Impact of Exchange Rates on Swedish Stock Performances:
Empirical study on USD and EUR exchange rates on the Swedish stock market.

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Abstract

This paper examines the impact of USD and EUR exchange rates on the Swedish stock market performance for different economic sectors over a time period of ten years (2003-2013). The growing integration between foreign exchange markets and stock markets with the wide spread use of hedging and diversification policies made it necessary to test the degree of impact these two distinct markets share between each other. Number of studies, were done studying the relationship between the exchange rates and stock performance combining and comparing different economies and currencies. Nevertheless, research gap prevailed when it came at the point of the studying the relationship on Swedish stock and foreign exchange market. The research was conducted with the quantitative method. Initially we have tested how the performance of Swedish stock market is correlated with the return of the USD and EUR in different economic sectors over different time periods. Later, we try to investigate if there is any spillover effect flows from the exchange market to the Swedish stock market. The Pearson’s correlation coefficient and GARCH (1,1) model were applied to study the correlation and spillover effect between the exchange and stock return respectively. Our empirical study showed that there is very low correlation which is statistically insignificant between the two different markets. Correlations were found to be significantly varied across the different economic sectors in different time periods. Moreover empirical study supported that the spillover effect exists and showed that movement of exchange rates will affect the future performance of stock market. The significant conclusions were that USD and EUR can be used as portfolio diversification and during the volatile exchange market, investors should diversify or hedge their risk domestically and vice versa. The implications of this finding is particularly very important for the portfolio managers when devising their hedging policies and diversifying their portfolios in order to minimize their unsystematic risk.

Keywords: Exchange rates, stock performance, Sweden, correlation, volatility spillover, diversification, hedging, GARCH (1,1).
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Glossary

Asian Tiger economies: Asian Tiger Economies consist of Hong Kong, South Korea, Taiwan and Singapore (Yusuf & Nabeshima, 2009, pp. 1-3).

Bear market (“Bearish”) is an expression for a widespread decline in security prices (Brealey et al., 2011, p. 911).

Bull market (“Bullish”) is an expression for a widespread rise in security prices (Brealey et al., 2011, p. 912).

Devaluation reduces the value of a fixed exchange rate (Begg et al., 2011, p. 691).

Fixed exchange rate is an exchange rate that has been fixed rate which it is being convertible against (Begg et al., 2011, p. 692).

Floating exchange rate is an exchange rate that has been allowed to find its equilibrium level without the central bank intervening with the help of FOREX reserves (Begg et al., 2011, p. 692).

G7 countries: G 7 countries include USA, Canada, France, Italy, Germany, UK and Japan (Yung-Yang & Doong, 2004, p. 142).

Growth-stocks are stocks that have low book-value-to-share-price ratios with high potential growth (Brealey et al., 2011, p.918).

Nominal Exchange Rate is the rate that can be observed at the time of measurement (Begg et al., 2011, p. 696).

Speculating is when you take a long-/short position in an asset in the hope that the value of the asset will increase/decrease (Begg et al., 2011, p. 559).

Spillover effect “the effect that one situation or problem has on another situation: for example, the weak European economy will have a spillover effect on the US dollar” (Longman, 2013).

Value-stocks are stocks that are intended to provide a steady return but with relatively low growth, are also referred to as stocks that have low ratios to market-to-book value (Brealey et al., 2011, p.926).

Abbreviations

ECB – European Central Bank
EMU – European Monetary Union
EUR - Euro
FOREX – Foreign Exchange
IMF – International Monetary Fund
SEK – Swedish Kronor
USD – US Dollar
Chapter 1 - Introduction

1.0 Historical overlook of the Swedish Currency from Bretton Woods to the present

The international currency- and payment system plays a crucial part in how well trade and capital moves between countries. A long history of monetary development lies as a ground to how the economic system works today (Ahlström & Carlson, 2006, p. 18). If we go back in history, many different metals have served as monetary standards (with gold and silver as the most dominant standards used in history), the monetary standard worked as a benchmark where the other types of money were converted against. Almost every important trading nation had adopted the gold standard in the beginning of the twentieth century. In practice, the amount of gold the country held in their central banks determined the amount of credit it could extend. The movement of gold across borders worked as a balance of payment, which caused fluctuations in total money supply and domestic prices (Cameron & Neal, 2003, p. 299).

The gold standard worked as a stabilizer on price movements but during and after the World War I countries abandoned the gold standard in order to borrow and print more money, which in the end led to inflation. The result from the increased inflation was that international trade suffered from decreased exports and imports. To fight the problem with international trade and wrongly valued currencies different tariffs were implemented to help the country's economy, some countries devaluated their currency to become more competitive on the global market, while others kept printing more money (Cameron & Neal, 2003, pp. 342-344).

After the demolition of Europe after World War II, the allies (USA and UK among others) decided during a monetary and financial conference in Bretton Woods (that off the name “Bretton Woods system”), New Hampshire, USA in June 1944 that something had to be done to support a healthy international economy. One of the points on the agenda was how to stabilize world trade. This led to the creation of the International Monetary Fund (IMF) and International Bank of Reconstruction and Development. IMF was allocated the responsibility to stabilize nominal exchange rates (here after just exchange rate) among member states, resulting in a fixed exchange rate against the US Dollar (USD) (USA was the economic powerhouse with promised loans to European allies) in return USA promised to trade USD against gold at a fixed rate (Cameron & Neal, 2003, p. 364).

The Bretton-Woods system broke down after the Vietnam War when US public finances became unbalanced and voices were raised if the USD was overvalued. This was not specific to only the USD, the UK pound faced the same concerns, and when the value of more currencies was questioned, the IMF had to let them float which led to the end of the Bretton Wood system (Fraser-Sampson, 2011, pp. 204-205).

Sweden, who held a position as a neutral country became member of IMF in August 1951 and fixed its exchange rate (SEK) against the USD at an rate of 5.17 SEK/1.00 USD (Edvinsson, 2009, p. 21).

Even though the Bretton Woods system broke down in early 70's, the SEK stayed fixed against the USD until early 1990’s when voices were raised if the SEK were overvalued or not. The Swedish National Bank did whatever they could to protect their fixed exchange rate, but they were forced to let the SEK float in 1992 (many devaluations had been done during
the period between the 70’s and 90’s), and it has been floated ever since (Jonung, 2000, pp. 24-26).
The Economic and Monetary Union (EMU) is collaboration between member states within
the European Union (EU) where all member states have the same currency, the Euro (EUR).
The EUR which was introduced January 1st 2002, states that the member states also need to
have the same monetary policy, where the European Central Bank (ECB) has the prime
responsibility. Together, they try to stabilize price movements and economic growth. 17 out
of 27 EU member states have joined the EMU, among them major economies like Spain, France and Germany (EU-Upplysningen, 2013) (EU-upplysningen).
The Swedish people voted for entering the EMU or not in 2003, a majority of the Swedish
voters turned down the suggestion and that’s why Swedes have their own currency, which is
floated against the EUR (European Union, 2012).

1.1 Problem background
With the floating exchange rate from the collapse of the Bretton Woods system, the exchange
rates became more volatile (Fraser-Sampson, 2011, pp. 205, 221).
Due to the high volatility linked with floating exchange rates, the currency risk has increased
as well, and this is something that global investors need to keep in mind when investing
internationally. Studies have been done on the subject of currency risk, Raheman et al. (2012),
Asaolu (2011), Lee (2010) and Horobet & Ilie (2010) all found that the currency risk has a big
impact on either cash-flows for international enterprises or for investors who are investing
abroad.
Nowadays when money flows more easily over borders to other markets, investors are given
the possibility to invest in foreign markets all around the world in the hunt for higher return
(Ekonomifakta, 2013). The Swedish stock market has given, in average, a return of 10-12
percent between the years 1978 and 2008 (Wilke, 2010, pp. 30-31). If you compare the
Swedish NASDAQ OMX and the American Dow Jones Industrial Index you can see from
figure 1 that the Swedish market is more volatile than the American with higher peaks and
lower troughs, which might give you the indication that the Swedish stock market is more
risky than the American Dow Jones Industrials.

Figure 1 – OMXSPI vs. DJI
(Ekonomifakta, 2013)
During the last twelve years, we have experienced at least three well-known crises, the IT-bubble which burst in 2001, the financial crisis in the US in 2008, and the European budget crisis in 2010-2011, and as a consequence, more Swede’s has left stocks for less risky investments. In 2002, 22.6 percent of the Swedish population owned stocks, this number has decreased to only 15.3 percentage in June 2012. One of the sectors of investors that has grown during the same period is the foreign investors, the increase of investors investing in Sweden has increased from 33.7 percentage in 2002 till 39.2 percentage in June 2012 during the same twelve year period. The USA (27.1%) and the UK (23.6%) are the two dominating countries among the group of foreign investors (Statistics Sweden, 2012).

If we take into consideration different currencies and sort the international investors by currencies on the date of 12-06-01, we can see from table 1 that countries with Euro as their currency owns 27.4 percent of the stock investments on the Swedish stock market (just above the US).

<table>
<thead>
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<th>Foreign ownership in companies traded on the Swedish Stock Exchange in percentage, 1999 – 2012</th>
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<tr>
<td>Belgium</td>
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<tr>
<td>Denmark</td>
</tr>
<tr>
<td>Finland</td>
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<tr>
<td>France</td>
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<tr>
<td>Ireland</td>
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<td>Japan</td>
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<td>Luxemburg</td>
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<td>Netherlands</td>
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<td>Norway</td>
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<td>Switzerland</td>
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<td>Germany</td>
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<td>USA</td>
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<tr>
<td>Countries</td>
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<tr>
<td>other</td>
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</table>

Table 1 – Foreign and domestic stock ownership (Statistics Sweden, 2013)

There has not been done a lot of research on this area, but research done by Tian & Ma (2010) found a positive correlation between movements in the exchange rate and stock prices, a research where they analyzed the changes in exchange rates of Hong Kong Dollar (HKD)/Yuan and USD/Yuan on the Chinese stock market. Other research done by Muller & Verschoor (2006, 2007, and 2009) shows that European stock returns are negative when the European currency depreciates against a foreign currency, the same result occurred when the authors analyzed the Asian markets and Asian currencies against foreign currencies. The third research the authors did in 2009 was on the US market where they analyzed if the risk in currency was correlated with the risk in the stock market after financial crisis, the result was a positive correlation.
Due to the increased foreign investors on the Swedish stock market and the extremely big market of foreign exchange it would be interesting to see how changes in the exchange rate affect the stock market. Due to the lack of research specifically related to the Swedish stock market and their currency we think that more research must be done.

1.2 Target Audience
This master thesis is written for researchers, investors and students who are interested in the financial market and in different financial instruments. We would recommend that the readers have basic fundamental knowledge in finance, investments and statistics to be able to grasp all the concepts and data we use and understand its importance to our research question.

1.3 Research Question & objective
Based on the problem background, the authors found that there is a sheer importance for the assessment of reflection of change of exchange rate on the stock market. The lack for research in this area in general and specifically directed to the Swedish market, which is exactly what this research will be directed towards. The objective of this research work is to find a relationship between the changes in exchange rates and their impact on stock return performance. In order to get a deeper understanding of the subject, this research paper will focus on the Swedish stock market (OMXSPI) and segregating the market into different economic sectors over different sub periods during 10 years. The considered currencies will be EUR and USD measured against SEK for the reasons explained earlier (in 1.1 Problem Background). In order to fulfill this objective, the authors have come up with the following research question:

- Research Question: Is there any impact from changes in Dollar and Euro exchange rates on the performance of Swedish Stocks?

  Sub question 1: Is there any correlation between the dollar & euro exchange rates and the Swedish stock market?

  Sub Question 2: Is there any Volatility Spillover effect within dollar & euro exchange market and the Swedish stock market?

1.4 Research Purpose
Considering the importance of the study from the problem background, the first purpose of our study is to test the relationship of the Swedish financial market and the currency market. The study will serve the purpose of measuring the degree of integration of Swedish stock performance and the USD and EUR exchange rate against the SEK. As the authors mentioned earlier in Research objective, the idea is to give the reader an in depth understanding both from a theoretical- and practical perspective of the research questions. In order to give the profound understanding of the research question, the Swedish stock market will be divided into different economic sectors and find the correlation between these different economic sectors with the exchange rates over the different sub periods in last ten years. Thus it will be more convenient to understand the impact of foreign exchange spreading over the whole Swedish stock market.
In addition, the study investigates the relation lies between the volatility of the foreign exchange and the Swedish stock performance. Currency risk involves a paradox with diversification. Currency risk can be considered as an obstacle for the international diversification, but at the same time number of studies and theories agreed that international diversification can produce more benefit in comparison with the domestic diversification. Thus the research question of identifying the linkage between the currency risk and the stock price risk will contribute to the better understanding of the currency risk for the investors and reduce their misunderstanding.

Moreover, by identifying, quantifying and defining the kind of link between these currencies and the Swedish stock market, the study will try to find a pattern or anomalies within the relationship. As it is discussed in the problem background, during the last 10 years several financial crises have hit the global financial markets and currency market, so to justify that if there are any other external factors affecting the relationship the time frame for the study will be divided into different economic cycles within the 10 year period to give more reliable results.

In general this study comes with different dimension and depth. The authors considered two different major currencies, the impact of these exchange rate changes on the Swedish stock index (NASDAQ, OMX, Stockholm) and then the further impact on different economic sectors.

Finally, good understanding of the linkage between currency and equity market will serve the purpose of efficient portfolio formation, both in aspect of returns, and risk allocation.

1.5 Research gap and Contribution

The growing degree of integration over time between the global equity markets and the FOREX market has increased the demand for research in this field. On the top of that, a couple of financial crises during the last 10 years have hit the global economy so hard that it has become necessary to understand the linkage between different financial markets. A study done by Tian & Ma (2010) studied the relationship between exchange rate and stock performance in the Chinese market. They found a positive correlation between these two variables. Muller & Verschoor (2006, 2007, 2009) did three different researches on different markets; USA, Asia and Europe to investigate the relationship between the exchange rate and the stock return. The empirical study by Muller & Verschoor (2009) where they tested the relationship between exchange rates and the US equity market stated that after a financial crisis the stock volatility has increased significantly and got more sensitive to the exchange rate especially on the trade and service oriented industries. Similar results derived from the empirical study done on Europe (2006) and Asia (2007). The European study showed that a depreciating euro against a foreign currency had a negative impact on the European stock return. Similar results derived from the empirical study in Asia from 2007.

Despite number of studies that are done regarding the relationship of exchange rate and stock performance, authors could not come up with any similar study done on Swedish stock market. Moreover, most of the studies tested the relation of different stock markets against single foreign currency, but in our study we chose to fill up this knowledge gap through testing the relationship of Swedish stock performance over two different currencies .i.e. USD & EUR, that means we are considering two currencies and comparing them separately with the Swedish stock market.
The studies done on Asia and Europe by Muller & Verschoor (2006, 2007) took a more
general approach to the study by considering a group of countries instead of critically
examining one country’s financial market against several currencies. Among the few research
papers that the authors could find that had been done on a specific country and with different
currencies are Muller & Verschoor (2009) where they studied the US equity market with the
changes in currencies from Asia and Latin America; and later on the study done by Tian &
Ma (2010) on the relationship between returns on the Chinese stock market and changes in the
exchange rates of Hong Kong dollar/Yuan and USD/Yuan.

The research is intended to contribute to fill up this research gap. This study is expected to
contribute in the benefit of academic and business research purpose and also for the
knowledge of investors.

Contribution to academic and business research: Both exchange rate and the stock return are
very attractive arena to research due to their high volatile characteristics. This research paper
aims to contribute scientifically by studying these two variables in the context of Sweden. The
scientific data collection approach and analysis assessing the impact of changes in USD/SEK
and EUR/SEK on the performance of stocks in different economic sectors on Swedish stock
market will fill up this research gap. The scientific data we are using for the research and our
result from this empirical study will enhance and provide a guideline for the further research.

Investors: The knowledge on the degree of dependency between these two variables will
allow the investors to diversify their international portfolio efficiently. The degree of
correlation will help the investors to construct their hedging policy and they will be able to
identify their exposure to the currency risk for their portfolio and diversify this currency risk
with proper hedging tools. Another contribution is the probability to predict movements on
the stock market by analyzing the FOREX market. A third contribution from an investor’s
perspective would be that an understanding of the relationship might argue against or for the
use of hedging to minimize the currency risk.

1.7 Delimitations
Like every other research, this study has its own delimitation. Limitations had to set up for the
choices made for this research. According to our research topic, the chosen variable includes
the currencies, Swedish stocks and time frame. Here in this following chapter we will try to
logically portray our choices for the selection of variables.

Firstly, the time frame can be considered as one of the delimitations for this research. The
delimitation chosen for this research is the 10 years period. We could have generated more
historical data for more than 10 years, but we limited ourselves in this particular period
because we observed that this period consists of bull market, bearish market and also the
recovery. Thus a complete economic cycle can be found within this period. Therefore while
analyzing this period it can be expected that all the other factors which are influencing the
relationship will neutralize within these positive and negative effects

Secondly, the geographical delimitation exists. This study is only performed on the Swedish
stocks performances because being the researchers from Sweden we wanted to make our
research convenient and useful for the academic and practical purposes in the context of
Sweden. We could have chosen other Nordic countries but we skipped that because we agreed
upon the idea that these Nordic stock markets have high chances to exhibit similar
characteristics thus to keep it simple and for better understanding we chose only Swedish stock market.

Thirdly, the boundary for choosing the foreign currencies has been restricted within USD and EUR. We intentionally avoided choosing other currencies like Chinese Yen and British pound sterling (GBP). We did not choose pound because we thought it will not create very distinct impact on Swedish stock market than the EUR. Chinese Yuan exchange rates is not as floating as the currencies like EUR or USD, thus it does not share much common characteristics as our other chosen currencies and more over there have been number of studies on China and other Asian economies regarding the similar research question. Lastly, but not the least, we had time constraints for this research work, so we tried to keep it simple for our reader to have better understanding.

1.8 Model of Research

Figure 2 shows how the research will be structured. At first, a theoretical framework has been built, upon which the knowledge will be built. The philosophical standpoint, research strategy and research approach are mentioned in this part. Secondly, literature review has been done. This part consists of all the theories regarding the research topic and studies, which had been done previously by different researchers. The third part represents the data collection. Data has been collected for both USD and EUR exchange rates against SEK and also for the Swedish stock market performance (and for different economic sectors) over the chosen time horizon. Fourth step, the correlation will be tested between the exchange rates and stock market performance and also the spill-over effect between the volatilities of the currencies and the stock prices will be tested. Fifth step, we will discuss the empirical findings from our quantitative study and interpret them to answer our research question. Detail explanation will be mentioned on how our findings and interpretation can be used by the investors in order to have a better understanding of the diversification involving foreign currencies. Lastly, a conclusion on the basis of our research question will be drawn from the discussion.
1.9 Disposition

Chapter 1 – Introduction
Page: 10-17
In this first part of the thesis we introduce our reader to the topic of financial market and the exchange rate market. Primarily we start out by providing a historical background of our chosen topic. We clarify the significance and value of our research idea with the historical significance. Then it leads us to the problem background and the research question followed by the knowledge gap, research purpose and contributions and our delimitations. Research model has been constructed to give a visual idea to the flow of the research. Lastly, we give the readers the overall disposition of our thesis.

Chapter 2 - Theoretical Methodology
Page: 18-28
This chapter states and elaborately explains the research philosophy, approach, types, methodology and research strategy. Data collection method and literature source has been mention in this chapter as well. Moreover, this chapter focuses on the ethical issues concerning the study, its validity and reliability. At the end of the chapter, the summary has been given so that the readers get a quick grasp of the theoretical methodology.

Chapter 3 - Literature review
Page: 29-42
In this chapter we stated all the theories those we found related to our research question. We started with the Efficient market hypothesis that followed by the random walk theory. Later on we described the Modern portfolio theory, diversification, behavioral finance and the hedging theory. Thereafter we explained the studies and theories connecting the Swedish stock market and foreign exchange market. Following that, the theories of correlation and volatility between the stock market and exchange rate have been explained. All these theories reflecting our research question which concerns the Swedish stock market, thus we have an introduction of Swedish economy at the end of this chapter. Finally, at the end of the chapter we placed a model, showing our literature framework and the way it is connected to our research question.

Chapter 4 - Practical method
Page: 43-49
In this chapter we depict the data collection method, provided the information regarding our data sample, placed our logic of choosing the data sample and the time horizon. The statistical theories and method, which will be used to analyze the data, have been explained in this chapter. At the end the hypotheses which will be tested to answer our research question, are mentioned and explained how we formulated them.

Chapter 5 – Empirical results
Page: 50-72
In this chapter we present all our findings from the data simulation and hypothesis testing. We present the values of correlation and significance test between the exchange rates and the Swedish market over the total and sub periods with different economic sectors respectively. Later on we present the different parameters obtained from the stationary test and modeling
the volatility of the exchange rates and the stock prices. Thereafter, the values of their correlation between the volatilities are presented through the regression analysis.

Chapter 6 – Analysis & Discussion
Page: 73-77
In this chapter we have analyzed our findings and tested our hypothesis, discussion around our findings will also be presented here and how they are used in our process to draw conclusions around our hypothesis. In the first part, three hypotheses that we set up to answer the correlation relationship with a discussion around the final findings of correlation. The second part is where our hypothesis concerning the spillover effect have been tested and a discussion around the problem is also presented.

Chapter 7 – Conclusion & Recommendation
Page: 78-81
In this chapter we draw the conclusion by answering our research question based on our empirical findings, state our contribution to the knowledge gap, provide suggestion for further research and discuss the limitations of our performed study. We conclude the chapter by assessing the quality of our research.
Chapter 2 - Theoretical Methodology

This chapter will delineate the research philosophies, research approaches, research types, research strategies, research method and the data collection process to conduct the study in the field of business administration. At the very beginning of the chapter, the choice of the subject and the preconceptions of the authors have been discussed. Later on, there are elaborate explanations of different research philosophies, approaches, strategies and methods; followed by the logical argumentations for choosing the best options that suits best with our research question. Moreover, at the end of the chapter the quality and ethical issues of our research are discussed such as validity, reliability and replicability.

2.1 Choice of subject
We have selected the field of Finance for our 30 credit Degree project. The reason behind this selection is, because of the shared interest between the authors and they intend to work within this field in the future. The financial market and the enormous amount of financial products are something that the authors are in particular interested in.
Both authors have successfully completed all compulsory courses on the advanced level financial management module, advanced financial statement analysis, corporate finance, investments and risk- and cash management. The broad theoretical background and high level of interest for the financial markets and its assets, has increased the authors curiosity to try to find a better understanding of the relationship between assets. The high volatility on exchange rates makes the currency risk a central risk to take into consideration when investing in stocks or other assets in other currencies (Snopek, 2011, p. 43). The FOREX market is the biggest financial market where over 1900 billion USD changes hand daily, the market is very liquid so it changes very fast (Aktiespararna, 2009).

This new empirical study based on USD and EUR against SEK concerns the investigation of correlation and volatility spillover effects between the different currencies and industry sectors. This study will be of great importance and be very valuable for investors who want to understand currency risk from either European investors investing with euros or an American investor investing with USD on the Swedish stock market, not just as individual investment assets but also to understand the relationship between currencies and stock indices.

2.2 Preconception
Biases are something that the author of a research must understand and try to eliminate to make the research as valid and scientific as possible. Throughout the whole research process, from the point where you chose your research area to the interpretation of the data and the conclusion biases can occur. The level of biases comes from the level of personal values a researcher implements to the research, personal values can be the background of the author, the education or a researcher’s believes. Even though the study can never be value-free it is important for the researcher to be self-reflective and to take an objective position towards the research in order to make the research as unbiased as possible (Bryman & Bell, 2011, pp. 29-31).

Both authors have a theoretical background in the field of finance on a bachelor and master level. This has given the authors fundamental knowledge about financial theories that will be used in their research, such as Markowitz Portfolio Theory, behavioral finance and other theories related to the research question. Furthermore, the authors have experience from the financial market which means that the authors can work more rational and logical throughout
the thesis. It will also in a practical way by taking an objective and value-free approach to the research. The authors will use a quantitative approach to their studies and methods that will be used are the Person's Product-Method Correlation and the GARCH (1,1) model. Both models are based on objective numerical data, and the interpretation and conclusions from the models will not be influenced by the authors’ preconceptions.

2.3 Perspective
Perspective is referred to the audience for whom the result of the study is useful. The authors’ research is mainly focused on investor's perspective; the result from the study can also be used by market analysts and financial analyst. During the last 10 years, the stock market has been very volatile and so has the FOREX market. As these two selected financial instruments are so volatile that this study, along with the others done previously by different authors will help the investors to reach their decision effectively and efficiently. The knowledge on the correlation between these two variables will enhance the quality of hedging decisions and investment strategies.

Previous research that has been done on the on the same topic shows that the FOREX market's prices and the stock market's prices are correlated, but our findings will provide foreign investors a better understanding on portfolio formation when investing in Sweden. We will also provide results on the spillover effect, which will be beneficial when trying to predict future behavior in exchange rates and stock market.

2.4 Research pyramid

Figure 3 – Research pyramid
Figure 3 exhibits the structure of the research methodology of the study. The very base of the pyramid consists of research philosophy, which explains the philosophical stand point or the nature of the research study. Second base is the research approach which presents that the study involves the use of existing theories. The third level represents the type of study has been performed. The fourth and fifth level represents the research strategy and research methodology of the study.

2.5 Research Philosophy

The choice of research philosophy shows the stand point of the researcher towards the study. It not only describes the direction of the study but also states the perspective of the authors towards the world and the study with social reality. Research philosophy is selected by having an alignment with the research purpose and also it will lead to the selection of research approach and strategy for the study. So it is very important to select the proper philosophy that goes along with the research purpose. Research philosophy has two stand points: Ontology and Epistemology (Bryman & Bell, 2011, p. 22).

2.5.1 Ontology

Ontology describes the social actors in the perspective of social entities. Ontological stand point explains the relationship between people, society and the world in general. Bryman & Bell (2011, p. 20); states that, “the central point of orientation here is the question of whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can and should be considered social construction built up from the perceptions and actions of social actors” Ontology has depicted itself into two distinct categories: Objectivism and Constructivism. Objectivism position assumes that social phenomena and their meanings have an existence which is independent from the social actors, and beyond our reach and influence. Social entities are not created by social actors but by the nature of reality. On contrary, constructivism position states that social actors and their meanings are continually being accomplished through social interactions (Bryman & Bell, 2011, p. 22).

This study selects objectivism as its ontological stance. Objectivism philosophy sure matches with our research purpose. The main purpose of our study is to analyze the impact of exchange rate on the performance of Swedish stock market within 10 year period. To analyze this relationship the data for the independent variables (exchange rates) and dependent variables (stock performance) will be collected from the scientific resources. These data were collected prior to this study by other actors and these data collection were not influence or biased by the subjectivity issue of social actors. These data will be analyzed statistically, using various statistical tools (elaborately explained in the research methodology chapter) to find more about the existing relationship rather than finding the new theories. Therefore these variables or data will be considered as the independent phenomena from the social actors and thus fulfilling the concept of objectivism.

2.5.2 Epistemology

Epistemology concerns how knowledge can be acquired which Plato and his followers defined as justified true belief (Robson, 2002) According to Bryman & Bell, 2011, p.15, “An epistemological issue concerns the question of what is or should be regarded as acceptable knowledge in a discipline.” The main understanding of the epistemological stance is that whether or not the social phenomena can be understood, explained or studied with the same principles and procedures of natural sciences (Bryman & Bell, 2011, p. 15) Positivism,
Realism and Interpretivism are three mutually exclusive philosophies embracing the epistemological stance (Saunders, et al., 2009, pp. 113-116).

“Positivism is an epistemological position that advocates the application of the methods of the natural sciences to the study of social reality and beyond.” (Bryman & Bell, 2011, p. 15).

In positivism stance one can study with the observable variable from the social reality and at the end of the research the general conclusions can be drawn from the laws of physical and natural sciences. Moreover in Positivism, existing theories are used to develop hypotheses which are tested to confirm or reject in order to have a further development of the existing theories (Saunders, et al., 2009, p. 113). One of the important assumptions underlying positivism is that “the researcher is independent of and neither affects nor is affected by the subject of the research” (Remenyi et al., 1998:32; as cited in Saunders et al., 2009, p.114).

In contrast of positivism, interpretivism position states “that a strategy is required that respects the differences between people and the objects of the natural sciences and therefore requires the social scientist to grasp the subjective meaning of social action.” (Bryman & Bell, 2011, p. 16). The important idea that underlies the interpretivist philosophy is “that the researchers have to adopt an empathetic stance.” (Saunders, et al., 2009, p. 116). Researchers should see the world from the lens of research subject. It is generally accepted that the interpretivism position is mostly appropriate for the research field of business management, organizational behavior and human resource. The complex and unique characteristics of organizations due to the mix of organizational rules and human behavior makes it difficult to study them objectively (Saunders, et al., 2009, p. 116).

Saunders et al. (2003, p.85) mentions that there is no single “best” research approach. The main purpose of the research method and approach is to satisfy the main research purpose. “The general principle is that the research strategy or strategies, and the methods or techniques employed, must be appropriate for the questions you want to answer” (Robson, 2002, p.80). Positivism position in epistemological stance serves our research purpose. The aim of our study is to find the relationship between the exchange rate and the stock performance of the Swedish stock market through the process of data analyzing of historical exchange rates and the stock returns with various statistical tools. Moreover we are not developing any new theory instead we are building hypotheses on the existing theories and testing the hypotheses with the laws of natural sciences. Interpretivism position does not serve our research purpose because we are not studying the factors affecting the relationship rather assessing the degree and pattern of the relationship.

2.6 Research Approach

The research approach determines the relationship between theory and research work, there are two different research approaches, either a deductive approach or an inductive approach to the research work. When using the deductive theory approach the researchers’ set up a hypothesis (hypotheses) which will be subject to empirical scrutiny. It is the already known theory and the hypotheses that drive the research forward, the data that are collected are then used to confirm the hypotheses or reject them and then revise result against the used theory (Bryman & Bell, 2011, p. 11). With the inductive theory approach, the outcome from the research is a theory. Here the researcher starts with the collection of observations and together with the findings the researcher comes up with a theory to support the observations/findings. The last step with the inductive theory approach is that the researcher might want to collect more data to test the conditions in which the theory will hold or not (Bryman & Bell, 2011, p. 13).

The deductive approach contains elements from the inductive theory when the results you have got are reviewed against the chosen theory, and the inductive approach contains
elements from the deductive approach when the theory are tested with new data if it holds or not.

The deductive approach is more suitable for our research because we used already stated theories instead of trying to create new theories. The same is with the hypotheses we intend to use which have been generated from previous studies on the same topic as our research where we intend to investigate the relationship and correlation between changes in exchange rates and the return from the Swedish stock markets in different economic sectors over a 10 year period. The statistical findings will then be used to reject or accept our hypotheses which will then be tested against our chosen existing theories. The discussion above shows that our research has the characteristics of a deductive approach.

2.7 Type of Study
Saunders et al. (2009, pp.139-140) has categorized the research studies into three different criteria: exploratory, descriptive and explanatory studies. An exploratory research is a way to clarify the understanding of the problem, to search new ideas and solutions, to ask questions and to assess happening events in a new light. A descriptive study is a means to identify an accurate profile of situation, event or person, but not the causal linkages of the elements. In contrast to descriptive study, the objective of explanatory research is to ascertain casual linkages between variables (Saunders, et al., 2009, pp. 139-140). This study involves two types of study approaches: descriptive and explanatory. The main purpose of the study is to find the relationship between the exchange rate change and performance of Swedish stock market. As per the definition of explanatory approach the study will find the casual relationship/linkages between the variables which in our case study are the exchange rates (independent variables) and the stock performance (dependent variables).
On the other hand the descriptive approach will allow us to identify the pattern profile of this relationship. More detailed knowledge about the linkages of these two variables exchange rates and stock performances over the different economic sectors of Sweden through a 10 years period.

2.8 Research Strategy
Research strategy must reflect the general plan of the process for answering the research question. The objectives of the research question must be clear, data collection sources must be specified as well as the constraints faced while conducting the research. Overall, the strategy must reflect that the researchers have thought carefully of the reasons for choosing the particular strategy (Saunders, et al., 2003, p. 90). Saunders et al. (2003, p.91) outline seven strategies which researchers can consider to adapt. They are:

Experiment: This strategy is related to the natural science. It involves defining or constructing a theoretical hypothesis, sampling from the populations and experiment them in different conditions.

Survey: This strategy is generally associated with deductive approach. It involves the collection of sampling data from the population and standardizing the data for an easy comparison. Due to its easy comparison characteristics this strategy is popular for presenting the research findings.

Case study: ‘a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence’ (Robson 2002, p. 178).

Grounded theory: data is collected without formulating an initial theoretical framework and then theory is developed from data. These data often generates predictions which are then tested in further observation to see whether the initial predictions have been right. Hussey and Hussey (1997; as cited in Saunders et al. 2003, p. 93) associate it with inductive/deductive approach.

Ethnography: attached to inductive approach, with the purpose to interpret ‘the social world the research subjects inhibit in the way in which they interpret it’. This strategy stretches over a long period of time since researchers constantly try to develop new patterns from the observations.

Action research: the name suggests its ‘applied’ characteristic and is different from other forms of applied research because of its vivid focus on action and promoting change within an organization (Marsick and Watkins, 1997; as cited in Saunders et al. 2003, p. 94). Coghlan and Brannick (2001; as cited in Saunders et al. 2003, p. 94) said that its purpose is not just to describe, understand and explain the world but also to change it.

Archival research: Archival research strategy refers to the idea of using “administrative records and documents” as the main/principal source of data (Saunders, et al., 2009, p. 150). In this study the data used for the empirical study can be considered as the secondary data and collected from the previously stored or recorded database named NASDAQ OMX and Thomason Reuters DataStream. Therefore, archival research strategy suits our method of data extraction and performs the empirical study to answer the research question.
Time horizons: splits in two strategies, cross-sectional and longitudinal. Cross-sectional is a ‘snapshot’ study of a particular phenomenon (or phenomena) at a particular time. Longitudinal study is more like a ‘diary’, spans over a period of time, studying change and development.

The time span chosen for the empirical study of this research question is 10 years period from 2003-01-01 till 2013-01-01. The daily stock indexes for Swedish market and exchange rates for USD/SEK and EUR/SEK have been obtained from the scientific sources named NASDAQ OMX and Thomson Reuters DataStream respectively. The observations over the change and development of daily data over the 10 years period over the Swedish stock market and foreign exchange have made the Longitudinal study feasible for the authors to meet the objectives and answer the research question.

On the other hand, the authors have segmented the Swedish stock market into different sectors and observed the changes of these sectors with the flow of time over the 10 years period, in different ‘snapshots’ during economic up and down turns. Thus these observation of particular sectors over the different sub periods within this 10 years, meet the criteria of the Cross sectional study. Thereby, both Longitudinal and Cross sectional study can be considered have been used by the authors to perform their empirical study.

2.9 Research Method
Research method defines the data collection techniques and the process of analyzing the data. This is very important consideration regarding the study because different philosophical stances associate with different methods. “Quantitative research methodology can be construed as a research strategy that emphasizes quantification in the collection and analysis of the data.” (Bryman & Bell, 2011, p. 26). In contrast a “qualitative research can be construed as a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data.” (Bryman & Bell, 2011, p. 27). Table 2 shows the categories of research approaches for distinct research philosophical stances. Quantitative method is appropriate for positivism and objectivism philosophical stance from Epistemological and Ontological orientation respectively with deductive approach. Whereas, the Qualitative method is appropriate for the interpretivism and constructionism philosophical stance with Inductive approach.

<table>
<thead>
<tr>
<th>Principal orientation to the role of theory in relation to research</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deductive; testing of theory</td>
<td></td>
<td>Inductive; generation of theory</td>
</tr>
<tr>
<td>Epistemological orientation</td>
<td>Natural Science model, in particular positivism</td>
<td>Interpretivism</td>
</tr>
<tr>
<td>Ontological orientation</td>
<td>Objectivism</td>
<td>Constructionism</td>
</tr>
</tbody>
</table>

Table 2 – Research Method

Philosophical stance of positivism and objectivism with the deductive approach leads our research methodology towards Quantitative method. Even the main purpose of this study is to find the relationship between the exchange rates and the stock performance of the Swedish stock market. This study will require analyzing the historical exchange rates as well as the historical price quotes for the stocks for the last 10 years period. During the study these data will be processed and analyzed with different advanced statistical tools to test the hypotheses and figure out the pattern of linkages between the variables. Therefore, from the numerical characteristics and philosophical stances the authors can conclude that the best possible research methodology for this study is a quantitative method.
2.10 Literature and Data source
After having decided on which research method for the research, the next step is to select what type of data to use and which source to use of data to use. There are three main categories of literature sources available; primary data which is data collected directly, secondary data which is data collected by someone else, and tertiary data which is a sum of primary and secondary data and can come in the form of abstracts or indexes (Saunders, et al., 2003, p. 51). The authors have chosen secondary data as their literature source as they are using historical data and literature written in the past. It will mainly come from books, databases, academic journals and websites.
For the theoretical framework and literature review we have used books and articles from sources like Google Scholar, EBSCO, Umeå University Library and other reliable sources. The numerical data that will be used for the statistical models are taken from the DataStream of Thomson Reuters for the exchange rates and the Stock returns will be retrieved from NASDAQ OMX website.
Some of the advantages of the use of secondary data are that it is that it is a good way to get reliable data cheap and fast, much cheaper and less time consuming than carrying out a primary data collection. Secondary data also offers the researchers the opportunity to do longitudinal analysis, divide the data in subgroups where large numbers of samples are used. The opportunity to analyze already analyst data offers new ways on how the data can be interpreted and it also gives the user of the data more time to analyze the data (Bryman & Bell, 2011, p. 313-320; Saunders et al., 2003, p. 200-201). All these factors make it very suitable for students to use limited time for their research and a limited budget.
The limitations with the use of secondary data are that the researcher lacks familiarity with the data, the data can also be very complex to understand and the research might not have the appropriate knowledge to interpret the data correctly. The third limitation is that the researcher doesn’t have any control of the quality of the data collected (Bryman & Bell, 2011, p. 320-321; Saunders et al., 2003, p. 201-203).
However, to deal with the limitations of not having any control of the data we are using very reliable sources to collect the data. The fact that we are only interested in changes in exchange rates and stock performance makes the data not too complex and easy to understand. Both authors are familiar with the data they intend to collect due to a strong fundamental knowledge of financial instruments, among them foreign exchange and stocks.

2.11 Reliability, Replicability and Validity
When doing a good business research, three important quality criteria must be fulfilled. The research must be reliable, replicable and valid.

Reliability refers to the question if the results of the study can be repeatable. The reliability criterion is well connected to the quantitative research method and should answer the question if the measurements are stable or not (Bryman & Bell, 2011, p. 41). Basically, can we trust the measurements and the result are concerned with the reliability of a research?

By answering three different questions, the reliability of a research can be assessed,

1. **Will the measures yield the same results on other occasions?**
2. **Will similar observations be reached by other observers?**
3. **Is there transparency in how sense was made from the raw data?**
(Esterby-Smith, et al., 2002, p. 53)
The replication of a research is very close to the reliability criterion. When a researcher chooses to replicate findings of another researcher he should be able to get the same result if he uses the same data and the same model. So it is very important when a researcher puts together his research paper that he explains his procedures in detail so that it can replicable by others (Bryman & Bell, 2011, p. 41).

This part belongs to the first question stated by Esterby-Smith et al. (2002) stated above. This research paper uses data collected that is publicly available to everyone who has access to the same source as anyone can re-do our test in the future. Although, if someone would like to replicate our research, they would need to use the same time period, use the same data, get the data from the same source and follow the same methodology to get the same results.

The second question concerns the access to the data. Our independent variables, the exchange rates have been collected by Thomas Reuters and are available for downloading from their DataStream database, so if the researcher has access to this DataStream then the researcher could also collect the same data as we have used for the exchange rates. To access the DataStream database one needs to sign up for a subscription which is not for free. We could use the DataStream database through Umeå University Library who is subscriber. The stock performance within different economic sectors has been created by NASDAQ OMX and is available to anyone.

“Validity is concerned with whether the findings are really what they appear to be about” (Saunders, et al., 2003, p. 101). Another way to put it is that validity refers to the integrity of the conclusions generated from the research and is according to Bryman & Bell (2011) the most important criterion in a research. The validity of a research paper can be divided into four different categories

1. Measurement validity
2. Internal validity
3. External validity
4. Ecological validity

Measurement validity is primarily linked to the quantitative research and refers to the question if the measurements that the researchers are using really reflect what the researchers intend to measure and if the concept is reflecting what it is intended to denote.

In our research we will analyze if changes in exchange rates have any effects on the performance of the Swedish stock market. We will be using SPSS 17 to process our data for the correlation test and we will use Eviews 7 to process our data for the VAR and GARCH (1, 1) test in an attempt to find an answer to our question. The whole process will be explained later.

Internal validity incorporates the causality of the measurements, and is linked to the question if we can be sure of the relationship between variables. Once we are sure that no other variables affecting the relationship, the strength of the relationship can be confirmed. Often when the causality is discussed it is usual that the independent variable causes the impact on the dependent variable which is affected (Bryman & Bell, 2011, p. 42).

As our research is focusing on causal relationship between the FOREX market and the stock market, internal validity is relevant to examine because we want to be objective on the relationship and neutralize from external factors like interest rate, inflation and economic policies.
External validity concerns the question if a result from a research can be generalized beyond a specific research context (Bryman & Bell, 2011, p. 43). The fast globalization of the world’s economies and integration of the financial markets, together with increased volatility on the financial markets, in particular the FOREX and stock markets, which maybe could be explained by the unstable economies all around the world. But the fact that we have chosen to do the research on two separate currencies and on a fairly stable economy, Sweden, we are confident that the quality of the result has not been affected by other factors, but we also believe that our research cannot be generalized over other sectors and variables.

Ecological validity. “This criterion is concerned with the questions of whether or not social scientific findings are applicable to people’s every day, natural social settings” (Bryman & Bell, 2011, p. 43). As our results can have an impact on investor’s behavior and indirectly on social impacts of investments, this type of validity is something that is very relevant to our research.

2.12 Research Ethics & Societal Issues

The research ethic is a crucial point in any research project, it doesn't matter if we are using secondary data or different types of collection of primary data, and it is likely important (Saunders, et al., 2012, p. 208). As our research is about if changes on exchange rates affect the performance of the stock market we are undertaking a quantitative approach with analysis of collected secondary data.

Umeå School of Business and Economics gives every student a manual to follow when writing their thesis, which is the same for every level of thesis. The manual contains all needed information about how to structure the thesis and ethical guidelines for the student to follow during the time of research.

Saunders et al. (2012, p.226) defines research ethics as “the standards of behavior that guide your conduct in relation to the rights of those who become the subject of your works, or are affected by it”. The scope of how ethical the research is conducted depends much on the researcher’s social norms which indicate how the researcher’s behavior is adapted depending on the situations facing the researcher (Saunders, et al., 2012, pp. 226-227).

There are some general ethical issues that are associated with data collected from the internet. As some of our data are collected from NASDAQ OMX official website some of these issues must be taken into consideration. One of the issues that are brought up by Saunders et al. (2012) and that are for both qualitative and quantitative studies are the copyright issue when collecting the data and analyzing it. Another problem is how the data is managed.

In the data collection stage it is important that the researchers maintain their objectivity and make sure that the collected data are accurate to avoid subjective selecting of data, which would hurt the validity and reliability of the research. To change the data from what is was originally is totally unethical and unacceptable action to do (Saunders, et al., 2012, p. 241).

A crucial part of the analysis is for the researchers to keep their objectivity towards the research. This part of the research must contain a great degree of trust towards the researcher and it is important that the research keeps a high level of integrity, it is up to the researcher to present his/her findings in a honest and trustworthy way (Saunders, et al., 2012, p. 245).
In our research we are taken an objective approach to the data without any presumed results. We are also using the Harvard reference system for all the information that we have collected from different resources so that the reader of our thesis can go back and validate our collected data and information. As we are using the NASDAQ OMX official website, we can be sure that the data we are collecting for the stock market performance are valid and correct (NASDAQ OMX, 2013); the same is with the collected data of exchange rates where we have used Thomason Reuters DataStream which keeps a high validity in financial statistics.

Umeå School of Business and Economics has appointed a supervisor to every research group who gives her point of view of ethical standpoint and the supervisor also has to approve the work before it can be published. The manual of thesis writing is the reference point for the research and we as students’ need to follow the instructions which is also reminded as very important by the supervisor.

This scientific research with valid resources is therefore to enhance the knowledge of the investors. Critical investigation over the correlation and volatility spillover between the foreign exchange and Swedish stock market, will contribute to hedge the risk with effective portfolio diversification both locally and internationally. Likewise, investors should also contribute to the ethical use of the research. Investors should use this knowledge to diversify their portfolio effectively, both domestically and internationally, rather than looking for arbitrage opportunity. This would decrease the risk taken by investors which would benefit the whole society, not just the financial sector.
Chapter 3 – Theoretical and Literature Framework

This chapter depicts the theories, concepts and studies that the authors have found important to answer the research question. The chapter begins with Efficient Market Hypothesis and Random Walk theories. In later part of the chapter Modern Portfolio Theory, Diversification, Behavioral Finance and the Hedging theory have been explained. Thereafter we explained the studies and theories connecting the Swedish stock market and foreign exchange market. Following that, the theories of correlation and volatility between the stock market and exchange rate have been explained. All these theories reflecting our research question which concerns the Swedish stock market, thus we have an introduction of Swedish economy at the end of this chapter. Finally, at the end of the chapter we placed a model, showing our literature framework and the way it is connected to our research question.

3.1 Random Walk and the Efficient Market Hypothesis

When Maurice Kendall examined the movements on the stock market in 1953 it was first said that the stock price reflected “prospects of the firm, recurrent patterns of peaks and troughs in economic performance” (Bodie, et al., 2011, p. 371) but Kendall couldn’t find anything that supported those statements, what he found was that the prices in the stock market move randomly and that it was impossible to predict the market. Even though some economists weren’t happy with his findings, in the end they all agreed to Kendall’s random walk theory and that it was actually this random walk who indicated a well-functioning and efficient market (Bodie, et al., 2011, pp. 371-372).

“The notion or the concept which states that the stocks already reflect all available information is referred to as the Efficient market Hypothesis (EMH)” (Hull, 2012, p.358). Brown (2011, p.82) states, if the hypothesis prevails then the market price of the stocks must reflect the expectation of what the security would be worth tomorrow. Moreover, Brown (2011) stated that EMH does not specify the mechanism by which the prices “reflect all available information” and does not even specify the rationality of market price. Thus there is a possibility that even the efficient market hypothesis remains silent if there is a possibility of bubble (also in Bodie et al., 2011, p.373).

Random work theory goes parallel with the EMH. If the stock price is responsive to the information then it must increase or decrease in response with the information. By definition, information must be unpredictable thus the movement of the stock price will be unpredictable. This leads to the theory of the random walk, which states that the price movements must be random and unpredictable (Hull, 2012, p.358).

In most of the financial academic books (for example in Bodie et al., 2011; Hillier et al., 2010; Brealey et al., 2011) there are often three different types of EMH; weak form, semi-strong form and strong form of EMH, which all differ in how “all available information” differ (Bodie, et al., 2011, p. 375).

3.1.1 Weak form of EMH

This form of hypothesis states that there is no point of study of trend analysis, because the current market price of the stock reflects historical information as historical prices, volumes and etc. (Hull, 2012, p.361). If these theory hold, then it would not be possible to make extraordinary profits because when factors in the history repeats itself, investors know in what direction the price will move and this would make extraordinary profits impossible because
everyone know in what direction the price will move (Hillier et al., 2010, p. 353 and Bodie et al., 2011, p.275)

3.1.2 Semi strong form of EMH
This form of hypothesis states that all publicly available information and historical information regarding the prospects of a firm must be reflected already in the stock price. Thus investor having access to the information can expect the information to be reflected on the stock price (Hull, 2012, p.361 and Hillier et al., 2010, p.353). This means that the price of a security should respond immediately when new information reaches the public, and as the price now reflects all historical information and immediately moves on new information, also this theory would make it impossible for investors to make any profits because all investors would end up paying the higher price (Hillier et al., 2010, p.354 and Bodie et al., 2011, p.376). To make it easier to understand, an investor cannot invest on information that he hopes will make the price of the security increase, which happens immediately when the information is released.

3.1.3 Strong form of EMH
The strong form of EMH implies that all information that is available to at least one investor is incorporated into the rice of the security, this means both public information and private information. If this theory would hold then there would not be possible to make any profits on insider trading because of the price incorporates the inside information and all other information available, so there are no secrets to trade on (Hillier et al., 2010, p.354 and Bodie et al., 2011, p.376).

3.1.4 Evidence against EMH
When researchers and academics have been studying the EMH more carefully they have found anomalies that are not in line with the EMH. One of this is that according to the EMH there are no possibilities to make any abnormal profits; the maximum you can earn is the expected return which is including risk in its calculation. But researcher has found that small companies stock has outperformed large companies stocks for many decades and while you can argue that smaller companies offers higher returns because of the higher risk, researchers argue that not all extra return can be explained by higher risk of the stock. Another implication on the difference in return depending on the size of the company is that Donald Keim (stated in Hillier et al., 2010, p.364) found evidence that most of the differences in return occurred during the month of January (Hillier et al., 2010, p.363-364; Brealey et al., 2011, p.350-351).

Research done by Fama and French (1998) found that value Stocks have outperformed growth Stocks on average annual returns every year between 1975 and 1995 in several European countries. And because of the easily found information on book-value-to-share-price ratio and due to the fact that the differences in return are so big, the result may be strong evidence against the EMH.

Another argument against the EMH is the bubbles and crashes that we have seen many time this during the last 100 years. According to Hillier et al. (2010, p.366) it could maybe be explained by the bubble theory which states that sometimes securities are traded high above their fundamental value and when the price falls back to "normal" then investors lose a lot of money. This could be evidence that during "bubbles" investors are rational and trade on
expected price movements but if the EMH holds then the price always reflects true value (also in Bodie et al., 2011, p.395).

The school of behavioral finance as mentioned above is truly against the EMH with evidence that EMH is violated in the real world and that there are too many anomalies (Hillier, et al., 2010, p. 367).

### 3.2 Modern Portfolio Theory (MPT)

As the aim our research is to increase the knowledge of how changes in exchange rates are related to the performance on the stock market, and how they may be correlated, which can be very beneficial for investors of different levels, the MPT is a good starting point to understand when starting investing as the theory concerns the expected return and the risk of the investment.

This theory was developed by Harry M. Markowitz in early 50’s and was first published in 1952, and was what gave Markowitz the Nobel Prize in Economic Sciences in 1990. What Markowitz wanted to do was to study the effects of diversification, correlation and risk on the expected return on portfolio investments (Production and Operations Management, 2009, p. x).

So as mentioned above, this theory can be useful for portfolio construction and is related to our topic of the research paper, both when that currencies can be used in the development of portfolios, but also because for international investors, the currency fluctuations are one type of the risks investors need to understand and maybe need to diversify against.

#### 3.2.1 Risk and Expected return

The *Expected return* \((E)\) in a portfolio is a weighted average on the expected return from the individual assets (Elton, et al., 2007, p. 53). To calculate the expected return in MPT, on a portfolio of assets, equation 1 is used:

\[
E(R_p) = \sum_i w_i E(R_i)
\]

*Equation 1 – Expected return (portfolio)*

- \(E(R_p)\) = Expected return of the portfolio
- \(w_i\) = Weight of a single asset in the portfolio
- \(E(R_i)\) = Expected return of individual asset

When we are talking about the *Variance* \((V)\) of an asset, you try to find how much the return of an asset deviates from the mean (average) return (Markowitz, 1991, p. 73). This can of course be done on a portfolio of assets as well. The variance of any assets gives you an indication on how risky the assets are, but not more than that. The equation (2) used to determine a portfolio’s variance is:

\[
\sigma_p^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_{i \neq j} w_i w_j \sigma_i \sigma_j \rho_{ij}
\]

*Equation 2 – Portfolio variance*
From the variance, the standard deviation is then calculated, which is the square root of the variance (Elton, et al., 2007, p. 19). It is another way of calculating the risk on an asset. The standard deviation gives you an indication on who risky/volatile the portfolio/asset is, the higher the volatility in the outcome, the higher will the standard deviation be (Bodie, et al., 2011, p. 157). Equation 3 explains how the standard deviation is calculated.

\[
\sigma_p = \sqrt{\sigma_p^2}
\]

Equation 3 – Portfolio Standard Deviation

3.2.2 Limitations with MPT
Gregory Curtis (2002, 2004) found that one of the disadvantages with MPT is that is descriptive, and also that the theory relies on assumptions that might not always valid in reality. Rom and Ferguson (1994) have also presented the same limitations in their article. They have also cited Harry Markowitz and William Sharpe about important limitations, and according to the founder of MPT a limitation is that the mean-variance approach sometimes could lead to wrong predictions of behavior.

Another limitation with MPT could be the use of historical data to predict the future, so when trying to predict the future with historical data it is important that that the numbers used are significant to what is being tested.

3.2.3 Diversification
With the help of finding the correlation of different assets it is possible to lower the risk of the portfolio. The correlation explains how two assets move in relation to each other. Correlation is not perfect and for some assets the correlation can be negative, meaning that the assets are moving in the opposite directions off each other, while some assets have a more positive correlation and are moving most often in the same direction. If some assets are perfectly correlated that you would not be able to decrease the risk when investing in both of them at the same time (Markowitz, 1991, p. 5). This is the foundation of portfolio diversification, to make the risk of a portfolio decreasing by adding assets that are not perfectly correlated. When we are talking about risk, we are talking about volatility and that which high volatility you can lose a lot but at the same time you can earn a lot. With diversification we can make the forecasted return is more reliable with possible fewer fluctuations at the same time as the risk of loss is reduced (Markowitz, 1991, p.108; Elton et al., 2007, p.214-215).
To understand the importance of diversification (Statman, 1987) analyzed how many stocks were needed to make a diversified portfolio. He found that the average standard deviation of a portfolio with only one stock was 49.2% while with increasing number of shares in the portfolio could make the standard deviation fall to only 19.2%, which shows the powerful effect on risk when diversifying a portfolio.

The level of diversification depends highly on the level of correlation between the assets in the portfolio (Brealey, et al., 2011, p. 216).

3.2.4 Systematic- and Unsystematic risk
When we are talking about risk and specifically the diversification effect and how that can help reduce some of the risk, we need to understand what type of risk we are actually reducing. There are two different major types of risks, Systematic risk and Unsystematic risk (also known as market risk and specific risk). The differences between these two types of risk is that the systematic risk is a type of risk that you cannot diversify away and so to say reduce by creating portfolios with different standard deviations. There are many different factors that affect this type of risk that threaten all businesses no matter which industry or sector the business is acting within (Brealey, et al., 2011, p. 198).

In contrast, the unsystematic risk is the type of risk that you can diversify away or at least reduce by putting more than one stock in your portfolio (the diversification was explained in section 3.2.3). The unsystematic risk is a type of risk that is specific to an individual company. The standard deviation explains the total risk of the portfolio which is as you now know divided into market- and specific risk. The part that is diversified away is the unsystematic risk, while the part of the risk that cannot be diversified away is the systematic risk (Bodie, et al., 2011, p. 225).
3.2.5 The Efficient Frontier

There are two different ways of creating the efficient frontier. One way is to combine risky assets with risk-free assets, and the other way is to only create the efficient portfolio out of risky assets. As this research is only combining risky assets, the authors will only explain the efficient frontier with risky asset portfolio.

The efficient frontier is the top line of the Minimum-Variance Frontier in a graph with the expected return, E(R), on the Y-axis and the level of risk (σ) on the X-axis. The line gives the investor an indication on how to construct a portfolio to maximize the expected return for the level of risk chosen. Figure 7 shows how the graph looks like with the efficient frontier and the Minimum-Variance Frontier.
As you can see from the figure (7) above, the portfolios that lie on the bottom part of the Minimum-Variance Frontier (below E) are inefficient with lower expected return than needed for the chosen level of risk. The portfolios that are located along the efficient frontier are called "efficient portfolios" by Harry M. Markowitz, reason for this is as explained above, that they offer the highest possible expected return for any level risk (Brealey, et al., 2011, p. 217).

3.3 Behavioral finance
This is a very interesting field that we think fits perfectly within our field of research, you might question why, but as exchange rates are a type of financial instrument which you might be able to use when diversifying your portfolio to minimize the risk, it is also a type of risk that every international investor faces.

The behavioral financial school is bringing pretty new views on the financial markets are questioning the earlier schools where the efficient market theory is the central point of discussion. While efficient market believers believe that the economy allocates resources efficiently and that it is not possible to beat the market no matter your investment strategy, the behavioral finance school argues that just because traders don’t beat the market, it is not proof that the market is efficient. Earlier and conventional theories assume that investors are rational, while behavioral finance starts with the assumption that this might not be the case. It is also argued that with the conventional theories, the human behavior isn't taken into consideration, and this is exactly what the behavioral finance people use. The idea with the efficient market is that the market is affected by the information that is available to everyone and that new information affects the market, along with the fact that it is extremely difficult for investors to beat the market. Behavioral finance argue that investors process information differently and in different ways (Bodie, et al., 2011, pp. 409-410).

“Behavioral finance studies the psychological factors that influence financial behavior both at the level of the individual as well as the level of the market” (Bruce, 2010, p. 301). Understanding behavioral finance helps when we try to explain how markets might be inefficient and why (Sewell, 2007, p. 1). Kahneman and Riepe (1998) (edited in Bruce, 2010, p.301-306), examined their practice as financial advisors from a behavioral standpoint and found that biases in behavioral finance could be categorized into three different categories, (1) biases on judgment – which include optimism, overconfidence, hindsight and overreaction to chance events (Barberis & Thaler, 2003, p. 1064), (2) error of preferences – include the tendency to value changes and not level of payoffs, nonlinear weighting of probabilities, narrow framing, the adoption of short versus long views and the use of a purchase price as a reference point, and (3) biases associated with living with the consequences of decisions – which is connected to the relationship between regret and risk taking and to regret of omission and regret of commission (Bruce, 2010, p.301; Bodie et al., 2011, p.411-412). These biases could be managed with the help of a proper investment strategy. The investing strategy is also an important tool for future investments when it comes to behavior among investors and their beliefs on the market, where the investor believes that it is possible to time the market, evidence shows that a proper investment strategy follows the investors’ preferences and restrictions (Bruce, 2010, p. 306).

The trade-off between risk and rewards is central part of the mean-variance analysis, meaning that with higher risk, the investor can get return that deviates more from the mean and vice
versa. So what affects the expected return from investments depends highly on how much risk the investor is willing to take on the investment (Markowitz, 1991).

One of the essential variables in any model which try to understand trading behavior and the psychology behind investors is how they evaluate risk and how risk averse they are. There are many different models and theories which try to understand the risky gambling of investments. Some of the most profound includes weighted-utility theory [Chew and MacCrimmon (1979), Chew (1983)], implicit EU [Chew (1989), Dekel (1986)], disappointment aversion [Gul (1991)], regret theory [Bell (1982), Loomes and Sugden (1982)], rank-dependent utility theories [Quiggin (1982), Segal (1987, 1989), Yaari (1987)], and prospect theory [Kahneman and Tversky (1979), Tversky and Kahneman (1992)] (stated in Barberis & Thaler, 2003, p.1064). And according to Barberis & Thaler (2003) the prospect theory (which is also explained by Sewell (2003)) is the most promising model when trying to understand people’s attitude to risk. The model shows that investors prefer gains and losses over final wealth, something that was identified as early as 1952 by Markowitz (Barberis & Thaler, 2003, p.1068; Markowitz. 1987; Bodie et al., 2011, p.413; Brealey et al., 2011, p.355).

Most financial and economic theories start from the assumption that investors are rational and uses all available information when taking decision on what to invest in, and as mentioned above, Behavioral finance questions those assumptions. But the Barnewall Two-Way Model which is based on work of Marilyn MacGruder Barnewall identifies two different types of investors: passive and active. The passive investors is someone who has become wealthy by risking the capital of others or has inherited capital, they prefer security over risk. The active investors who are active in their decisions and are using their own capital, they tolerate risk more because they believe in themselves, but when the control drops so to the risk tolerance. Other classifications have been done in the Bailard, Biehl, and Kaiser Five-Way Model (also known as the BB&K Model) where they use the personality traits on one axis and on the second axis they have placed the investors approach to his/her life (Pompian, 2011, p. 294):

![Figure 8 – BB&K Model (Polcyn, 2006)](image)

From that we have thought that every investor acts in the same way and is rational, which is still being learned in school today, to that researcher have taking it as far as dividing investors in different categories to understand how they act on information and choice of strategies. As our research is about international investors who are investing in the Swedish stock market, an understanding on how they perceive risk and return is very interesting, as the
international investors are always reminded of the currency risk and also because you can speculate and trade on exchange rates.

3.4 Hedging
“The basic principal is when an individual or a company chooses to use the future markets to hedge a risk, the objective is usually to take a position that neutralizes the risk as far as possible.” (C.Hull, 2012, p. 47).

Campello et al. (2011 p.1615) states that hedging reduces the odds of negative returns, thereby reducing the expected costs of financial distress. Hedging has recently been important for the risk management purpose. The International Swaps and Derivatives Association (ISDA) reports that almost the entire world’s largest companies use derivatives to hedge their business and financial risks. According to the Bank of International Settlement (BIS), the outstanding interest rate and foreign exchange derivatives have increased from $6.1 trillion to $35.6 trillion and $3.3 trillion to $8.8 trillion respectively between the periods from 2000 till 2009 (Campello, et al., 2011, p. 1615). The strongest arguments for the hedging are that it eliminates the risk or uncertainty of the economic variables like interest rate, exchange rate and commodity prices; which are almost impossible to predict accurately. Thus hedging protects the individual investors or the companies from the sudden shock that can be derived from the changes of these macroeconomic variables (C.Hull, 2012, p. 50).

This research paper is focused on the impact of exchange rates changes on the stock performance. Thus the foreign currency hedging is closely related to our research topic. “Foreign currency hedging specifically tries to reduce the risk that arises from future movements in an exchange rate.” (Bligh, 2012, p. 40). This change in exchange rate can both have positive and adverse effect. To prevent the adverse effect and keep the cost lower and the income stable managers generally hedge the currency risks. Bligh (2012) explains more about the hedging tools and techniques: a forward contract, an immediate foreign-exchange purchase in the money market, futures contracts, options, or a currency swap. Moreover Bligh (2012) explains the appropriate choice of the hedging tools with different scenarios. As this research paper is not concerned about the hedging tools and techniques in order to manage the currency risk, thus the detailed description of the tools have been skipped.

3.5 Exchange rate and the stock performance
Empirical studies on the impact of macroeconomic factors on stock prices give more highlight to the techniques for examining the relationship between stock performances and the foreign exchange rate. Numerous studies, including Chen et al. (1986), Mukherjee and Naka (1995) and Tian and Ma (2010), showed that the long-run elasticity of macroeconomic Variables are generally consistent with the hypothesis that exchange rate does have impact on the stock performance. For example, Mukherjee and Naka (1995) found that the relationship between the Tokyo Stock Exchange (TSE) and the exchange rate was negative (that is, the TSE increases as the Japanese yen depreciates against the US dollar). This result is consistent with the goods market theory (Tian & Ma, 2010, p. 492).

3.5.1 What affects exchange rates and stock performance?
The relationship between the stock prices and exchange can be explained in two different approaches or theories; firstly, goods market theory (also called either the ‘flow-oriented model’ or the ‘traditional approach’) and secondly, the portfolio balance theory (also called
the ‘stock oriented model’). Goods market theory imposes that foreign exchange rate affects the international competitiveness and trade balance of an economy thus affecting its real income and output. “The changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output” (Dornbusch and Fischer, 1980 as cited in Tian and Ma, 2010, p.492). In simple words, an appreciation of the local currency will hurt the exporters, thus affecting its share price in the market. This impact will be large if the economy is export oriented. (Tian and Ma, 2010, p.491; Yang and Doong 2004, p.140)

Conversely, portfolio balance theory asserts that share market plays an important role in determining the dynamics of exchange rates or in simpler words, the causality runs from the stock market towards exchange market. Since the present value of the future cash flows of the companies can be defined as the stock prices, which should adjust to economic perspectives. (Tian and Ma, 2010, p.491; Yang and Doong 2004, p.140) Thus, depending on these factors and many other factors, there is a net increase (net decrease) in the share market index with the appreciation (depreciation) of the home currency. “For example, currency appreciation is expected to stimulate the share market of an import-dominated country (a positive effect) and depress that of an export-dominated economy (a negative effect)” (Obben et al., 2007 as cited in Tian and Ma, 2010, p.492). Chen et al. (1986) found that the variables (industrial production, the money supply, inflation, the exchange rate, and long- and short term interest rates) influence the risk adjusted discount rate or the future cash flow in the calculation of stock price valuation model, which assumes that the future expected cash flow is the present value of the stock (Wongbangpo and Sharma, 2002, as cited in Tian and Ma, 2010, p.492).

Tian and Ma (2010, p.493) summarizes that theoretical consensus exists within the relationship between the stock prices and the exchange rate or especially to its direction. Moreover, they found that, “the goods market approach indicates that currency appreciation is expected to show a positive correlation between the exchange rate and stock prices in an import-dominated economy, while a negative correlation is expected for an export-dominated economy” (Tian & Ma, 2010, p. 493).

### 3.5.2 Currency risk

Exchange rate risk is one of the unique risks for the international investments (Bodie, et al., 2011, p. 902). This research paper is not focused on the international investment but the authors find exchange rate risk theories to be relevant to the research aim that is to find the relationship of USD/SEK and EUR/SEK to the stock performance in Swedish market. Though the research is focused on investments on Swedish stock market, but the exchange rates have impact on the performance level of the domestic companies and thus affecting the stock prices. In the context of international portfolios, exchange rate risk may be partly diversifiable (Bodie, et al., 2011, p. 904). Moreover, the knowledge on the relationship of the volatilities between the exchange rate and stock return will have a significant contribution for the investors to decide when to create an international portfolio diversification. Lee et al. (2011) suggested, form their empirical study of dynamic correlation of stock price and exchange rate; that during the stable stock market, investors can hedge risk between stock and foreign exchange in domestic market. Otherwise in volatile stock market, it’s less risky for the investors if they diversify their portfolio internationally because volatile stock market results in to volatile exchange market since their correlation becomes higher.
3.5.3 Correlation between exchange rates and stock performance
Granger et al. (2000) stated from the study of Asian Financial crisis that the stock prices in South Korea are positively correlated with the exchange rates. However the data from the Philippines exhibited the negative correlation. Fang (2002, as cited in Tian and Ma, 2010, p.496) found from the data analysis of Thailand and four Asian Tiger economies that stock returns and/or the market volatility are adversely affected by the currency depreciation. Similarly, Phylaktis and Ravazzolo (2005) studied the US market and found that stock and foreign exchange markets are positively related.

3.6 Cross rate
As we are trying to find the relationship between different currencies and the Swedish stock market we also need to understand the cross rate between USD and EUR to see if this cross rate affects the exchange rates of EUR/SEK and USD/SEK. According to Eiteman et al. (2001, p.112) many currencies are not quoted against every single currency in the world, so they are set as a function of their relationship to a currency. The cross rate “refers to an exchange rate calculated from two exchange rates for a third currency – the first for the base currency and the second for the price currency” (Riksbanken, 2011). There are not a lot of research done on the cross-rates and the possibility of arbitrage profits. But Kalyvitis & Skotida (2010) found that unexpected monetary policy changes in the US affected cross-rates in such a way that it generates excess return. This could be evidence that arbitrage opportunities are created by the people who are responsible of monetary policies within a country, even though it might just be speculations.

From an investor perspective, the cross-rate can also explain anomalies in the market where no arbitrage possibilities should be able to occur. In perfect market conditions it should not be able to make any arbitrage profits by trading currencies, this is not always true, which means that if we can find differences in the cross-rates, then we can also draw the conclusion that the market is not perfect. From another perspective, the international business, the cross rate can be used when setting up budgets and internal prices to get a consistency across foreign subsidiaries (Eiteman, et al., 2001, pp. 112-113).

![Figure 9 – Cross Rate](image-url)
3.7 Volatility spillover effect between the stock market and the foreign exchange

Yang and Doong (2004) studied the volatility spillover effect between the stock and foreign exchange market in the G7 countries. Yang and Doong (2004) stated the knowledge gap within the transmission of volatility or volatility spillover between the stock and currency market. Moreover the study of the volatility spillover process increases the knowledge of the understanding of the how the information flows or is transmitted from the foreign exchange market to the stock market. Yang and Doong (2004, p. 151) concludes that there is a volatility spillover effect of the foreign exchange market on the stock market in the countries like France, Italy, Japan and USA. They found an established integration between the flow of information between the foreign exchange and stock market.

In addition Chiang and Yang (2003 as cited in Yang and Doong, 2004, p.141) found the significant volatility spillover effect between the US and major world stock markets. Similar studied done by. Lapodis (1998) and (So, 2001) about the details of the volatility transmission mechanism of exchange rates and the dynamic spillover effect between interest rates and the exchange values of the US dollar. Yang and Doong (2004) implied the EGARCH model to study the spillover effect.

Similarly Lee (2010) investigated the weekly data from Malaysia, Indonesia, Philippines, Taiwan and Thailand from the period 2000 to 2008 to test the dynamic correlation hypothesis between the stock prices and the exchange rates. Likewise Yang and Doong, Lee et al (2011) did the empirical study with the STCC GARCH model. The empirical study by Lee et al (2011) showed that there is a significant impact of price spillover effect from the stock market to the exchange rate within these studied countries mentioned above. Furthermore, Lee et al (2011) found that the correlation between the foreign exchange market and the stock market increases with the increase of the level of volatility within these two markets. In addition, Lee et al (2011) mentioned the importance of these results in case of hedging and diversification strategies. Lee et al (2010) suggests that the risk between the foreign exchange and stock prices can be hedged within the domestic market as long as the stock market is stable; but in case of volatile market the correlation between the stock foreign exchange market increases, thus the hedging and diversification should be done internationally.

Likewise, the above studies discussed in this chapter, the authors of this research paper are also investigating the correlation and volatility spillover effect between the Swedish stock market and the foreign exchange rate. Hence using the GARCH (1,1) model (explained in details in section 4.8) to perform the empirical study.

3.8 Introduction to the Swedish economy

Sweden started out as a country that heavily depended on their agriculture, but since the industrial revolution in early 20th Sweden has moved more towards an industrial country. This fast development could be done because Sweden took a neutral position during the World Wars and has reliably and supported entrepreneurialism, which has led to the development of well-known global companies as H&M and IKEA.

Sweden is a role model to many politicians and economists because of its successful combination of welfare benefits and high-tech capitalism. When rankings has been put
together over the countries with highest competition, innovation and standard of living Sweden are most often placed among the top countries in the world. Sweden is among the 15 richest countries when looking at the GDP per capita. Major sectors and very important sectors in Sweden are the forestry, telecommunication, automobile and pharmaceutical. Even though the automobile sector has shrunk they still have companies who are world leaders in their field, as Scania and Volvo in heavy trucks. The Swedish economy has grown are and growing due to the high standard of education and skilled workforce. The country came back quicker and stronger from the global financial crisis in 2008-2009 than many other industrial countries (Sweden.se, 2013).

With a strong currency and sound financial system Sweden was not expected to be hit as hard by the recession that followed by the financial crisis in 2008 and with low national debt. Sweden has since 1994 when the debt/GDP was as highest 60% made sure to keep a budget surplus to reduce the country's debt. And in the long-run most of the companies don't hesitate to invest, employ and/or consume, and that is one of the reason for the quick recovery from recessions (Fredén, 2008).

3.8.1 The Swedish stock market
The Swedish stock market was founded in 1863 and is located in Stockholm, it was acquired by NASDAQ OMX in 2003 and merged with the Finish stock exchange in 2004 (NASDAQ OMX Nordic, 2013).

<table>
<thead>
<tr>
<th>Swedish Markets (OMXSPI)</th>
<th>Economic sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMX Large Cap</td>
<td>Oil &amp; Gas</td>
</tr>
<tr>
<td>OMX Mid Cap</td>
<td>Basic metals</td>
</tr>
<tr>
<td>OMX Small Cap</td>
<td>Industrials</td>
</tr>
<tr>
<td></td>
<td>Consumer goods</td>
</tr>
<tr>
<td></td>
<td>Health care</td>
</tr>
<tr>
<td></td>
<td>Consumer service</td>
</tr>
<tr>
<td></td>
<td>Telecommunication</td>
</tr>
<tr>
<td></td>
<td>Financials</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
</tr>
</tbody>
</table>

Table 3 – Economic sectors
(SvD Näringsliv, 2013)

Table 3 gives you an overview on how the Swedish stock market is constructed.

The average return on the Swedish stock market has been 9.7% since 1918 (inflation adjusted 6.3%) (Nyman, 2013). In march 2012 Price Water Cooper (PwC) did a study on the risk premium on the Swedish stock market which landed on 7.8% (PwC, 2012, p. 6).
3.8 Summary of Chapter 3

Figure 10 – Theoretical framework

Figure 10 shows how all the theories are connected and floating out into our research question. As can be seen from the figure, theories that are linked to both sides of different theories (Hedging are both related to MPT and Behavioral Finance, and Stock Market Performance are linked together with Exchange rates by the Spillover effect). It has been narrowed down to how they are related to Sweden which is in consistency with our research question.
Chapter 4 - Practical Methodology

In this chapter we depict the data collection method, provided the information regarding our data sample, placed our logic of choosing the data sample and the time horizon. Statistical method and models have been explained as well as the hypotheses.

4.1 Sample Data
The purpose of this thesis is to analyze if changes in exchange rates affect the performance of the return on the Swedish stock market between the years of 2003-2013 you had before 2002-2012 and for different sub-periods within this ten year time frame. Beside of different time periods we have also chosen to analyze how the changes affect the return on different economic sectors on the Swedish market. To be able to compare the different economic sectors we have use the same data in every sector. We have used the NASDAQ OMX Nordic website to utilize daily returns during the chosen period for all chosen economic sectors. As we are utilizing the all data from the same website, we can be sure that the data has been collected in the same way by NASDAQ and this makes the data comparable. The methodology used by NASDAQ OMX can be found on their website (NASDAQ OMX Group, 2013). There are a total of 9 different economic sectors, and together with the whole stock market (OMXSPI) there are 10 different indices we have chosen to analyze, can be seen in table 3 on page 38.

The exchange rates of USD and EUR against the SEK and the cross rates have been collected from Thomason Reuters DataStream. We are using daily exchange rates just as we have done for the stock market return.

4.2 Time horizon
When choosing the time horizon of your research there are according to Saunders et al. (2012, p.190) two different type of snapshots of the time period you chose to use in the research. It's either over a cross-sectional perspective or the longitudinal perspective on the time horizon. As explained earlier, we are trying to find a correlation between exchange rates movements and stock market returns in different economic sectors within the Swedish stock market over different time periods. The time periods that we have chosen are presented in figure 11 as well as in table 4 below.
Table 4 – Chosen periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Dates</th>
<th>Market condition</th>
<th>No. of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2003-01-01 to 2013-01-01</td>
<td>Total time period</td>
<td>2514</td>
</tr>
<tr>
<td>2</td>
<td>2003-01-01 to 2007-07-17</td>
<td>Bull market</td>
<td>1140</td>
</tr>
<tr>
<td>3</td>
<td>2007-07-18 to 2009-03-31</td>
<td>Bear market</td>
<td>428</td>
</tr>
<tr>
<td>4</td>
<td>2009-04-01 to 2011-01-13</td>
<td>Recovery</td>
<td>449</td>
</tr>
<tr>
<td>5</td>
<td>2011-01-14 to 2013-01-01</td>
<td>Consolidated market</td>
<td>497</td>
</tr>
</tbody>
</table>

The exchange rates of USD and EUR against the SEK and the cross rates have been collected from Thomason Reuters DataStream. We are using daily exchange rates just as we have done for the stock market return. The sub periods that we have chosen have been divided up in different economic conditions as is being explained in table 4. We changed to a new period when we could observe a change in the market conditions, the second period (Bull market) ended the day after we had observed the highest closing price. For the third period (Bear market), we ended that period when we could observe a major change in the following market condition. The fourth period (recovery) was ended when we observed the highest market value after the period had started, and the fifth period (Consolidated) is from the day after the highest observed market price over period four. As during the last ten year we have observing all these different types of market condition, so we thought that we could get reliable results from using this ten year period.

4.3 Calculation of Return

When we have calculated the daily return of the stock market and for the exchange rates we have used the logarithmic method. Evidence from Bodie et al. (2011, pp.175-176) shows that when compounding are used, a asymmetry in the distribution is shown which indicates that when compounding is used over time we cannot use standard deviation of terminal value, instead we have to use the binominal distribution and that instead of a normal distributed
return, we get a lognormal distribution over time. According to Bodie et al. (2011) and Brealey et al. (2011) when analyzing return of assets to up to a month, then the difference between the normal distribution and the lognormal distribution is insignificant, but for longer intervals, lognormal gives a more accurate result on the return. And as we are intended to analyze period that are longer than 1 month, then we feel that the right way to measure the return are with the logarithmic return calculation. To calculate the logarithmic return we have used equation 4

\[
\eta_{log} = \frac{\ln R_t}{\ln R_{t-1}}
\]

**Equation 4 – Lognormal return**

\(\eta_{log} = \text{Logaritmic return}\)
\(R_t = \text{Return time } t\)
\(R_{t-1} = \text{Return time } t - 1\)
\(\ln = \text{Lognormal}\)

### 4.4 Data Collection Method

This research is made up of secondary data, collected and sorted by numerous sources. There are three different types of secondary data that have been highlighted by Saunders et al. (2012, p.307-308): 1) Documentary-, 2) Survey- and 3) Multiple source data. The data we have collected for our research is of the documentary type of secondary data as we have collected our data from sources that have collected the primary data themself. As mentioned above, we have used Thomson Reuters DataStream for the collection of exchange rate movements, and the official NASDAQ OMX website for the collection of stock performance in different indices.

### 4.5 Pearson Product-Method Correlation (PPMC)

The correlation between two variables explains how the variables are related to each other. The mostly used method to calculate the correlation is the Pearson Product-Method Correlation, which gives you a linear relationship between the variables (Statistics How To, 2013). As our study is to analyze if changes on exchange rates have any effects on the performance on the stock performance, we need to see if there is any correlation between these two variables. The correlation also gives us indications on if it is worth hedging against the currency risk if you an international investor investing in the Swedish stock market. The formula for calculating the correlation between two variables is this:

\[
\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y}
\]

**Equation 5 – Correlation coefficient**

\(\rho_{x,y} = \text{Correlation between variable } X \text{ and variable } Y\)
\(\sigma_{x,y} = \text{Standard deviation variable } X \text{ and variable } Y\)
\(\text{cov}(x,y) = \text{Covariance between variable } X \text{ and variable } Y\)
\(X \text{ & } Y = \text{Return on variable } X \text{ & variable } Y\)
\(\mu_{x,y} = \text{The average return over a period in time for a population}\)
The results from this method lie always between -1 and 1. -1 means that the variables are perfectly negatively correlated (meaning that the two variables move in perfect opposite directions) and 1 means that the variables are perfectly positively correlated (meaning that the variables move exactly in the same direction), but these perfectly correlations are very rare and so is the correlation of 0 (Statistics How To, 2013 and Hillier et al., 2010, p.261).

4.5.1 Limitations with PPMC
As this method does not separate between independent variables and dependent variables you might get a correlation that makes no sense at all. So when using the PPMC you need to be mindful of the variables that you are using to get a result that makes sense. The PPMC does not give you any information on the slope of the line, it only tells you if the correlation is high or not (Statistics How To, 2013). Another limitation with the method is that it does not take into consideration any outliers which might offset the strength of the correlation (University of Leicester, 2000).

4.6 Time Series and Stationarity
Time series data refer to a sequence of observations of some variables over a period of time. In our research the historical exchange rates and the stock prices over different sectors can be considered as the time series data. Different statistical models can be included in the time series data. When we deal with statistical models, the parameters need to be set up in order to reduce the forecast uncertainty. Moreover, the statistical model which describes the time series data should include parameters so that the model can well describe the behavior of the time series data. In order to assume that the statistical model has enough parameters to avoid the biasness of the output the time series data must have the property called stationarity.

“Stationarity stochastic processes are probability models for the time series with time-invariant behavior” (Ruppert, 2004, p. 101). Stationarity process assumes that all the behaviors of the time series data are constant over the change of time. The probability distribution of for stationarity process of a sequence with n observations does not depend on their time origin. This is a very strong assumption; however, the weak stationary assumes that the mean and variance do not change over time, and the autocorrelation between two observations depends only on the time distance between them (Ruppert, 2004, pp. 102-103).

4.7 Unit Root Test
Studies of interest rate, foreign exchange rates, or the stock prices often tend to be non-stationary. These non-stationary time series are called unit root non stationary time series, and this time series can be explained with random walk model. The stationarity of the time series can be explained with whether if the time series follow the random walk or random walk with a drift, the following Unit root test is performed with auto regression (AR1) model.

\[ Y_t = \theta + \alpha Y_{t-1} + \varepsilon_t \]

Equation 6 – Unit Root test

- \( Y_t \) = Current value of the time series
- \( \varepsilon_t \) = denotes the independent random variables at time
- \( \theta \) = constant number
We have used the Augmented Dicky Fuller (ADF) test to test the null hypothesis: time series has unit root. According to Dickey and Fuller (1979, p.427), if \( p < 1 \), the time series \( Y_t \) moves towards stationarity and in case of \( p = 1 \) the time series does not follow the stationarity but rather can be considered as Random walk with the variance of \( t \). In case of \( p > 1 \) the time series does not follow the stationarity and “the variance of the time series grows exponentially as the \( t \) increases” (Ruppert, 2004, p. 427) (Bollerslev, 1986, pp. 307-308).

The ADF test formula is given as following:

\[
ADF = \frac{(\lambda - 1)}{se(\lambda)}
\]

\( \lambda \) = value obtained from least square regression

\( se(\lambda) \) = least square regression error.

To accept or reject the hypothesis, we compare the ADF test value with the critical values. The null hypothesis will be rejected if ADF value exceeds the critical value. Alternatively, the null hypothesis will be rejected. (Tsay, 2010, pp. 76-78)

### 4.8 GARCH model

Eagle (1982) first introduced the ARCH (Autoregressive Conditional Heteroskedastic) model, the parametric model which studies the time series allowing the variance of the time series to be changed over the time period. Later in year 1986 Bollerslev introduced the model GARCH (Generalized Autoregressive Conditional Heteroskedastic), the extensive version of the ARCH model. ARCH and GARCH models are the major tools for characterizing the volatility from the previous unpredictable changes of the return of an asset to predict the future time varying changes of the return of the asset. (Altay-Salih, 2003, p. 485) Considering the clustering phenomenon of volatility is the distinct characteristic of GARCH family models. [Mandelbrot (1963) and Fama (1965) as cited in (Altay-Salih, 2003, p. 486),] GARCH model resembles the process of standard time series with the extension of the AR model to autoregressive integrated moving average (ARIMA) model (AR, moving average (MA), ARIMA) (C.Hull, 2012).

Models of the GARCH type have spread through the finance industry, especially in regulation and volatility prediction. Thus, Bonilla and Jean Sepulveda (2011) studied the effectiveness of the use of such models. Yang and Dong (2004), studied the mean and volatility transmission mechanism between the foreign exchange and the stock market for the G-7 countries. Yang and dong (2004) adopted EGARCH model to investigate the dynamic price and volatility spillover between the stock and exchange market for the G-7 countries; and their empirical study found that the volatilities in exchange rate has less impact on the future stock return instead the changes in stock return has more impact on the future exchange rates. Similarly, Lee et al. (2011) studied the dynamic correlation between the stock prices and exchange rate, using the STCC-GARCH model and applying the weekly data from Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand to test the hypothesis of dynamic correlation for the period 2000 to 2008. Their empirical study found that significance price spillover effect exists between the stock and foreign exchange market for Indonesia, Korea, Malaysia, Taiwan and Thailand. In addition their study concluded that correlation between the stock market and foreign exchange increases with volatility in the stock market.
Moreover, Tsay (2010, p.142), states that the return of the security may depend on its volatility. In order to model this phenomenon the GARCH-M model can be used, where M stands for Garch in the mean. In GARCH (1,1) model, the $\sigma^2$ is found from the long run average variance rate, $V_L$, as well as from $u_{n-1}$ and $\sigma_{n-1}$. The equation from GARCH(1,1) is the following:

$$\sigma^2_n = \gamma V_L + \alpha u^2_{n-1} + \beta \sigma^2_{n-1}$$

Equation 8 – GARCH (1,1)

$\gamma, \alpha, \beta = \text{are the weights assigned}$

$V_L = \text{long run average variance rate}$

$u^2_{n-1} = \text{residual square estimation}$

$\sigma^2_{n-1} = \text{last term variance estimation}$

Where, $\gamma, \sigma$ and $\beta$ are the weight assigned to $V_L, u^2_{n-1}$ and $\sigma^2_{n-1}$ respectively. The weights add up to 1. So it follows the equation $\gamma + \alpha + \beta = 1$. (Hull 2012, pp.218)

“The “(1,1)” in GARCH (1,1) indicates that $\sigma^2$ is based on the most recent observation of $u^2$ and the most recent estimation of the variance rate. The more general G (p,q) model calculates $\sigma^2$ from the most recent $p$ observations on $u^2$ and the most recent $q$ estimates of the variance rate. GARCH (1,1) are by far the most popular of the GARCH models.” (Hull 2012, pp.218-219)

4.9 Hypothesis and how it will be tested
To be able to answer our research question we have set up different hypotheses which will first answer our two sub questions and with the results from them we hope to be able to answer our main question. (Sheng Yung-Yang, 2004)

4.9.1 Hypothesis for Sub Question 1: Is there any correlation between the dollar & euro exchange rates and the Swedish stock market?
As the first sub question concerns the correlation between exchange rates and stock market performance, we have chosen these three hypotheses;

Hypothesis 1: There is no correlation between changes in exchange rates and stock market performance
Hypothesis 2: Correlation is constant over time
Hypothesis 3: Correlation is constant across economic sectors

To test these hypotheses we are using the software SPSS17 and the Pearson Product-Method Correlation test (explained more thoroughly in section 4.5). The test states that if $H_0$ is true, then we can reject our hypothesis. If $H_0$ is not true then we cannot reject our hypothesis.

$$H_0 : \rho = 0 \quad \text{Reject}$$

or
The t-statistics has been used to test the significance in our test; this also gives us an indication on the probability that the sample also is reflected within the population (Bryman & Bell, 2011, p. 355). At a significant level of 0.05 with n-2 degrees of freedom, the $H_0$ will be rejected if T value exceeds the critical value of T, if not then the $H_0$ will be accepted. This means that if the probability is less than 0.05, then we can say that the correlation is statistically significant and if it is greater than 0.05 then the significant is not statistically significant (Saunders, et al., 2009, p. 456).

**The equation for the t-statistic test is:**

$$T_{n-2} = \frac{2\sqrt{n-2}}{\sqrt{1-r^2}}$$

Equation 9 – T-statistic test

- $T_{n-2}$ = T value at number of observations minus 2
- $n$ = Number of observations
- $r^2$ = Correlation between the variables

Basically, the lower (closer to zero) the T-score the more certain we can be that our calculations can be transferred to the whole population and this strengthen our assumptions around our findings.

### 4.9.2 Hypothesis for Sub Question 2: Is there any Volatility Spillover effect within dollar & euro exchange market and the Swedish stock market?

In order to answer the second sub question, hypothesis 4 will be tested.

**Hypothesis 4: There is no volatility spillover effect between the exchange rate and stock market performance.**

$$H_0 : \rho = 0 \quad \text{Reject}$$

or

$$H_A : \rho \neq 0 \quad \text{Don't reject}$$

Several studies are done to investigate how the volatility of the exchange rate affects the stock return. This hypothesis test will allow us to understand, whether or at what extent the volatility spillover affect exists within the two different form of financial market. This test will increase the knowledge on the volatility transmission within these two financial variables.
Chapter 5 - Empirical result

This chapter presents our findings from the data simulation. We present the values of correlation and significance test between the exchange rates and the Swedish market over the total and sub periods with different economic sectors respectively. Later on we present the different parameters obtained from the volatility spillover test for the exchange rates and the stock prices. Figure 12 explains the flow of our different statistical tests towards our hypothesis test.

5.1 Descriptive statistics and preliminary analysis

Before discussing the results of our findings, we shall present the movements on the exchange rates and the stock market indices over the period of 2003-2013. We will also show the changes in volatility over the same period for every economic sector and the exchange rates.
5.1.1 Exchange rates movements

As can be seen in figure 13, the USD/SEK exchange rate has moved more within a broader range over the period 2003-2013 with a top notation at around 0.17 USD/SEK down to a bottom notation at around 0.11 USD/SEK, which is a range of about 55% and this change happened around 2008-2009 so the USD/SEK exchange rate is quite unstable, especially compared to the EUR/SEK exchange rate which is seen in the same figure. The EUR/SEK was tabled between the start of and period till the end of 2008 of around 0.11 EUR/SEK. A bottom notation is seen in the beginning of 2009 at around 0.09, with a top notation of around 0.12 in the middle of 2012 (a range of about 33%). We do not see the same growth in the FOREX market as we can see in other financial markets like the stock market, this is because, as explained in chapter 3, that the exchange rates usually move toward an equilibrium. According to our figure, the USD/SEK rates are much more volatile than the EUR/SEK, you can also see from the figure that after 2009 it seems that the FOREX market has become more volatile at least for the USD and the EUR to SEK.

5.1.2 Stock markets performance
In figure 13 and 14 we can see as we would expect, the stock market indices are volatile with both ups and downs, basically they all follow the same movements, but we will see in the section about volatility that the degree of volatility are different among the different economic sectors. The indices grew strongly from the beginning of 2003 till around 2008 when we had the global financial crisis, where the majority of all sectors plumbed. What is interesting to see is that the Basic Material sector did not respond as the other sector did with a drop later than will other sectors, it actually started to drop before the other sectors but has a big upward trend when the other sectors were falling and then after a few months later, the Basic Material sector plumbed. From looking at figure 14 and 15, OMXSPI showed a positive trend from 2003 till 2007 and also between 2007 and 2009. It lost about 50% of its value which is also in the range of movement for the OMXSPI during the 10 year period. The biggest fluctuations can be seen in Basic Material sector with a range of about 90% fluctuations during the period. But the general assumption is that all economic sectors follow almost the same pattern with quite small differences.
5.2 Volatility in the USD exchange rate

From figure 5-1 we can see the volatility of the USD/SEK exchange rate over the whole ten year period. It was somewhat stable between 2003 and till the third quarter of 2008 as can be seen in figure 5-2 and 5-3 with the high peak of around 0.025 around the beginning of 2005 and with the biggest drop around April 2004 where when the rate fell to -0.025. It wasn't until around September to October 2008 when the exchange rate started to move substantially compared to previous years with movements between -0.04 and almost 0.06. Fluctuations of about 250% from the bottom to the top (see figure 5-3). From figure 5-3 and 5-4 we can see that these enormous fluctuations were short lived and from the first quarter of 2009 till the end of 2012, movements have stayed within -0.03 and 0.03; reflecting fluctuations of about 200% from the bottom to the top. So even though the exchange rate seems stable as in figure 5-1 and 5-5, there are still very volatile and according to the figures it seems like the volatility have increased after the financial crisis in 2008-2009 compared before the crisis.
5.3 Volatility in the EUR exchange rate

The volatility of the EUR exchange rate against the SEK is quite similar to the USD explained in section 5.2, with no major movements until the middle of 2009. As figure 5-7 shows, only twice during 2003 and August 2007 the fluctuations reached above 0.01 and below -0.01. It was not until the middle of August 2008 that major fluctuations were shown as can be seen in figure 5-8, where fluctuations reaching -0.03 and 0.03 were seen in the end of 2008.

Around the beginning of 2010 the exchange rate started to move back to a more stable path, even though it was higher than before the big movements in 2008-2009. With just a few bigger break outs when the exchange rate reached almost -0.025 once between April 2010 and July 2010. Since 2011, the exchange rate seems to have settled around -0.01 and 0.01 with just a few breakouts. The stability of the volatility of the exchange rate can also be seen in figure 5-6 where even though the exchange rate has become more volatile after the crisis than before the crisis, it has stabilized substantially as figure 5-10 shows.
5.4 Volatility on OMXSPI

As can be seen from figure 5-11 the OMXSPI is quite volatile and have been so throughout the whole ten year period, but some periods have been more volatile than others. We can see from figure 5-12 that the market started to stabilize in the middle of 2004, but high fluctuations in the market was seen in May to June 2006 (figure 5-13), the global financial crisis started to affect the Swedish stock market in October to November 2008 with fluctuations from almost -0.08 to 0.09 before the year ended (figure 5-13). The market stabilized some around the beginning of 2009 of between -0.05 and 0.05 and the fluctuations decreased until the middle of July 2011 (figure 5-14 and 5-15) where you can observe higher volatility again, but we are now back at a more normal condition at volatility between -0.03 and 0.03 as before the global financial crisis during 2008-2009 (figure 5-11 and 5-15).
5.4.1 Volatility in the Oil & Gas sector
The Oil & Gas sector seems to be a very volatile sector with fluctuations of around -0.2 and 0.15 as the most, from figure 5-16 there are no stable period for longer timer, but what we can see is a decrease in the volatility in the end of 2012. When we look at the figures which have broken down the periods into the sub-period that we have chosen (specific figure 5-17, 5-18 and 5-20), we can see that the volatility only stays stable for about one year and then it changes. We have some peaks when the volatility reached over 0.15 in end of June 2006 (figure 5-17), the end of November 2008 (figure 5-18) and in the beginning of September 2010 (figure 5-19). We can observe more drops below -0.15, in the beginning of July 2004 and July 2006 (figure 5-17) and September to November 2008 (figure 5-18). Since the beginning of February 2012, the volatility seems to have stabilized between -0.05 and 0.05 (figure 5-20).
5.4.2 Volatility in the Basic metals sector
The Basic metals sector is not that very volatile if compared with the Oil & Gas sector, observations in figure 5-21 shows that it is very rare that the volatility passes 0.1 and goes under -0.08. Actually only twice has the volatility passed 0.10 and only once has is dropped below -0.08 (figure 5-23). The volatility seems to be quite stable between -0.05 and 0.05 even though there are periods when this has not hold (figure 5-21). Severe changes in volatility that passed 0.05 was not until September 2008 and for the rest of 2008 which were quite unstable (figure 5-23), but went back to more a more normal interval in the beginning of 2009 with only around a dosing times between 2009 and 2013 where the volatility has moved over 0.05 and below -0.05 (figures 5-24 and 5-25).
5.4.3 Volatility in the Industrial sector

The volatility in the Industrial sector does not have been affected very much during our chosen period with economic crisis and growth/recovery periods. Even though we have seen major fluctuations on the financial markets all around the world, the industrial sector has not made it above 0.10 and not below -0.09 (figure 5-26). From figure 5-27 we can see that there were a very short period between April and June 2006 when the volatility increased above 0.05 which also dropped below -0.05 once during this time. When the global financial crisis hit the world in the end of 2008, you can see that it also affected the industrial sector in Sweden, which could be expected but no major outbreaks during the period between September and December of 2008 (figure 5-28), and then it moved back to more stable intervals of around -0.05 and 0.05. Since the third quarter of 2010, the volatility has been on the same low levels are in 2004-2006 of around -0.03 and 0.03 (figure 5-26, 5-27 and 5-30).
5.4.4 Volatility in the Consumer goods sector
A very stable sector, with very few major fluctuations for volatility, can be seen in figure 5-31. It was not until the beginning of November 2008 as we could see that the volatility increased above 0.05 and below -0.05 except for on time in the middle of 2006. When the financial crisis in the second half of 2008 affected the consumer goods sector in Sweden the fluctuations was not as severe as within any other sector mentioned so far. We can see from figure 5-32 and 5-33 that a period between September 2008 and June 2009 a more unstable market were shown but only from some bigger fluctuations in the middle of 2010 and beginning of the second half of 2011 the sector has been very stable (figure 5-34 and 5-35). From September 2012 and 2013, the volatility has laid between -0.02 and 0.02 (figure 5-35).
5.4.5 Volatility in the Health Care sector
Even though figure 5-36 shows a volatile sector, the volatility is staying within a quite narrow range between -0.05 and 0.05 during the period of ten years that we have chosen. From figure 5-37 we see that the beginning of our chosen period (2003) and to the third quarter of 2004 the volatility were decreasing, but with some points where the volatility increased to -0.06 and below only three times between 2003 and 2013 (figure 5-36, 5-37, 5-38, 5-39 and 5-40). It does not seems like the sectors was severely affected of the financial crisis in 2008 (figure 5-38). A more thorough analysis of the figures (5-37, 5-38, 5-39 and 5-40) gives you the information that most often the volatility lies between -0.02 and 0.02, which is not a lot.
5.4.6 Volatility in the Consumer service sector
As figure 5-41 shows, the consumer market sector has just a few very severe fluctuations during the last ten years, the only major changes in volatility occurred around the financial crisis in 2008 as can be seen in figure 5-41. Figure 5-43 which should show the increased fluctuations do not show any severe fluctuations from normal, you can see the same fluctuations in volatility in the beginning of 2006 as well. We can also see a peak in the beginning of 2010 (figure 5-44) and again in the last quarter of 2011 (figure 5-45). The highest peak in volatility can be observed in the end of 2011 when the volatility increased to as high as 0.08-0.09 (figure 5-43) and the bottom drop is in august 2011 when the volatility dropped to around -0.06 (figure 5-45).
5.4.7 Volatility in the Telecommunication sector

The volatility in figure 5-46 shows a quite volatile sector with a wide spread of the volatility, ranging between -0.10 and 0.10. The sector was highly volatile in 2003 and onwards with fluctuations between -0.10 and 0.07, during the period from 2003 till the middle of 2007, the volatility range between -0.05 and 0.05 which seems quite normal in the sector over the whole ten year period (figure 5-46 and 5-47). What is remarkable is that the severely hit by the financial crisis in 2008-2009, the highest peak was 0.08 and the biggest drop was -0.07. It was actually before the crisis, in spring 2008 when the biggest fluctuations were observed with a peak over 0.08 and a drop below -0.08 (figure 5-48). A period after 2008, in fact during the whole 2009 and 2010 a decrease in volatility can be observed in figure 5-49. Figure 5-50 show a small increase in volatility from the middle of 2011 and till the middle of 2012, but were back on the low numbers that were shown within the period 2009-2010 (as seen in figure 5-49). Over all a stable sector where the volatility was smaller in 2013 than it was in 2003.

Figure 5-46

Figure 5-47

Figure 5-48

Figure 5-49

Figure 5-50
5.4.8 Volatility in the Financial sector

Overall a quite stable sector which are showing volatility in the range of -0.05 and 0.05 during the majority time of the period, but with a dramatic increase in the volatility during the financial crisis with start in the middle of September of 2008, which are to be expected when the volatility reached above 0.1 and almost down to -0.1 (figure 5-51 and 5-53). During the period from October 2003 till April/May 2006, the volatility was only around -0.02 and 0.02, but no severe increases or decreases could be observed during other periods either (figure 5-52). The volatility was quite fast back to a normal range of -0.05 and 0.05 after the increase due to the financial crisis, in May of 2009 the sectors volatility was decreasing (figure 5-54). We can also observe big fluctuations in the volatility in May/June 2010 and July to December 2011 when the volatility increased above 0.05 and below -0.05 (figure 5-54 and 5-55).
5.4.9 Volatility in the Technology sector
The volatility within the technology sector stays within -0.05 and 0.05 during the majority of the period, but with some fluctuations above and below that range (figure 5-56). It looks like the sector was quite volatile in the beginning of 2003 and reached more a more normal interval in the middle of 2004, it might have been the effects from the IT-crash in 2001 that was the reason for the high volatility in the beginning of 2003 (figure 5-57). Figure 5-58 shows a severe drop in volatility the it reached below -0.20 in the end of September of 2007. The financial crisis in 2008 made the sector increase the volatility with a peak around 0.14 in September 2008 and a drop to almost -0.14 just before November 2008. After January 2009, the sector stabilized within an interval of 0.05 and -0.05 (figure 5-58, 5-59 and 5-60). We can also see a major drop in the middle of January 2012 when the volatility reached -0.13, but beside of that the volatility did not move above 0.10 and -0.10 more than a handful of times from 2009 and the present (figure 5-58, 5-59 and 5-60).

Figure 5-41

Figure 5-42

Figure 5-43

Figure 5-44

Figure 5-45
5.5 Correlation between changes in USD and EUR exchange rates and stock market performance

In this stage of the research we will present the result of the Pearson Product-Method Correlation test between the exchange rates and the stock market performance for the different economic sectors in Sweden. The chosen order for this presentation is as follows:

1. The correlation for the period between 2003-01-01 and 2013-01-01
2. The correlation for the period between 2003-01-01 and 2007-07-17
3. The correlation for the period between 2007-07-18 and 2009-03-31
4. The correlation for the period between 2009-04-01 and 2011-01-13
5. The correlation for the period between 2011-01-14 and 2013-01-01

In sections and belonging tables the correlation will be presented with a statistical significant of minimum 0.05 which has been tested by a two-tailed t-test.

5.5.1 Correlation between exchange rates and stock performance: 2003-01-01 to 2013-01-01

Table 5 presents the correlation over a ten year period between EUR/SEK and EUR/USD for different economic sectors on the Swedish stock market.

<table>
<thead>
<tr>
<th></th>
<th>Oil&amp;Gas</th>
<th>Basic Metals</th>
<th>Industrials</th>
<th>Consumer Goods</th>
<th>Healthcare</th>
<th>Consumer Service</th>
<th>Telecom</th>
<th>Financials</th>
<th>Technology</th>
<th>OMXSPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUR/SEK</td>
<td>-.007</td>
<td>-.003</td>
<td>.012</td>
<td>.003</td>
<td>.006</td>
<td>.013</td>
<td>.001</td>
<td>.007</td>
<td>-.006</td>
<td>.046*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.714</td>
<td>.865</td>
<td>.556</td>
<td>.867</td>
<td>.768</td>
<td>.514</td>
<td>.945</td>
<td>.738</td>
<td>.777</td>
<td>.021</td>
</tr>
<tr>
<td>USD/SEK</td>
<td>.004</td>
<td>.015</td>
<td>.023</td>
<td>.017</td>
<td>.003</td>
<td>.012</td>
<td>.027</td>
<td>.027</td>
<td>.004</td>
<td>.038</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.827</td>
<td>.459</td>
<td>.257</td>
<td>.389</td>
<td>.891</td>
<td>.555</td>
<td>.174</td>
<td>.178</td>
<td>.835</td>
<td>.057</td>
</tr>
</tbody>
</table>

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

Table 5 – Correlation for 2003-01-01 to 2013-01-01

From the table we can see that none of the underlying variables (exchange rates) has any significant correlation to any of the individual economic sectors.

For the EUR/SEK exchange rate, the market sector (OMXSPI) has the strongest of correlation at 0.046, with 0.038 as the second highest correlation at OMXSPI with USD/SEK. Telecom and the Financials tied for the strongest correlation at 0.027 with USD/SEK among all other economic sectors. All individual sectors are showing positive correlation with USD/SEK. If we observe carefully, we can see that individual economic sectors are found to have stronger correlation with USD/SEK exchange return than EUR/SEK return. The least correlated sector is the Healthcare sector (0.003) followed by the Technology sector tied with the Oil & Gas sector (0.004)

For the EUR/SEK exchange rate, some of the sectors shows a negative (but very small) correlation, Oil & Gas (-0.007), Basic Metals (-0.003) and Technology (-0.006). The correlation for the market index (OMXSPI) is stronger to the EUR exchange rate than the USD (0.046) and is the sector with the highest correlation found. Beside the relatively high
correlation between the OMXSPI and EUR/SEK all other sectors are showing very low correlation where the Consumer Service sectors and Industrial sector places right after OMXSPI at 0.013 and 0.012, respectively.

We are considering the 95% confidence interval that is the 5% (0.05) significance level to interpret the probabilities and significance level of the statistical tests. Keeping that in mind, we can see all the p-values for the correlation of different economic sectors and exchange returns are higher than the chosen significance level, except for the p-values between EUR/SEK or USD/SEK return and OMXSPI (discussed in chapter 6.1).

5.5.2 Correlation between exchange rates and stock performance: 2003-01-01 to 2007-07-17

From table 6 the correlations are shown for the bull market period on the stock market.

<table>
<thead>
<tr>
<th></th>
<th>Oil &amp; Gas</th>
<th>Basic Metals</th>
<th>Industrials</th>
<th>Consumer Goods</th>
<th>Healthcare</th>
<th>Consumer Service</th>
<th>Telecom</th>
<th>Financials</th>
<th>Technology</th>
<th>OMX SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUR/SEK</td>
<td>.019</td>
<td>.038</td>
<td>.076*</td>
<td>.073*</td>
<td>.047</td>
<td>.051</td>
<td>.028</td>
<td>.055</td>
<td>.038</td>
<td>.058*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.512</td>
<td>.198</td>
<td>.010</td>
<td>.014</td>
<td>.116</td>
<td>.163</td>
<td>.338</td>
<td>.064</td>
<td>.200</td>
<td>.048</td>
</tr>
<tr>
<td>USD/SEK</td>
<td>.025</td>
<td>.004</td>
<td>.018</td>
<td>.010</td>
<td>.014</td>
<td>.004</td>
<td>.024</td>
<td>.031</td>
<td>.031</td>
<td>.026</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.399</td>
<td>.893</td>
<td>.547</td>
<td>.741</td>
<td>.628</td>
<td>.880</td>
<td>.399</td>
<td>.295</td>
<td>.303</td>
<td>.382</td>
</tr>
</tbody>
</table>

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

Table 6 – Correlation for 2003-01-01 to 2007-07-17

As it is presented in table 6, the results from the correlation tests are very low. It is only the Healthcare sector which shows a negative result to the USD exchange rate (-0.014) which the highest correlation in the Technology and Financial sectors at 0.031 followed by OMXSPI at 0.026.

The bottom three sectors are the Healthcare sector, Basic Metals sector and Consumer Service sector at -0.014, 0.004 and 0.004, respectively.

The EUR exchange rate shows stronger correlation across all sectors compared to the USD with the Industrial and Consumer goods sectors in the lead at 0.076 and 0.073 respectively. Again, the market index (OMXSPI) is not the most correlated sector as with the USD during this period. The sector that shows lowest correlation is the Oil & Gas sector at 0.019 followed by the Telecom at 0.028.

The significance level (2-tailed) related to the EUR are wide spread between 0.512 as the highest (Oil & Gas) and 0.010 as the lowest (Industrials). The second and third highest are 0.338 (Telecom) and 0.200 (Technology). Financials and Consumer Goods are showing lowest numbers (0.064 and 0.014, respectively).

For the USD, highest significant levels can be observed with Basic Metals at 0.893, followed by Consumer Service (0.880) and Consumer Goods (0.741). The lowest significant levels can be observed in Technology, OMXSPI and Financials (0.303, 0.382 and 0.295, respectively).
5.5.3 Correlation between exchange rates and stock performance: 2007-07-18 to 2009-03-31

During this period the stock markets was falling due to the global financial crisis and table 7 shows the effect of this bear market and correlation to the exchange rates.

**Table 7 – Correlation for 2007-07-18 to 2009-03-31**

<table>
<thead>
<tr>
<th>Oil &amp; Gas</th>
<th>Basic Metals</th>
<th>Industrials</th>
<th>Consumer Goods</th>
<th>Healthcare</th>
<th>Consumer Service</th>
<th>Telecom</th>
<th>Financials</th>
<th>Technology</th>
<th>OMXSPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUR/SK</td>
<td>-.006</td>
<td>.034</td>
<td>-.012</td>
<td>-.040</td>
<td>.009</td>
<td>.008</td>
<td>-.017</td>
<td>.034</td>
<td>.033</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.906</td>
<td>.482</td>
<td>.809</td>
<td>.407</td>
<td>.849</td>
<td>.868</td>
<td>.732</td>
<td>.486</td>
<td>.490</td>
</tr>
<tr>
<td>USD/SK</td>
<td>.001</td>
<td>-.013</td>
<td>-.059</td>
<td>-.085</td>
<td>-.020</td>
<td>-.051</td>
<td>-.064</td>
<td>-.029</td>
<td>-.072</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.991</td>
<td>.794</td>
<td>.224</td>
<td>.081</td>
<td>.683</td>
<td>.294</td>
<td>.189</td>
<td>.546</td>
<td>.137</td>
</tr>
</tbody>
</table>

The table presents the results from the correlation test and we can see that many of the sectors showed negative results correlated to the USD and some of the sectors showed negative results against the EUR.

The only two sectors that actually showed a positive result correlated with the USD was OMXSPI (0.009) and Oil & Gas (0.001), all other sectors showed a negative result. The most negative correlation can be found with the Industrial sector at -0.085 followed by the Technology sector (-0.072) and the Telecom sector (-0.064).

Half of the number of sectors showed a negative correlation to the EUR during this period, where the two most positive results were in the Basic Metal sector and the Financials sector (tied at 0.034), followed by the Technology at 0.033. The most negative sectors were Consumer Goods, OMXSPI and Telecom at -0.040, -0.035 and -0.017, respectively.

For EUR, Oil & Gas (0.906), Healthcare (0.849) and Consumer Service (0.868) are the highest top three; while the significance level are lowest for Consumer Goods (0.407), OMXSPI (0.472) and Basic Metals (0.482).

For the USD highest level of significance can be found in the Oil & Gas sector (0.991), followed by OMXSPI (0.861) and Basic Metals (0.794). Lowest level of significance is found at the Consumer Goods sector, Technology sector and Telecom sector (0.081, 0.137 and 0.189, respectively).

5.5.4 Correlation between exchange rates and stock performance: 2009-04-01 to 2011-01-13

During this period we could spot a recovery on the stock market after the financial crisis where the stock market grew, the results from the correlation tests are presented in table 8.
Starting with the USD against the stock market and its different sectors, we can see that half of the sectors are positively and the other half is negatively correlated. The sector with the highest negative correlation is OMXSPI with -0.116 followed by the Industrials sector and the Technology sector (-0.083 and -0.060, respectively). The highest positive correlations could be found within the Consumer Goods sector and the Health care sector at 0.044 and 0.035 respectively.

For the EUR, only two sectors are negatively correlated, the rest is positively correlated. The two sectors that shows negative numbers are OMXSPI (-0.090) and the Industrials sector (-0.060). The highest positively correlation that stands out is the 0.045 shown in the Consumer Service sector, followed by 0.028 for the Financial and Basic Metals sector.

Highest significance level could be found at Oil & Gas (0.741) and Technology (0.759) for the EUR and lowest significance at OMXSPI (0.057) followed by Industrials at 0.206 and Consumer Service at 0.343. The USD has a high significance level with Basic Metals (0.996), Telecom (0.963) and Financials (0.940), but lowest significance with OMXSPI (0.014), Industrials (0.078) and Technology (0.203)

### 5.5.5 Correlation between exchange rates and stock performance: 2011-01-14 to 2013-01-01
During this period we experienced the European Budget crisis with budget deficits in countries in Europe with the most severe crisis in Greece, so the market was somewhat consolidating during this period and quite unstable.
Table 9 presents the correlation during this time and for the USD exchange rate the correlation is close to zero for all sectors beside Oil & Gas (0.016), Basic metals (-0.025), Consumer service (-0.035) and Technology (-0.040). 7 out of 10 sectors shows a negative correlation, with the highest negative numbers found in Technology (-0.040), Consumer Service (-0.035) and Industrials (-0.025). The only sectors with positively correlation were Oil & Gas, Consumer Goods and Health care (0.016, 0.001 and 0.004, respectively).

For the EUR, only one sector showed a negative correlation and that was the Oil & Gas sector with -0.002. The other sectors showed relatively high correlation with Industrials, Financials and OMXSPI (0.088, 0.080 and 0.079, respectively). The gap between the lowest correlated sector (Oil & Gas) and the second lowest was 0.034 (Technology at 0.032).

The EUR significance levels are highest for Oil & Gas (0.969), Technology (0.483) and Consumer Service (0.469). The lowest significance is found in Industrials (0.050), Financials (0.076) and OMXSPI (0.081). For the USD, highest levels can be observed for Consumer Goods, Telecom and Financials (0.984, 0.973 and 0.959, respectively); while the lowest levels are found at Technology, Consumer Service and Basic Metals (0.380, 0.434 and 0.579, respectively).

5.6 Volatility spillover between exchange and stock market.

In order to test our fourth hypothesis, \( H_0 = \) there is no volatility spillover effect between the stock price and exchange rates, we do the following volatility spillover test. The sample period enable us to estimate the dynamic relationship between stock prices and the exchange rates. Rates of return of the stock prices and the exchange rates are calculated with this equation:

\[
R_{i,t} = 100 \times \ln \left( \frac{P_t}{P_{i,t-1}} \right)
\]

\( R_{i,t} = \) return of the market i at time t  
(\( P_{i,t} = \)) Price level of the market i at time t

5.6.1 Unit root test

In order to run the spillover test between the two different time series, the stationary of the series should be measured. We performed the ADF test to test the stationarity of the series with null hypothesis, \( H_0 = \) series has a unit root. The test has been performed with the Eviews 7 software.

The ADF vales are compared with the critical values at 1%, 5% and 10%, and it is found that the time series for both stock and exchange rates are stationary at significance level of 1%. Therefore, the null hypothesis, \( H_0 = \) series has a unit root has been rejected. (The results of the ADF test are included in the appendix).
5.6.2 Mean and Volatility spillover over between the stock market and exchange rate

To model the dynamic volatility relation between the stock prices and the exchange rates, we use the following Auto regressive (AR) model with the extended version of AR family, GARCH (1,1) to fit it’s both mean and variance part of the time series.

\[ X_{i,t} = C_{i,0} + C_{j1,t} + C_{j2,t} + \epsilon \sqrt{ \gamma + \alpha \mu_{ij12,t-1}^2 + \beta \sigma_{t-1}^2 } \]

\[ i = \text{Stock market} \]
\[ j = \text{Exchange rate (1=USD & 2=EUR)} \]
\[ X_{i,t} = \text{Conditional variance equation for Stock market at time } t \]
\[ C_{i,0} = \text{Constant coefficient of Stock variance at } t = 0 \]
\[ C_{j,t} = \text{Constant coefficient of USD at time } t \]
\[ C_{j2} = \text{Constant coefficient EUR at time } t \]
\[ \gamma = \text{Constant coefficient conditional variance} \]
\[ \alpha = \text{Constant coefficient for squared residual} \]
\[ \beta = \text{Constant coefficient for last period variance} \]
\[ \mu_{ij12,t}^2 = \text{Residual square estimation} \]
\[ \sigma_{t-1}^2 = \text{Variance from the last time period} \]

In the above model, the first part, \( C_{i,0} + C_{j1,t} + C_{j2,t} \epsilon \) represents the AR model i.e the mean equation where, \( C_{i,0}, C_{j1,t} \) and \( C_{j2,t} \) are parameters that gives the coefficient of USD and EUR mean on time \( t \) and \( \epsilon \) is the conditional variance of the series. This conditional variance represents the residuals that derived from the difference of observed value of stock price and the estimated function. To be estimated to investigate the mean spillover test between the market. \( \epsilon \) is the residual from the AR model which has been fit to this \( \sqrt{ \gamma + \alpha \mu_{ij1,t}^2 + \beta \sigma_{t-1}^2 } \)

\{GARCH (1,1) \} model; where the parameters \( \gamma, \alpha \) and \( \beta \) are to be estimated to measure the volatility spillover effect, with \( \epsilon(0,1) \) mean = 0 and variance=1.

Equation 5.1 helps us to understand the conditional variance of the stock market depending on its own time series lag conditional variance and lag residual\(^1\) within the stock and exchange rates. To understand the volatility effect of exchange rates on the stock market, the parameters of this equation will be estimated through the different sectors of Swedish stock market over the ten years period of time. Here in this equation \( i=\text{stock market}, \) is the dependent variable and the exchange rates of USD and EUR are the following \( j=1,2 \) independent variables. The considered lag for the AR model is 1. As we are analyzing the time series with daily data, so the recommended lag is lower number for the daily data thus we considered lag number 1. In case of monthly data its 12 and quarterly its 4.

\(^1\) “A residual is the difference between an observed value of the response variable and the value predicted by the regression line.” (David S.Moore, 2009)
We used the software Eviews 7 to calculate the parameters, stated in equation 5.1. In table 10, the following descriptive statistics from the conditional variance (GARCH 1,1) equations, are presented respectively. The analysis data will be followed in the next chapter.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Mean μ</th>
<th>Standard deviation</th>
<th>Skewness²</th>
<th>Kurtosis³</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMX</td>
<td>-0.042704</td>
<td>0.999823</td>
<td>-0.371614</td>
<td>4.002024</td>
</tr>
<tr>
<td>OIL</td>
<td>-0.010410</td>
<td>1.000172</td>
<td>-0.116195</td>
<td>4.861816</td>
</tr>
<tr>
<td>BM</td>
<td>-0.016454</td>
<td>1.000159</td>
<td>-0.135262</td>
<td>4.155975</td>
</tr>
<tr>
<td>CONSUMER GOODS</td>
<td>-0.034205</td>
<td>0.999777</td>
<td>-0.500020</td>
<td>6.82</td>
</tr>
<tr>
<td>FINANCE</td>
<td>-0.042823</td>
<td>0.999802</td>
<td>-0.193277</td>
<td>3.923679</td>
</tr>
<tr>
<td>CONSUMER SERVICE</td>
<td>-0.023373</td>
<td>1.000793</td>
<td>-0.192764</td>
<td>5.572422</td>
</tr>
<tr>
<td>HEALTH CARE</td>
<td>-0.013077</td>
<td>1.001056</td>
<td>-0.472225</td>
<td>5.597756</td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>-0.035835</td>
<td>0.999849</td>
<td>-0.251318</td>
<td>3.744167</td>
</tr>
<tr>
<td>TECHNOLOGY</td>
<td>-0.003713</td>
<td>1.001201</td>
<td>-1.225459</td>
<td>22.95246</td>
</tr>
<tr>
<td>TELECOM</td>
<td>-0.013240</td>
<td>1.000579</td>
<td>-0.295209</td>
<td>6.574103</td>
</tr>
</tbody>
</table>

Table 10 – Descriptive statistics from the Variance equation

The histograms from the normality test of the variance equations for different economic sectors against USD and EURO exchange rates, are presented in the appendix.3 Fig:A16-25. The mean and the standard deviation for the general index OMX-SPI and other 8 different economic sectors, seem to have similar kind of values with left skew in all sectors. Technology sector seems to be exception from other sectors, as it has the highest skew with lowest value for mean. Kurtosis of the distribution seems to have quite difference in values. Likewise mean standard deviation and skewness; the value of the kurtosis for Technology sector varies significantly than others.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>OMX</th>
<th>OIL</th>
<th>BM</th>
<th>CONSMR</th>
<th>FNC</th>
<th>HC</th>
<th>Consumer service</th>
<th>IND.</th>
<th>TECHNO.</th>
<th>TELECOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₀</td>
<td>0.01506</td>
<td>-0.06225</td>
<td>-0.01214</td>
<td>-0.02985</td>
<td>0.00855</td>
<td>0.135260</td>
<td>-0.00537</td>
<td>0.000255</td>
<td>0.000377</td>
<td></td>
</tr>
<tr>
<td>C₁</td>
<td>0.010123</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td>0.044367</td>
<td></td>
</tr>
<tr>
<td>C₂</td>
<td>0.028860</td>
<td>-0.023540</td>
<td>0.025510</td>
<td>-0.051214</td>
<td>-0.02985</td>
<td>0.00855</td>
<td>0.135260</td>
<td>-0.00537</td>
<td>0.000255</td>
<td>0.000377</td>
</tr>
<tr>
<td>γ</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td>3.48E-06</td>
<td></td>
</tr>
<tr>
<td>α</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td>0.085276</td>
<td></td>
</tr>
<tr>
<td>β</td>
<td>0.902606</td>
<td>0.82128</td>
<td>0.927658</td>
<td>0.897506</td>
<td>0.992354</td>
<td>0.919251</td>
<td>0.919251</td>
<td>0.919251</td>
<td>0.919251</td>
<td></td>
</tr>
</tbody>
</table>

² “Skewness is a measure of the degree of asymmetry of a distribution” (Wolfram MathWorld, 2013)
³ “Kurtosis is the degree of peakedness of a distribution, defined as a normalized form of the fourth central moment μ₄ of a distribution.” (Wolfram MathWorld, 2013)
Table 11 – Estimation of parameters from Variance equation

<table>
<thead>
<tr>
<th></th>
<th>$R^2$</th>
<th>0.498112</th>
<th>1.964706</th>
<th>0.844765</th>
<th>0.433016</th>
<th>0.695090</th>
<th>0.377078</th>
<th>0.000560</th>
<th>0.737248</th>
<th>1.219404</th>
<th>0.670034</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>7600.078</td>
<td>5766.187</td>
<td>7028.358</td>
<td>7707.364</td>
<td>7336.150</td>
<td>7714.953</td>
<td>7425.236</td>
<td>7070.592</td>
<td>6229.112</td>
<td>7035.818</td>
<td></td>
</tr>
<tr>
<td>Akeike</td>
<td>-6.041430</td>
<td>-4.582488</td>
<td>-5.586601</td>
<td>-6.126781</td>
<td>-5.831464</td>
<td>-6.132819</td>
<td>-5.902336</td>
<td>-5.620200</td>
<td>-4.950765</td>
<td>-5.592536</td>
<td></td>
</tr>
<tr>
<td>Schwarz</td>
<td>-6.036380</td>
<td>-4.577438</td>
<td>-5.572688</td>
<td>-6.112868</td>
<td>-5.817551</td>
<td>-6.118906</td>
<td>-5.888422</td>
<td>-5.606287</td>
<td>-4.936852</td>
<td>-5.578623</td>
<td></td>
</tr>
</tbody>
</table>

Table 11 represents all the values of the coefficients and significance level of coefficient’s probability []; for both mean and variance part of the equation. It seems from the table that all the coefficient constants from the variance equations are statistically significant with significance level at both 1% and 5%. The $\beta$ coefficients are found to be stronger than the $\alpha$ coefficients, the possible interpretations of these values will be more discussed in details in next analysis chapter. Moreover, the Akaike info criteria and Schwarz criteria has been added to the table. These criteria are used to see the best fit models out of more than one. In our case we just have one model that is the GARCH (1,1), but still we observed these info criteria for different sectors to have a knowledge if there is any big difference of model fit values.

The conditional variance curves from the GARCH(1,1) model for each different economic sectors of Swedish stock market are presented on appendix 2 Fig:A6-15.
Chapter 6 – Analysis & Discussion

6.1 Correlation between changes in EUR and USD exchange rate, and Stock market performance

6.1.1 Hypotheses 1,2 &3
In this part of the research paper we intend to answer the first sub question: *Is there any correlation between the dollar & euro exchange rates and the Swedish stock market?*
To help answer this first sub question we constructed these three different hypotheses

_Hypothesis 1: There is no correlation between changes in exchange rates and stock market performance_

_Hypothesis 2: Correlation is constant over time_

_Hypothesis 3: Correlation is constant across economic sectors_

Hypothesis 1: *There is no correlation between changes in exchange rates and stock market performance.*

As can be observed in table 13 there are correlation between the changes in exchange rates and stock performance but the results are relatively small. We have used a table created by Cohen (1988) to decide if the correlation is non-existent, small, medium or strong, even though the medium and strong will not be necessarily for us to decide upon the level of correlation.

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Negative</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>- 0.09 to 0.00</td>
<td>0.00 to 0.09</td>
</tr>
<tr>
<td>Small</td>
<td>- 0.30 to - 0.10</td>
<td>0.10 to 0.30</td>
</tr>
<tr>
<td>Medium</td>
<td>- 0.50 to - 0.30</td>
<td>0.30 to 0.50</td>
</tr>
<tr>
<td>Strong</td>
<td>- 0.50 to 1.00</td>
<td>0.50 to 1.00</td>
</tr>
</tbody>
</table>

Table 12 – Interpretation of Correlation (Cohen, 1988)

<table>
<thead>
<tr>
<th></th>
<th>Oil&amp; Gas</th>
<th>Basi c Meta ls</th>
<th>Industr ials</th>
<th>Consu mer Goods</th>
<th>Healthc are</th>
<th>Consu mer Service</th>
<th>Telec om</th>
<th>Financ ials</th>
<th>Technol ogy</th>
<th>OMX SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUR/SEK</td>
<td>-.007</td>
<td>-.003</td>
<td>.012</td>
<td>.003</td>
<td>.006</td>
<td>.013</td>
<td>.001</td>
<td>.007</td>
<td>-.006</td>
<td>.046*</td>
</tr>
<tr>
<td>p-values</td>
<td>.714</td>
<td>.865</td>
<td>.556</td>
<td>.867</td>
<td>.768</td>
<td>.514</td>
<td>.945</td>
<td>.738</td>
<td>.777</td>
<td>.021</td>
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<td>USD/SEK</td>
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<td>.015</td>
<td>.023</td>
<td>.017</td>
<td>.003</td>
<td>.012</td>
<td>.027</td>
<td>.027</td>
<td>.004</td>
<td>.038</td>
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<tr>
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<td>.891</td>
<td>.555</td>
<td>.174</td>
<td>.178</td>
<td>.835</td>
<td>.057</td>
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**2003-01-01 to 2013-01-01**

**2003-01-01 to 2007-07-17**

EUR/ | .019 | .038 | .076* | .073* | .047 | .051 | .028 | .055 | .038 | .058*
The data from table 13 shows that almost all of the significance values for the correlation tests are statistically insignificant with the confidence level of 95% (significance level of 0.05). As in almost all cases $p>0.05$, we can say that with 95% confidence level that the null hypothesis can be accepted. Even if we compare the correlation values with created by Cohen (1988), we can see that the correlations are so weak that according to the table 12 there is no correlation between our chosen variables. The table from Cohen (1988) strengthens our findings.

Only three $p$ values (marked in bold table 13), are found to be less or very close to our significance level 0.05 which are EUR and USD against the OMXSPI over both 10 and 2 (2009-2011) years period. The correlations between the variables at these points are statistically significant at the 95% significance level. Nevertheless if we compare their correlation values with the Cohen (1988) table, we can see that the correlation values are too low to take into account. Therefore we can conclude with 95% certainty that Swedish stock performance for different economic sectors are not correlated with the exchange returns, except the general index OMXSPI are found to have statistical significant correlation with exchange returns for the period between 2003-2013 and 2009-2011 respectively; but

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<td>2007-07-18 to 2009-03-31</td>
<td>-0.006</td>
<td>0.34</td>
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<td>0.09</td>
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<td></td>
<td>0.906</td>
<td>0.482</td>
<td>0.809</td>
<td>0.407</td>
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<td>2009-04-01 to 2011-01-13</td>
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<td>-0.060</td>
<td>0.020</td>
<td>0.020</td>
<td>0.045</td>
<td>0.027</td>
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<td>0.015</td>
<td>-0.090</td>
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<td>0.741</td>
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<td>2011-01-14 to 2013-01-01</td>
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<td>0.063</td>
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<td>0.032</td>
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<td></td>
<td>0.969</td>
<td>0.206</td>
<td>0.050</td>
<td>0.090</td>
<td>0.164</td>
<td>0.469</td>
<td>0.090</td>
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<tr>
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<td>-0.002</td>
<td>-0.002</td>
<td>-0.040</td>
<td>-0.009</td>
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<tr>
<td></td>
<td>0.723</td>
<td>0.579</td>
<td>0.937</td>
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<td>0.936</td>
<td>0.434</td>
<td>0.973</td>
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<td>0.380</td>
<td>0.835</td>
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</table>

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

Table 13 – summary of table 5-9
according to the Cohen (1988) table 12, the correlation values are too low to be considered. Hence, we accept the null hypothesis.

Hypothesis 2: Correlation is constant over time.

To test this hypothesis we need to examine how the correlation in the different sectors looks like in table 13. What we can observe from these tables is that level of correlation changes over different time period. So, the correlation is not constant over time and we will reject Hypothesis 2.

Hypothesis 3: Correlation is constant across economic sectors.

Table 13 also gives us the evidence we need to answer this hypothesis (H3), and according to the table the correlation is not constant over different sectors but in fact there are quite big differences between the different sectors. We reject Hypothesis 3.

A summary of our three hypotheses is that there is no correlation between out chosen variables and the correlation fluctuates over time and economic sectors. One point that we find interesting when testing the correlation is that the majority of the results are not statistically significant at 95% confidence level. A second point we want to address can be observed in table 13, during this time period the OMXSPI shows a small correlation for the USD with the stock market at a confidence level of 95% (the correlation with EUR is -0.09, but not significant at 0.05).

6.1.2 Discussion around the hypotheses

In this part of our research we intend to discuss our findings concerning the three first hypotheses, if our findings are contradictory against the other research done on the same type of study mentioned in the literature review part and how our findings supports the purpose of our research.

Our empirical research started by analyzing the correlation between changes in USD and EUR against how the Swedish stock market performed during 2003 – 2013 and for different sub periods that we have chosen in an attempt to give the reader as correct results as possible.

The theory that we have chosen to use that is linked to our first three hypotheses is the Modern Portfolio Theory (MPT) (section 3.2). The MPT concern a perfect portfolio containing financial assets which lower the risk in the portfolio, the lower the correlation between the financial assets, the more of the risk will be diversified away. As our result shows no correlation between the stock market and the exchange rates, together they make a great diversified portfolio.

During the general period of ten years, we can be 95% certain that the EUR are not correlated with the Swedish stock market performance. In general terms, it was all positive numbers for the majority of the sectors, but with some negative numbers for Oil & Gas, Basic Metals and Technology sectors against the EUR, all sectors were showing positive numbers against the USD. This is in line with what Tian & Ma (2010) found in their research were they analyzed the relationship between the Yuan and the Chinese stock market, they could observe a positive correlation between the market indices and exchange rate, that is what we have also found. Another group of researchers, Muller & Verschoor (2006, 2007 and 2009), studied the
relationship between the USD against the US equity market (2009), the Yuan against Asian markets (2007) and EUR against European markets (2006). They found the same results as Tian & Ma (2010) when they tested the domestic currency (USD) against the US Equity market, and that a depreciating EUR had negative effects on European stock market returns, similar results were observed on the relationship between Yuan and the Asian market.

During the sub periods that we choose, the correlation are close to 0 (zero) in each period even though it fluctuates between positive and negative numbers. What we also observed is that when one exchange rate shows negative numbers during one of the periods, the other exchange rate shows an opposite sign. This is observed in every sub period except during 2009-04-01 and 2011-01-13. As we have been studying the correlation during different economic conditions, bear or bull, the same non-existing, or low, correlation has been observed, which makes it clear that the currency risk is always present and the need for hedging/diversification is something that all investors investing in Swedish stocks with EUR or USD have to keep in mind. From an investor perspective, the low or non-existing correlation makes currencies great diversifier in a portfolio of Swedish stocks.

6.2 Volatility spillover test: between changes in EUR and USD exchange rate, and Stock market performance

6.2.1 Hypothesis

In this section we intend to answer the second sub question: ‘Is there any Volatility Spillover effect within dollar& euro exchange market and the Swedish stock market? In order to answer this sub question we established the following hypothesis:

Hypothesis 4: There is no volatility spillover effect between the exchange rate and stock market performance.

The hypothesis have been tested with the GARCH (1,1) model, and the following results in table 11, represents whether if there is any volatility spillover between exchange rate and stock prices. From table 11; we can see that all the probabilities ($p$) of coefficients of conditional variances are less than both significance level of both 5% and 1%. Thus, we can reject the null hypothesis, and alternatively it proves that there is volatility spillover effect from exchange rate to stock market. The hypothesis tests for every single economic sector are presented in table 14.

<table>
<thead>
<tr>
<th>$H_0$: No Volatility spillover</th>
<th>USD</th>
<th>EUR</th>
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<tbody>
<tr>
<td>OmX_SPI</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td>OIL &amp; Gas</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td>Basic material</td>
<td>Rejected</td>
<td>Rejected</td>
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<tr>
<td>Consumer goods</td>
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<td>Finance</td>
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<tr>
<td>Industry</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td>Technology</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
</tbody>
</table>
6.2.1 Discussion around the hypothesis

Here in this section we are going to discuss the descriptive statistics and results from the volatility spillover over test within different economic sectors and foreign exchange rates. If we look at the descriptive statistics in table 10, the interesting part we found is the kurtosis values. We found the kurtosis values are comparatively higher, as in statistics the kurtosis values around 3 are found to be normal; whereas we have minimum values range from 4 to the maximum value of 22.95. This shows that the series of these residuals have volatility and this volatility in residual is significant in technology sector. The coefficients $\beta$ are closer to 1, whereas the coefficient values for $\alpha$ are comparatively very low, which means the $\beta$ coefficients have stronger impact than the $\alpha$ coefficients. In other words the expected stock price depends more on the accumulated volatility of the exchange and stock returns till the last date. Comparatively less influenced by the volatility from the last day only.

Secondly, from table 14, we can see that null hypothesis can be rejected with both significance level of 95% and 99% at every Swedish economic sector. The p values are less than significance level 0.05. In the volatility spillover test we had stock market as our dependent variables and exchange rate as our independent variables as we mentioned earlier in our empirical study. This means that all the economic sectors in Swedish market including the general index OMX-SPI are affected by the volatility of the foreign exchange market or more precisely by the exchange rate of USD and EUR against SEK. This proves that ARCH effect exists between these two variables; which means that the current variance of the stock market can be considered as the function of the actual variances of exchange rate from the previous time periods and also the function of its own variance from the last period. In simpler words the volatility of the stock market is the growing cluster from its own volatility from the previous periods and also from the volatility of exchange rates as well.

Thirdly, if we look at our conditional variances curves in appendix 2, we once again get the proof of ARCH effect. In all sectors we can find that continuous low volatility clusters into higher degree of volatility and vice versa. Our observed curves for conditional variances show that the continuous low volatility prevails during the bull market between the periods 2003 till 2007 for more or less all sectors, which compounded to high peak of volatility during the period of 2007 till 2009. In case of technology sector (appendix 2, Fig:A11), we can see that our observed period started with higher volatility, which we think from the effect of the dot com bubble from 2001.

This study produces similar kind of results as the earlier studies done by Yung-Yang & Doong (2004). Yung-Yang (2004) found that stock prices have more impact on the future exchange rate movements, whereas exchange rates have less impact on the future changes of stock prices in the markets for France, Italy, Japan and US. Two markets foreign exchange and stock market are found to be integrated through the information flow. Similarly, our study also found that in Sweden, the integration between these two markets exist; through the transmission of information from foreign exchange to stock market. The changes of exchange rates of USD and EUR against SEK will affect the future changes in prices of Swedish stocks, and this is found to be scientifically true for every selected economic sectors. Similarly, this work can be considered as an extended part of the previous study of Chiang & Dong (2003), who found the presence of volatility spillover effect from the foreign exchange market to the stock market, in the countries like France, Italy, Japan and USA and now this paper added Sweden in the list as well. Even our study supports and extends the idea of Chen et al. (1986);
who found that the variables (industrial production, the money supply, inflation, the exchange rate, and long- and short term interest rates) influence the risk adjusted discount rate for the calculation of the stock return. Moreover our study reflects the similar empirical results by Muller & Verschoor (2009) where they tested the relationship between exchange rates and the US equity market stated that after a financial crisis the stock volatility has increased significantly and got more sensitive to the exchange rate especially on the trade and service oriented industries. Similar results derived from the empirical study done on Europe (2006) and Asia (2007). The European study showed that a depreciating euro against a foreign currency had a negative impact on the European stock return. Similar results derived from the empirical study in Asia from 2007. Similarly, we found that sensitivity of the Swedish stock market will increase with the volatility of the foreign exchange market.

Though in this thesis we are not testing the market efficiency (chap: 3.1), but still this information of volatility transmission from exchange rates to stock market, can be aligned with the market efficiency theory. This existence of information transmission reflects that the market efficiency prevails in Swedish stock market. This study is not intended to say how strong the market efficiency is, but instead we wanted to test if the information flows. In spite of that we found the coefficient \( \beta \) to be quite strong reflecting a high degree of information flows from foreign exchange market to Swedish stock market.

Moreover, if we look at the behavioral finance as we mention in section 3.3, we expect the investors to act rationally over this information. The rational behavior from the investors will be to diversify their portfolios in the local market in case of volatile foreign exchange market. From our data analysis and hypothesis testing, we also recommend that in case of stable foreign exchange market, investors should hedge their investment internationally whereas in case of volatile foreign exchange market it is better to diversify their portfolios in domestic market because we found that the volatility of exchange market transforms to the Swedish stock market. For example, in recent turmoil of EUR, the investors in Sweden should possibly diversify their portfolio domestically rather diversifying them in whole Europe because these current volatilities of EUR will transform to stock prices as well. And also as we have scientifically found that exchange return has no correlation with Swedish stock return, it is safer to diversify the portfolio within different economic sectors rather hedging their risk internationally. Therefore this study has scientifically justified the rational behavior of the investors.
Chapter 7 – Conclusion and recommendations

In this part of the research paper we will present the conclusion from our research and how the findings are connected with our purpose of the research, we will also explain how we narrow the research gap for this area of research. We will also explain the quality and limitations of our research and give recommendations on further research.

7.1 Conclusion
The main purpose of this research paper was to examine the relationship between EUR and USD exchange rates against the Swedish Stock market. The two sub questions, that are used to answer the question, are as follows:

Is there any impact from changes in Dollar and Euro exchange rates on the performance of Swedish Stocks?

Sub question 1: Is there any correlation between the dollar & euro exchange rates and the Swedish stock market?
The answer to our first sub question from the statistical inference is that; No, there is no correlation between the dollar and euro exchange rates and the Swedish stock market.

In the beginning of the thesis, our mentioned research purpose was firstly, to test the relationship of the Swedish stock market and the exchange rates in terms of their correlation. In order to get the profound understanding of how they are correlated, we divided the Swedish stock market into different economic sectors and found the correlation between these different economic sectors with the exchange rates over the different sub periods in last ten years. Our empirical analysis found that there is not statistically significant correlation between the exchange rates and the Swedish stock market. Some sectors in particular time periods even showed negative correlation. The different correlation strengths in different time periods and sectors gave more knowledge to the investors for diversification. Therefore, with other things equal, investors can use this knowledge of correlations between these two variables in different economic cycles in portfolio diversification. The sectors which lowest or no correlation can be well suited for diversification of the portfolios

Sub Question 2: Is there any Volatility Spillover effect within dollar & euro exchange market and the Swedish stock market?

Yes, there is volatility spillover effect from the dollar and euro exchange rate over the Swedish stock market.

The purpose of the research question was to identify the dynamic volatility relation from exchange rate to the Swedish stock market. As we mentioned earlier that this purpose of the study is to create a better understanding and performance of the investors while diversifying their portfolios locally or hedging their risk internationally. Thus we served our purpose by figuring out the relation and increasing the knowledge of the investors. Empirical investigation shows that volatility spillover effect exists in each chosen Swedish economic
sector over the 10 years period for both USD and EUR exchange rate. Therefore the investors should act accordingly. Our recommended act from this study, that during the volatile stock market the investors should diversify their portfolios domestically and in case of stable stock market, investors may have international diversification.

In conclusion we can say that Yes, there is impact from changes in Dollar and Euro exchange rates on the performance of Swedish Stocks. Thus we fulfilled our purpose by answering our research question.

7.1.1 Contribution of our research
Results obtained from the correlation test are similar to the findings of Tian & Ma (2010) and Muller & Verschoor (2006, 2007 and 2009), where they all found mostly positive correlation between the market indices and exchange rate and also found that a relation exists between the volatilities between these two markets. This study also supports the previous conclusion made by Lee et al (2011) where he recommended the similar suggestions for the hedging and diversification policies. Suggesting that investors; that the risk between the foreign exchange and stock prices can be hedged within the domestic market as long as the foreign exchange market is volatile; but in case of stable foreign exchange market the hedging and diversification can be done internationally.

Theoretical contribution
This study is the extension of the previous studies made by several scientific researchers before in different countries. More precisely, we successfully found a research gap regarding this topic in the context of Swedish stock market and its foreign exchange. This research paper has filled up this research gap and contributed to create this required knowledge. Therefore, in future it may create some guideline or can give some idea beforehand about the topic to the academic researchers. It will help the academic researchers to justify or explain the rational behavior of the investors through the scientific approach. Moreover, it provides information to the researchers that information transmissions exist between these two different markets, hence they can build different hypotheses around this finding. It contributed knowledge to use the modern portfolio theory.

Practical contribution
The practical contribution of this study can be found in two folds. Firstly, the knowledge on the correlation between the exchange rates and the different economic sectors will allow the investors to have effective diversification policies. During a high volatile Forex market one can diversify their portfolio which has the lowest correlation with exchange rate returns. It gave them an overview of the strength and probable correlation between these two different markets in different economic cycles. Of course these have been measured from the historical values but still it sets the stage for better estimation. Secondly, the finding of evidence that volatility of the Forex market increases the volatility of the Swedish stock market with the spillover effect. This should mean that investors should stay rational, stick to the local market with their investments and not leave one market just because they think it would be better to have investments in another market which is less volatile. This would reflect an irrational behavior and our study shows that this might not help international investors escape the volatility. If we want to wrap up the details about the contribution towards investors, we will say that these findings about the correlation in different economic sectors and situations will surely contribute to the effective portfolio formations and diversification policies. Investors will get some idea of where to switch their investment during the volatile foreign exchange
market. Similarly it provides the knowledge for having effective hedging to minimize the systematic risk.

7.2 Quality of Research

In the empirical finding part and the discussion part, many different results have been discussed which should help investors and other market participants to understand the relationship between two major exchange rates and the Swedish stock market. This research paper has scientifically proven that there is an impact of exchange rate changes on the Swedish stock market. However, we recognize it is important to assess the reliability and validity of the results that guides and sets boundaries for the readers for the generalization aspect of this study.

This study has fulfilled its reliability criteria, because the same results can be obtained repeatedly using the same raw data with same statistical and econometrics model indistinctive to the observer. Transparency is maintained as all data and output results are saved to submit if it is required. As far as the validity concerned, the empirical studies are solely focused on the research questions. And having no other variables acting upon them, the values for the relationship can be confirmed. But these results are restricted to the existing framework of this thesis. Same results should not be expected from other financial markets or using different currencies. Lastly, the results obtained are beneficial for the investors for their decision makings especially in risk management, but nevertheless they should not consider these vales to be the absolute truth for future rather they can use the following results to understand the trend, pattern and connection between these two different markets.

7.3 Limitations of Research

One of the limitations can be considered for our study is that we performed the volatility spillover test over the ten years across the different economic sectors instead of doing the test in different sub periods. This is mainly due to the time constraints for the research work. Moreover, we tested the volatility spillover using the stock market as our dependent variable and exchange rate as our independent variable showing the volatility transmission from the exchange market to the stock market. Likewise could be done using the exchange rates as the dependent variable. But from the previous studies done by other authors, as mentioned in chapter 3.5 and 3.7, we can assume that the similar kind of spillover effect prevails in short run and the effect is vice versa between the variables.

7.4 Recommendations for further research

As like all other research this thesis has its own delimitation. There are several issues which we were concerned of and that is beyond the scope of this research paper. Our findings, discussion and conclusion left space for further investigation between the foreign exchange market and the stock market. Firstly, considering the dynamic and fast changing characteristic of financial market, we suggest to replicate the similar kind of research in other financial markets and including more currencies. In addition this research can be made more significant through using more sophisticated econometric models in order to grasp the strength and
direction of the spillover effects. Similar kind of knowledge from different financial markets; for example, similar test in emerging economies, will surely help the investors who are particularly interested to diversify their portfolios internationally.

Secondly, the market efficiency can be tested through finding out the rate of transmission of information from the foreign market to the stock market and the behavior of the investors upon the information. This will definitely create knowledge on the type of market efficiency the financial market is possessing and even contribute to the knowledge of behavioral finance.

Thirdly, further research can explore the possible hedging policies or arbitrage opportunities, following the relation between the foreign exchange and stock market.

Fourthly, as our research is taking the perspective from international investors whom are investing in the Swedish stock market with either EUR or USD, we would recommend a research done form the perspective of a Swedish investor investing in other markets. This would be more relevant, as we believe, will be the majority of nationality that will be reading this research paper.

Fifthly, as we have be able to find evidence that exchange rates works well as diversifiers in a portfolio of stocks, but we don’t know exactly how effective exchange rates works as diversifiers we would recommend a study concerning this issue.

And lastly, as prices on commodities are affected by the price, the demand and supply should also be affected by the exchange rates. This could be of great information for investors investing in commodities because with an understanding on how exchange rates affects the demand and supply of different commodities would might be able to make better forecast of future prices.

The above recommendations are relevant to our research, but we have also come up with some interesting areas which we would like to see more research being done at, and they are:

- How changes in exchange rates are related due to the cross-rate
- With the impact of volatility, how efficient is the market really acting
- How should exchange rates be interpreted in a portfolio containing both stocks and exchange rates, as diversifier or risk?

Even thou these questions or recommended topics might not be big enough for a research paper we hope that it at least will make the investor and researcher thinks around these questions and that a discussion could be formed. Because we as authors of this research paper would be very interested to find answers or gain more knowledge around them.
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Appendix:

1. Correlation between the economic sectors and exchange rates

1.1 2003-01-01 to 2013-01-01

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<tr>
<th>Correlations of</th>
<th>OKGas</th>
<th>BasicMetals</th>
<th>Industrials</th>
<th>Consumer Goods</th>
<th>HealthCare</th>
<th>Consumer Services</th>
<th>Telecommunications</th>
<th>Financials</th>
<th>Technology</th>
<th>OMXSPI</th>
<th>USDSEK</th>
<th>EURSEK</th>
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</thead>
<tbody>
<tr>
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<td>.530**</td>
<td>.514**</td>
<td>.417**</td>
<td>.334**</td>
<td>.397**</td>
<td>.342**</td>
<td>.512**</td>
<td>.276**</td>
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** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
c. Lenthra N=2514

Figure A1
### Correlation Table

**Correlation Table for 1.2 2003-01-01 to 2007-07-17**

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

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

Figure A3
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** *= Correlation is significant at the 0.01 level (2-tailed).
*  *= Correlation is significant at the 0.05 level (2-tailed).

Figure A4
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<tr>
<td>EURSEK</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td><em>1.00</em>**</td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td><em>0.56</em>**</td>
<td><em>0.49</em>**</td>
<td><em>0.58</em>**</td>
<td><em>0.58</em>**</td>
<td><em>1.00</em>**</td>
<td><em>0.49</em>**</td>
<td><em>0.49</em>**</td>
<td><em>0.49</em>**</td>
<td><em>0.42</em>**</td>
<td><em>0.76</em>**</td>
<td><em>0.76</em>**</td>
<td><em>0.03</em>**</td>
</tr>
</tbody>
</table>

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

** Figure A4 **
2. Conditional variance graphs for different economic sectors

<table>
<thead>
<tr>
<th>Basic Metals</th>
<th>Consumer Goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure A6</td>
<td>Figure A7</td>
</tr>
<tr>
<td>Financials</td>
<td>Health care</td>
</tr>
<tr>
<td>Figure A8</td>
<td>Figure A9</td>
</tr>
<tr>
<td>Industrials</td>
<td>Technology</td>
</tr>
<tr>
<td>Figure A10</td>
<td>Figure A11</td>
</tr>
</tbody>
</table>
3. Histograms-Normality tests of residuals for economic sectors

OMXSPI

Series: Standardized Residuals
Sample 1 2514
Observations 2514

Mean  -0.042704
Median  0.008012
Maximum  3.702321
Minimum  -5.075845
Std. Dev.  0.999823
Skewness  -0.371614
Kurtosis  4.002024
Jarque-Bera  163.0369
Probability  0.000000
Oil & Gas

Figure A17

Basic Metals

Figure A18

Consumer Goods

Figure A19
Financials

Figure A20

Health care

Figure A21

Industrials

Figure A22
4. Unit root test for Exchange rates USD & EUR

<table>
<thead>
<tr>
<th>t-statistic</th>
<th>Intercept</th>
<th>Intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USD/SEK</strong></td>
<td>-53.35118</td>
<td>0.769893 (0.4414)</td>
</tr>
<tr>
<td><strong>EUR/SEK</strong></td>
<td>-53.25491</td>
<td>-0.597249 (0.5504)</td>
</tr>
</tbody>
</table>

*Probability ()*

Table A1

4.1 Unit root test for Stock returns on different economic sectors

<table>
<thead>
<tr>
<th>t-statistic</th>
<th>Intercept</th>
<th>Intercept and Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OMXSPI</strong></td>
<td>-50.25969</td>
<td>1.323801 (0.1857)</td>
</tr>
<tr>
<td><strong>Oil &amp; Gas</strong></td>
<td>-49.61485</td>
<td>2.295278 (0.0218)</td>
</tr>
<tr>
<td><strong>Basic materials</strong></td>
<td>-50.14677</td>
<td>0.676851 (0.4986)</td>
</tr>
<tr>
<td><strong>Consumer goods</strong></td>
<td>-49.77667</td>
<td>0.456903 (0.6478)</td>
</tr>
<tr>
<td><strong>Financials</strong></td>
<td>-49.96173</td>
<td>1.109449 (0.2673)</td>
</tr>
<tr>
<td><strong>Industrials</strong></td>
<td>-49.14849</td>
<td>1.017337 (0.3091)</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>-49.03537</td>
<td>1.502695 (0.1330)</td>
</tr>
<tr>
<td><strong>Telecommunications</strong></td>
<td>-51.13446</td>
<td>0.551325 (0.5815)</td>
</tr>
<tr>
<td><strong>Health care</strong></td>
<td>-49.13734</td>
<td>0.903549 (0.3663)</td>
</tr>
</tbody>
</table>

*Probability ()*

Table A2