 21 it increased. The significance value is 0.085, which is not quite within the confidence interval of 95 %, but well within the 90 % confidence interval. We can therefore argue that the null hypothesis can be rejected in favor of the alternative hypothesis.

<table>
<thead>
<tr>
<th>Ranks</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Ranks</td>
<td>8</td>
<td>13.38</td>
<td>107.00</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>23</td>
<td>16.91</td>
<td>389.00</td>
</tr>
<tr>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Postbeta10day < Prebeta10day  
b. Postbeta10day > Prebeta10day  
c. Postbeta10day = Prebeta10day  

Table 20 - Wilcoxon beta large cap 10 days  
It was found that beta were the 10 days closest before and the 10 days closest after the split date were excluded, included 8 negative ranks and 23 positive ranks when the Wilcoxon Signed Ranks Test was conducted. This means that of the 31 stock splits that were conducted in the large cap segment, 8 stock splits experienced a decrease in the beta in the post period, whereas 23 experienced an increase. The significance value is 0.006, which is a very strong indication that the null hypothesis can be rejected in favor of the alternative hypothesis.

5.5 - Binomial Z Test  
The binomial Z test measures how many increases compared to decreases in standard deviation and beta after a stock split our data contained. The test shows whether there is a significant difference in the proportions of increases compared to decreases. Although
the changes in both standard deviation and beta often are rather small, it is interesting to see whether there are any significant differences in the amount of increases in volatility compared to decreases. This will hence be examined with the binomial Z test.

<table>
<thead>
<tr>
<th>Binomial Test</th>
<th>Category</th>
<th>N</th>
<th>Observed Prop.</th>
<th>Test Prop.</th>
<th>Exact Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeSTD</td>
<td>Group 1</td>
<td>Increase</td>
<td>54</td>
<td>.60</td>
<td>.50</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Decrease</td>
<td>36</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>90</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 21 - binomial Z test standard deviation

The binomial Z test shows that there were 54 increases in standard deviation throughout our sample period. The amount of decreases in standard deviation added up to 36. We can thereby see that 60% of all the stock splits faced an increase in standard deviation following a stock split. This means that 40% faced a decrease in standard deviation following a stock split. The significance level is 0.073, meaning that it is not within the 95% confidence interval but within the 90% confidence interval. We can therefore argue that there are a significantly higher proportion of increases compared to decreases following a stock split. Hence, we can reject the null hypothesis in favor of the alternative hypothesis.

<table>
<thead>
<tr>
<th>Binomial Test</th>
<th>Category</th>
<th>N</th>
<th>Observed Prop.</th>
<th>Test Prop.</th>
<th>Exact Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeBETA</td>
<td>Group 1</td>
<td>Increase</td>
<td>54</td>
<td>.60</td>
<td>.50</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Decrease</td>
<td>36</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>90</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 22 - binomial Z test beta

As for standard deviation, our other volatility measure, beta, has also an amount of increases that totals to 54 and amount of decreases that totals to 36. This means that the volatility measure beta also showed that 60% of the stock splits were followed by an increase in beta, whereas only 40% of the stock splits faced a post-split decrease in beta. The significance level for changes in beta is 0.073 which mean that it is not within the 95% confidence interval but it is within the 90% confidence interval. Therefore, we can reject the null hypothesis in favor of the alternative hypothesis.
For the -75 to -10 and +10 to +75 days sample, we see that the amount of increases in standard deviation is 52, whereas the decreases add up to 38. Thus, when 10 days pre and 10 days post the stock split has been removed, the amount of increases in standard deviation following a stock split is hence 58% and the amount of decreases in standard deviation following a stock split 42%. The significance value is here 0.170, which means that it is well above the confidence interval. Therefore, we cannot reject the null hypothesis.

Table 23 - binomial Z test standard deviation 10 days

In the 10 days sample for beta, 51 increases were detected as well as 39 decreases following a stock split. This means that 57% of all stock splits faced an increase in beta in the post period and 43% faced a decrease. The significance value is 0.246 which is well above the confidence interval. Thus, the null hypothesis cannot be rejected.

5.5.1 – Binomial Z Test for Size Segments
Examining the size segments, the binomial Z test found no significant results in neither the mid cap, nor the small cap splits. However, in the large cap segment, all of the tests generated significant values. We will therefore examine the large cap segment further below.

Table 24 - binomial Z test beta 10 days

Table 25 - binomial Z test standard deviation large cap
Examining standard deviation using a binomial Z test, we find that the amount of increases in standard deviation in the large cap segment stands for 21 of the changes whereas 10 are decreases in standard deviation. This gives us a significance value of 0.071. This significance value is well within the 90% confidence interval and we can therefore reject the null hypothesis in favor of the alternative hypothesis.

<table>
<thead>
<tr>
<th>Binomial Test</th>
<th>Category</th>
<th>N</th>
<th>Observed Prop.</th>
<th>Test Prop.</th>
<th>Exact Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeBETA</td>
<td>Group 1</td>
<td>Increase 22</td>
<td>.71</td>
<td>.50</td>
<td>.029</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Decrease 9</td>
<td>.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>31</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 26 - binomial Z test beta large cap

For beta, we see that 22 of the changes in the large cap segment are increases whereas only 9 are decreases. The significance value is 0.029, meaning that it is highly significant. We can therefore reject the null hypothesis in favor of the alternative hypothesis.

<table>
<thead>
<tr>
<th>Binomial Test</th>
<th>Category</th>
<th>N</th>
<th>Observed Prop.</th>
<th>Test Prop.</th>
<th>Exact Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeSTD10</td>
<td>Group 1</td>
<td>Increase 21</td>
<td>.68</td>
<td>.50</td>
<td>.071</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Decrease 10</td>
<td>.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>31</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 27 - binomial Z test standard deviation large cap 10 days

When examining standard deviation when the 10 days closest before and after the stock split date is removed, we see that the amount of increases in standard deviation in the post-split period are 21 and the amount of decreases in standard deviation are 10. The significance value is 0.071, which means that we can reject the null hypothesis in favor of the alternative hypothesis.

<table>
<thead>
<tr>
<th>Binomial Test</th>
<th>Category</th>
<th>N</th>
<th>Observed Prop.</th>
<th>Test Prop.</th>
<th>Exact Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeBETA10</td>
<td>Group 1</td>
<td>Increase 22</td>
<td>.71</td>
<td>.50</td>
<td>.029</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Decrease 9</td>
<td>.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>31</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 28 - binomial Z test beta large cap 10 days

The binomial Z test for beta in the post-split period when 10 days before and after the split date has been removed shows that 22 of the changes are increases while 9 are
decreases. The significance value is 0.029. Therefore, we can reject the null hypothesis in favor of the alternative hypothesis.

As seen, the significance value for standard deviation +75 days and +10 to +75 and -10 to -75 generated the same result in proportion of increases/decreases, indicating that the effect a stock split has on volatility should not differ depending on time in the large cap segment. The same is true for beta which also showed the same amount of increases and decreases despite the days it was measured in.

5.6 - Summary of Hypotheses Testing

5.6.1 - Hypotheses for Paired Samples t-test

\[ H_0 = \bar{x}_2 - \bar{x}_1 = 0 \]
\[ H_a = \bar{x}_2 - \bar{x}_1 > 0 \]

The null hypothesis could not be rejected in any of the tests performed, both with standard deviation and beta as variables.

5.6.2 - Hypotheses for Wilcoxon Signed Rank Tests

\[ H_0 = M\sigma_2 - M\sigma_1 = 0 \]
\[ H_a = M\sigma_2 - M\sigma_1 > 0 \]
\[ H_0 = M\beta_2 - M\beta_1 = 0 \]
\[ H_a = M\beta_2 - M\beta_1 > 0 \]

We reject the null hypothesis in favor of the alternative hypothesis in both tests were standard deviation and beta is measured on a time period covering 75 days before and 75 days after the stock split. Thus, indicating that the median of the measure of volatility in the post-split group is significantly higher than pre-split.

However, when excluding 10 days before the stock split and 10 days after the stock split, thus measuring -75 to -10 days and +10 to +75 days surrounding the stock split the results are different. The test performed on standard deviation and beta resulted in quite high significance values, thus we cannot reject the null hypothesis.

As the results differ depending upon which time period the volatility measures have been measured on it indicates that the most volatility increases occur in the 10 closest before and the 10 days after the stock split date. To clarify, the results become significant and indicate an increase in volatility following a stock split, only when the 10 days before and after the stock split date is included.

5.6.3 - Wilcoxon Signed Rank Tests and the Size Segments

We cannot reject the null hypothesis for mid cap and small cap. The test performed on the large cap observations on the other hand resulted in p-values of 0.052 on the test on standard deviation and 0.005 when testing beta. Accordingly, there is a higher median of both standard deviation and beta in the post-split than pre-split in the large cap segment, but not in small or mid cap. Also the test on the standard deviation and beta were the 10 days closest before and after the stock split is excluded proved quite low p-values and we can reject the null hypothesis in favor of the alternative hypothesis.
5.6.4 - Hypotheses for the Binomial Z Test

\[ H_0 = \Pr (\sigma_2 > \sigma_1) = 0.5 \]
\[ H_a = \Pr (\sigma_2 > \sigma_1) > 0.5 \]

\[ H_0 = \Pr (\beta_2 > \beta_1) = 0.5 \]
\[ H_a = \Pr (\beta_2 > \beta_1) > 0.5 \]

The binomial Z test resulted in a rejection of the null hypothesis in favor of the alternative hypothesis when measuring standard deviation and beta on a time period of 75 days pre and 75 days post the stock split. Thus, indicating that the proportion of increases in standard deviation and beta is significantly higher post- than pre-split. However, just as for the Wilcoxon Signed Rank Test results we could not reject the null hypothesis when measuring the variables on a time period of -75 to -10 days before and +10 to +75 days after the stock split. Again, indicating that most of the increases in volatility occur in the time nearby the stock split date.

5.6.5 - Binomial Z test and the Size Segments

Again, just as for the Wilcoxon Tests only the large cap segment proved significant results, whereas we could not reject the null hypothesis for the small and mid cap segments. All four test performed on the large cap segment had low p-values thus we reject the null hypothesis in favor of the alternative. What is notable is that in the large cap segment, compared to the tests on all observations, there is no difference in test results depending on which time period is used when calculating the volatility measures.
Chapter 6 – Discussion

This chapter will include a discussion of the empirical results in relation to previous research and the theoretical framework presented in chapter 3. The chapter starts off with an overall summary of the empirical results. It is then followed by an interpretation of the findings in relation to the signaling theory, the liquidity hypothesis, the optimal price/tick, agency theory and the procedure/structure hypothesis. Lastly, the empirical results are discussed in light of the economic irrelevance theory.

6.1 - Brief Summary of the Empirical Results

The paired samples t-tests produced high p-values meaning we could not reject the null hypotheses, providing evidence against that the mean of standard deviation and beta significantly differs before and after a stock split. However, as the t-test relies to an extent upon the assumption of normal distribution the evidence provided by these tests are not as reliable as test with less rigid assumptions. As the variables were not normally distributed the paired samples t-test is not as suitable as the Wilcoxon Rank Signed Test or the binomial Z test. The two aforementioned tests resulted in similar findings but different from the paired samples t-tests. In most of these tests (Wilcoxon and binomial Z test) the null hypothesis were rejected in favor of the alternative hypothesis when testing all observations. However, when performing the Wilcoxon test and binomial Z test with standard deviation and beta using a time period of -75 to -10 days before and +10 to +75 days after the stock split we could not reject the null hypothesis. Neither could the null hypothesis be rejected in the small and mid cap segments for any of the tests. The large cap segment resulted in findings supporting the alternative hypothesis both in the Wilcoxon test and the binomial Z test.

The empirical results indicate that there actually seem to be a significant increase in standard deviation and beta following a stock split. These findings are in coherence with the findings of Ohlson and Penman (1985) and Brennan and Copeland (1988b). On the contrary, the findings are not consistent with theory where the stock split should have no effect on volatility (Brennan and Copeland, 1988b, p.1012).

Moreover, the findings suggest that the main increase in volatility can be ascribed to the 10 days before and the 10 days after the stock split date. Additionally, the volatility increases mainly seem to be ascribed to the large cap segment as well. The results for small and mid cap proved low p-values which indicate that there is no significant difference in the volatility measures before and after the stock splits conducted in these segments, whereas there is an significant increase in the volatility measures in the large cap segment.

It is also interesting to highlight that from the 90 stock split observations in the sample, over 50 % were conducted during 2005 to 2007. Additionally, there seem to exist a seasonal effect in the sample as well. Out of 90 stock splits, 32 occurred in the month of May. June follows with 18 splits and April also seems to be a popular month totaling 15 splits. None of the 90 stock splits observed occurred in January. The fact that the sample observations are not evenly spread among the years covered and between the months should be taken into consideration, as it might have an effect on volatility. Thus, one should be aware of this when interpreting the findings.
6.2 - Empirical Findings and the Signaling Theory

As discussed in chapter 3, He and Wang (2012, p.132) explained that the signaling theory hypothesized that a stock split announcement should signal information about future performance from managers to investors. If the volatility in the post-split period is significantly higher than it has been in the pre-period of the stock split we could be able to assume that the signaling effect might be present. Thus, the difference in volatility pre-split compared to post-split could be the result of the signaling effect.

Grinblatt et al., (1984, p.461-462) mentioned that the effect a stock split has on accounting is only cosmetic. Although, the majority of our empirical findings says different. Two out of the three statistical tests that were conducted in this study shows that the post-split volatility is higher than the pre-split volatility for both standard deviation and beta when 75 days before and 75 days after the stock split are taken into account. This could mean that the signaling effect might be present among our observations. Since the tests generated no significant results when 10 days before and after the split date was removed, we can assume that if the signaling effect is present, the signaling is effective immediate after the split has been conducted.

McNichols and Dravid (1990, p.857) hypothesized that managers might signal their private information through stock splits. Most of the findings generated in this study might support their belief. Since we see an increase in volatility directly after the stock split has been conducted, it is not unreasonable to assume that investors starts trading because of the fact that they believe that a stock split is a positive indicator of future performance. Thus, managers might be able to send a signal to investors about future performance through a stock split conduction.

Examining the size segments, we see that for the two tests, Wilcoxon test and the binomials Z test, that were conducted on the size segments both generated approximately the same results. For small and mid cap companies there is no significant change in volatility after the stock split compared to before the stock split. In the large cap segment however, volatility increased following a stock split. We hypothesize that the signaling effect might be present among our observations, but the reason as to why it is only notable in the large cap segment is because investors that place money on large cap companies are more active traders. Hence, they are more open to signals and act on these. Small and mid cap investors however might be comfortable with holding shares for a longer period of time and may not care as much about signals of future performance.

6.3 – Liquidity Hypothesis and the Empirical Findings

The empirical findings in this study seem to point toward a slight increase in return volatility of a stock following a stock split. As such, the findings contradict the economic irrelevance that a stock split is assumed in theory to have. Accordingly, it is of interest to discuss how these findings might be explained by the liquidity hypothesis.

The liquidity hypothesis proposes that liquidity is enhanced by increased trading volume or an increased number of shareholders (Baker et al., 1995, p.29). It is probable to expect a higher return volatility when trading volume increases or more shareholders invest in the stock. Accordingly, the consequence of a stock split is a lowered share price. This lower share price may attract more investors and increase trading and
transactions as evidenced by Lakonishok and Lev (1987) and Maloney and Mulherin (1992), which in turn can lead to an increased return volatility.

As the empirical result point toward most volatility increases occurring in the large cap segment following a stock split rather than in the small or mid cap segment also suggest that the liquidity hypothesis can, to an extent, explain the findings. This is because it is reasonable to assume that the trading volume is higher in the large cap segment. Companies listed in large cap are often more familiar to the investor and have a higher news coverage than smaller firms. Therefore, it could be hypothesized that a stock split made by a firm in the large cap segment will receive more attention than small or mid cap firms. Consequently, increased liquidity in the form of higher trading volume and number of shareholders should be more probable for a large cap firm than a small cap firm or a mid cap firm following a stock split. Which, in turn, can affect return volatility.

Moreover, the empirical finding that it seems to be the 10 days closest after the split date that increases standard deviation and beta the most can also be seen as a sign of the liquidity hypothesis. This can be argued as increased trading is likely to occur due to the new share price and the attraction of smaller scale investors, which subsequently may affect return volatility.

6.4 - Optimal Price/Tick Hypothesis

He and Wang (2012, p.125) mention that a stock has an optimal price and tick size range. He and Wang (2012, p.125) also mentioned that a company which holds stocks for which the price is too high and the tick size is too low benefits from conducting a stock split since that will bring the price and the tick size to its optimal range. We can therefore hypothesize that if this is true, volatility should increase when a certain stock reaches this optimal price and tick range. This because the stock becomes more popular due to its optimal price and thus trading increases which subsequently may increase volatility. As mentioned earlier, both standard deviation and beta -75 to +75 days shows a significant increase in volatility in the post-split period compared to the pre-split period. Therefore, we can assume that there might be an optimal price and tick. In case there is, investors are reacting immediately after the stock split has been conducted. We can assume that since we found no significant results when 10 days right before and after the stock split has been removed.

Although, since we do not find that volatility is significantly higher after a stock split when measuring -10 to -75 and +10 to +75 days after a stock split, our results could also contradict to the optimal price/tick hypothesis since volatility does not stay high for long. If a stock moved to the optimal price and tick size, we should be able to see a continuously high volatility since investors should be more eager to trade among stocks that are in the optimal price and tick size. Hence, the effect should be more consistent and not only aim at the days closest after the stock split. Alternatively, it could be that the stock split leads to an optimal price right after the split, which increases trading which in turn increases volatility. Consequently, stock prices rise and the stock moves away from its optimal price and therefore trading decreases or stabilizes, in turn decreasing or stabilizing return volatility closer to its pre-split levels.

Examining the size segments, we find that only the large cap segment seems to be affected by a stock split. We can therefore hypothesize that large cap investors might be
more price sensitive and therefore more likely to start trading when a stock split occurs than investors in the small and mid cap segment.

6.5 - The Procedure/Structure Hypothesis

As mentioned in chapter 3, the procedure/structure hypothesis examines regulations that affects stock splits as well as other features but also the market structure of trading in relation to stock splits (He and Wang, 2012, p.136). The hypothesis explains among other things that the reason to abnormal returns on the ex-date is because of a tax effect, microstructure of the market and inconveniences on the record day (He and Wang, 2012, p.136). Our study shows that this might be the case. Since we found that volatility is higher on the ex-date through most of our tests, we can argue that the tax effect, microstructure of the market and inconveniences on the record day due to the stock split might explain the volatility increase in the post-split period.

The procedure/structure hypothesis is also bringing up, among other things that volatility is higher because small-volume investors are attracted by the when-issued trading (trading before the ex-split date but after the record day) and after the split, they go back to “trading the regular way” and volatility increases. This is interesting since it goes in line with our findings.

6.6 - Agency Theory, Information Asymmetry and the Empirical Findings

An announcement and the conduction of a stock split is a piece of information that managers might have had for long time. Once management declares it to the public the outside investors might become wary that the managers know more than they do. In such a situation information asymmetry arises. According to Cheng (2008, p.108) a declaration of a stock split conveys positive inside information to shareholders which reduces the information gap and in the long term increases firm value.

If a stock split conveys management’s positive inside information to the investor it might reduce the information gap. However, it could be argued that it might increase information asymmetry as well and increase agency costs. Especially if shareholders feel that they do not receive sufficient information regarding the split and thus feel the need to monitor management more closely. Either way, the empirical findings in this study could partly be explained by the agency theory. Either decreased or increased information asymmetry subsequent to a stock split announcement could have an impact on stock price movements, consequently affecting return volatility. It is reasonable to assume that with greater dispersion of ownership the smaller the agency costs will be, thus the relationship between stock splits and return volatility might also be affected by the ownership structure of the firm at hand. More specifically, the greater the institutional ownership is the lower the information asymmetries are due to the resourceful information acquisition of these institutions (Baker et al., 1995, p.27). As such, a firm that has low institutional ownership conveys much more newsworthy and “inside information” to its investors when declaring a stock split than a firm with high institutional ownership does. Consequently, the share price reaction following a stock split might have more momentum in the low institutional ownership firm.
6.7 - Economic Irrelevance Theory and Empirical Findings

Millar and Fielitz (1973, p.35) mention that the only thing that happens when a stock split is conducted is that shares outstanding increases and the par value decreases. If this was true, we believe there to be no difference in volatility in the pre-split period compared to the post-split period. Although, the empirical findings generated in this, and many other studies, indicate that a stock split has an effect on volatility. Findings show that the market reaction to a stock split is immediate. However, according to economic irrelevance theory, if one would measure the effect a stock split has on volatility a period after the conduction of a stock split, then they would find volatility to be unchanged.

Dowen (1990, p.927) mentioned that a company cannot just change their shares outstanding and expect their market value to change. Our findings, however, shows that this is probably not the case. Since most of our findings indicate that volatility rises directly after a stock split, there has to be circumstances that increases volatility in the aftermath. What these circumstances are is hard to say, but as mentioned, there are theories contradicting the economic irrelevance, and these might be very applicable for our findings.

The economic irrelevance theory does actually fit in rather good with the findings in the small and mid cap segment. It might very well be that a stock split is not relevant for the market in these segments and therefore, the companies in these segments cannot change their market value through changing the amount of shares outstanding. Hence, the economic irrelevance theory might be of interest for some of the findings in this study. But overall, the main findings of this study contradict the economic irrelevance theory a stock split is assumed to have.
Chapter 7 – Conclusion

This chapter will go back to the research question and finally conclude upon it in light of the empirical findings. The chapter then continues with concluding comments on how the research purpose is achieved, the input to the research gap and the contribution of the research. The chapter ends with suggestions on how the study could be extended in further research.

7.1 – Answer to the Research Question

With the empirical results presented in chapter 5 and the discussion in chapter 6 we will now provide the reader with a conclusion upon the research question which was presented in the first chapter. It reads as follows:

“Does a stock split affect stock return volatility on stocks listed on NASDAQ OMX Stockholm?”

With a deductive approach using a quantitative method and a longitudinal and cross-sectional design covering the years 2002-2012 we developed hypotheses based on previous literature. This in order to answer the research question at hand. We observed 90 stock splits during these years by firms listed on NASDAQ OMX Stockholm that had a split factor of at least 2:1. The hypotheses were then tested by means of the paired samples t-test, the Wilcoxon Signed Rank Test and the binomial Z test. The empirical results from these tests were presented in chapter 5 and discussed in relation to the theoretical frame of reference in chapter 6.

The findings of both the Wilcoxon Signed Rank Test and the binomial Z test which are both non-parametric test, and thus more suited for this study’s data, indicate that there is an increase in standard deviation as well as beta in the post-split period. We therefore conclude upon the research question with yes, a stock split conducted by a firm listed on NASDAQ OMX Stockholm can affect its stock return volatility post-split.

According to theory the event of a stock split should be of economic irrelevance for the firm. Thus, a stock split should not affect firm value and thus not stock return volatility. The findings of this study directly contradicts this. The empirical results are similar to Ohlson and Penman’s (1985) as a significant increase in standard deviation is identified post-split. Additionally, a significant increase in systematic risk measured as beta post-split is identified which is in line with Brennan and Copeland’s (1988b) findings.

Moreover, we can conclude from the empirical findings that the main volatility increases may be attributed to the period closest to the actual stock split date. Additionally, the main volatility increases following a stock split may also be ascribed to firms in the large cap segment. We discussed that this could be due to higher trading activity in the large cap segment than in the smaller size segments. Furthermore, it should be emphasized that, as could be seen from the descriptive statistics, there is a seasonal effect with most stock splits occurring in April through June and between the years 2005-2007. This could possibly affect the result.

Finally, the findings of this study were discussed as possibly being explained by enhanced liquidity, signaling hypothesis, information asymmetries and agency costs as well as the hypothesis of the optimal price/tick.
7.2 - Fulfillment of Research Purpose, Research Gap and Contribution

The main purpose of this research was to investigate if a stock split is related to significant changes, specifically increases, in return volatility in a period following the split date. Secondly, we aimed to see whether old findings such as Ohlson and Penman’s dating back to 1985 still hold grounds and if they also hold in a different market (Sweden). Thirdly, we aimed to examine if there is a difference between the impact of a stock split on return volatility between small, mid and large cap firms.

The findings in this study suggest that there is an increase in return volatility, measured as both standard deviation and beta, in the post-split period. Additionally, that this change is mostly attributed to the days closest after the split date. Thus, the elevated levels of return volatility seem to stabilize or decrease the longer period after the split. Moreover, the main increases in return volatility are also ascribed to firms conducting stock splits in the large cap segment.

As the findings suggest that the main volatility increases occur in the days closest after the split and then seem to stabilize the implication for investors is not that large. Investors who actively trade day to day might find a window to beat the market during the days surrounding the stock split. For management, the findings suggest that the effect of a stock split on return volatility is not continuous for a very long period and thus it should not be a concern when considering a conducting a stock split.

We have with this study on the Swedish market tried to contribute to a research area which mainly have evidence from the US market. As the US and Swedish market differs we were not sure that research previously conducted in the US would hold ground on the Swedish market. However, as stated, this study actually confirms the findings of many studies primarily conducted in the US. Moreover, most previous research on this topic dates back to the 1980-90s. Thus, with this study we have contributed with more updated knowledge on the topic.

Furthermore, we aimed for this study to contribute both in a theoretical manner as well as a practical manner. The theoretical contribution is that we have provided a base for further research on this topic that could focus on the Nordic markets. The practical contribution has been updating knowledge on the relationship between stock splits and return volatility that both managers as well as investors can benefit from.

7.3 - Suggestions for Further Research

Although this research answers a lot of questions regarding the affect a stock split has on volatility, there are more issues to be examined. Throughout the research process we have come to think of a few suggestions for further research to help deepen the understanding of stock splits’ relationship with volatility. These will be presented in this section.

Firstly, as this study examines if a stock split has an effect on volatility, an interesting study would be to examine why stock splits affect volatility. We have tried to explain our findings in the discussion with help from previous suggested theories but this is mostly speculation. Thus, an inductive study with qualitative nature could be used to examine this issue further. By doing so, the reasons behind our findings would be explored and a deeper understanding of stock splits effect on volatility would follow.
Secondly, although NASDAQ OMX Stockholm provided us with a large enough sample, it would be interesting to see if an even larger sample would generate the same results. Since this would be hard to do on the Swedish market alone, we suggest that a research is conducted on the whole Nordic market.

Thirdly, it would be of great interest to conduct a study which examines only the days closest before and after the split date. That is, doing the opposite of what was done in this study and examine for instance only -15 days to +15 days around the stock split. That is since we found that volatility is at its highest directly after the conduction of a stock split.

Fourthly, this study has only examined the effect stock splits have on volatility and hence, only observations that conducts a stock split has been included in the sample. It would of interest for further research to compare the volatility of companies that has conducted a stock split to a control group of companies that has not conducted a stock split and see how the results differ.

Fifthly, this study was conducted on the whole NASDAQ OMX Stockholm. In the future, it would be interesting to expand this study and examine whether the effect a stock split has on volatility is different in different sectors. It would be interesting to see if the effect is stronger in some sectors than others.

Finally, as the majority of the stock splits are conducted around May, a suggestion for further research is to examine if there is a difference in the effect a stock split has on volatility depending on which month of the year the stock split is conducted in. Hence, it would be interesting to see if this could be the reason companies choose to conduct stock split in foremost April, May, June.
Reference List


