Lund University
School of Economics and Management
Department of Economics

Exchange Rate Sensitivity

A study of stock price sensitivity to unexpected changes in the $\frac{EUR}{SEK}$ exchange rate.

Hampus Asphage

Adam Lidén

LUND UNIVERSITY
School of Economics and Management

Master's thesis in Financial Economics

Supervisor: Karl Larsson

June 2014

ABSTRACT

Title: Exchange rate sensitivity – A study of stock price sensitivity towards the $\frac{EUR}{SEK}$ exchange rate

Seminar date: 2014-06-03

Course: NEKN02, Master's thesis in financial economics.

Authors: Hampus Asphage & Adam Lidén

Supervisor: Karl Larsson

Key words: Currency sensitivity, foreign exchange risk, asset pricing, Fama-French three-factor model

Purpose: To investigate if there is a significant stock price sensitivity towards the $\frac{EUR}{SEK}$ currency pair for portfolios of Swedish companies and how this sensitivity differs between sectors, firm size and foreign to total sales ratios.

Methodology: Use orthogonalized unexpected movements in a market index and the $\frac{EUR}{SEK}$ exchange rate and regress these on portfolio returns sorted by sector, firm size and foreign to total sales ratios. This is done with instruments for information available to investors and through the use of multiple linear regression analysis.

Applied Theories: The thesis is largely influenced by the article by Doukas, Hall and Lang (2003). The thesis makes use of well-known theories within asset pricing and theories about both the stock market and the foreign exchange. Some of these theories are the CAPM and Fama-French three-factor model.

Results: We found significant stock price sensitivity towards unexpected currency movements in several portfolios. This means that the stock returns are influenced by changes in the foreign exchange rates and something that an investor should be aware about. We also found that the sensitivity differs between sectors, firm size and foreign to total sales ratios.

TABLE OF CONTENTS

1. INTRODUCTION

This chapter introduces the reader to the background of the thesis and presents the problem discussion and research questions.

1.1 BACKGROUND

Forecasting future prices on the stock market is one of the hardest things that you can occupy your time with. There are countless factors that affect the stock price. In the end it is the fundamentals and the psychology of the market that determines the long-run price of stocks traded at an exchange. Some of the fundamentals are known to the market and some are not. A way of interpreting the psychology of the market can be through indices, based on for instance volatility or risk appetite, but also through more abstract things such as the current mood in social media.

One of the observable fundamentals in the market is the change in foreign exchange rates. It is important to know both how and why fluctuations in foreign exchange rates affect the pricing of stocks. Any given country's foreign trade, both import and export, will be dependent on currency movements of their home currency against other countries currencies with which there is ongoing trade. The foreign demand for products in a country with a weak currency will be greater than in a country with a strong currency since a weak currency implies a discount on the product. The opposite is true for import; if a country has a strong currency relative to another currency it is beneficial to import goods from this country. (Fregert and Jonung, 2010)

Sweden is what is called a net exporting country since the Swedish export is greater than its import. In 2013, export corresponded to 46% of the Swedish GDP. This means that, in monetary terms, the export corresponded more than 1 600 billion SEK. The manufacturing industry represents over 40% of Sweden's export of goods and the automotive-, forest-, and mining industry are important components of the industrial culture in Sweden. The import corresponded to 40% of the Swedish GDP in 2013. (Näringslivets ekonomifakta, 2014)

With these numbers in mind it is easy to assume that the exchange rate of the Swedish krona against other currencies is an important factor for Swedish companies that either import or export goods across the Swedish border. Even companies with no foreign trade might be indirectly affected by the fluctuations in exchange rates because of how this changes the domestic demand of their goods. Because of the exposure that Swedish firms face towards

foreign exchange fluctuations there should exist a sensitivity in firms towards unexpected changes in these exchange rates. This sensitivity can be described as a beta for a factor that describes unexpected changes in foreign exchange rates. The factor coefficient determines how much the foreign exchange variable contributes to changes in the dependent variable and it is this coefficient we refer to as sensitivity.

There are however several ways to minimize or eliminate the foreign exchange risk when trading with other countries. Many of the larger companies use hedging instruments to control their currency risks. Hedged or not, companies are affected by changes in the foreign exchange market and this caught our interest.

1.2 Problem discussion

As the world is becoming increasingly globalized we observe a greater focus towards the management of foreign exchange risks and the use of currency derivatives. This is in accordance with the widely held view that exchange rate movements affect the value of firms, both with and without international trade (Koller, Goedhart and Wessels, 2010). This is however not in accordance with the many studies that fail to prove that firms are exposed towards this risk and the fact that this risk is priced in the stock market (Jorion, 1991 and Bartov and Bodnar, 1994).

We aim to find a foreign exchange sensitivity that significantly affects stock prices. We also wish to investigate how this sensitivity differs between portfolios of stocks depending on sector classification, market capitalization and foreign to total sales ratios.

There are many different models used to estimate expected returns and to measure sensitivities to different risk factors. We will briefly connect our model with asset-pricing models and discuss the difference of perspectives.

1.3 Research questions

How are Swedish companies sensitive to unexpected changes in the $\frac{EUR}{SEK}$ *exchange rate?*

How does this sensitivity differ depending on sector, firm size and foreign involvement?

1.4 Expected results

This study has been carried out with the guidance of Doukas, Hall and Lang (2003), who were able to find stock price sensitivity towards unexpected currency fluctuations in Japan. We will

apply their method on the Swedish market and the Swedish krona towards the Euro. We expect to find a significant sensitivity in the Swedish stock market as well.

Large Swedish firms are often heavily reliant on their export and one would expect these companies to benefit from a weaker Swedish currency. Even if large firms are likely to hedge their currency exposure in one way or another, the currency market still heavily influences them (Nydahl, 1999). The same goes for smaller firms but in a different way. Small firms are more likely to operate in their domestic market than larger firms. Yet, currency movements still influence them. If the Swedish krona is strong in relation to other currencies, import becomes cheaper and the demand for domestic products might decline. This could then be negative for the small domestic firms. With that being said, a sensitivity towards unexpected currency movements is expected to be found in both small and large firms. However, there could be a problem in finding a sensitivity in medium-sized firms since they are big enough to hedge their foreign transactions but not large enough to hedge their foreign operational risks.

The size of firms' foreign to total sales is another potential variable that could create differences between firms. We expect to find a greater sensitivity for the companies with large foreign to total sales since a bigger foreign involvement should logically also give a larger exposure.

We are also interested in how this sensitivity differs between sectors and we will look at this while dividing all firms based on their sector classification. We expect industrial firms to be sensitive to foreign exchange fluctuations through their dependency on exports. Looking at other sectors we also expect medicine, materials and technology to be sensitive towards unexpected fluctuations in the exchange rate for the same reason. We expect consumer goods to be sensitive through their dependence on imports since the Swedish industry is not very focused on consumer goods. It is probable that also consumer services are sensitive in the same manner.

1.5 Limitations

This thesis focuses on the Swedish krona against the Euro because of two reasons; first, the European Union is Sweden's largest market for both import and export and a majority of the countries within the EU uses Euro as their currency (Näringslivets ekonomifakta, 2014). Second, a further restriction is the time available for the underlying research for this thesis, since currency pairs would make the workload impossible.

In order to secure a large amount of time-series observations only stocks traded on the Nasdaq OMX Stockholm with a history dating back to the beginning of 2000 and up until 2012 will be included in the sample portfolios. This is regardless of whether they are traded on the First North, small-cap, mid-cap or large-cap list. Companies without a complete history of stock price, foreign sales as percentage of total sales and market capitalization will be excluded. There will not be any firm-level analysis of currency sensitivity; only portfolios of firms will be included. We are restricted by time but a Swedish firm-level analysis would be of great interest and something we hope to see in the future. Also, due to its complex financial structure the financial sector have been excluded from this study.

1.6 THESIS OUTLINE

To introduce the reader to the subject of foreign exchange rate movements and risks, as well as to the mechanisms of the stock market, chapter two presents theories used in this thesis. Some of the theories used in order to answer the research questions are the Fama-French three-factor model and other asset pricing models. Chapter three describes the methods used in the research of stock price sensitivity to unexpected changes in foreign exchange rates. A deeper econometric description of the model is found in this chapter as well as a presentation of the dataset and its characteristics. In chapter four the reader is presented with the results obtained through the research. In chapter five the results are discussed and interpreted with the help of theories presented in chapter two. This paper is then summarized in chapter six where we present our conclusion and in chapter seven we give some propositions to future research.

1.7 PREVIOUS STUDIES

Two of the earliest and most important papers on foreign currency fluctuations and its connection to the stock market were written by Solnik (1974) and Adler and Dumas (1984). Solnik (1974) found, and was later confirmed by Sercu (1980) and Adler and Dumas (1984), that the sensitivity of assets with currency returns should be a priced factor in the ICAPM (International Capital Asset Pricing Model). They included a currency risk premia factor in the ICAPM and found it to be significant. This meant that there was a proven relationship between currency fluctuations and asset pricing. Adler and Dumas (1984) also showed that the exposure to foreign exchange risk should be defined as the sensitivity of an assets value to a change in exchange rates.

Jorion (1991) used both a two-factor and a multi-factor model to quantify the size of the included variables. He used market returns, industrial production growth series, change in expected inflation, unexpected inflation, risk and default premiums in the market as well as a foreign exchange factor. An industry specific relationship between the foreign exchange risk and stock returns was found, but the study was unable to prove that the exchange rate risk is priced in the stock market.

Following Jorion's work, Bartov and Bodnar (1994) investigates the relationship between excess returns on the US stock market and contemporaneous and lagged changes in the values of the US dollar. They found that the changes in the US dollar had very little explanatory power in the stock returns and their result was in line with the work of Jorion (1991).

However, there are a couple of studies that have been more successful in pricing the foreign exchange risk in the stock market. He and Ng (1998) examined the Japanese stock market similarly to what Bartov and Bodnar (1994) did a few of years earlier. They regressed market returns on stocks between 1979 and 1993 on a number of variables including a currency basket built as a trade weighted index. They found that 25% of all firms in their sample had a significant exposure to currency fluctuations. Nydahl (1999) later performed a similar study where he found that the percentage of Swedish firms significantly exposed to exchange rates was equal to the 25% found by He and Ng (1998) in the previous year.

An important addition to the research on how currency sensitivity is priced was published by Friberg and Nydahl (1999). They studied how exposure and sensitivity differs between eleven industrialized countries, including the US, Japan and Sweden. The study found that a more open economy give rise to a stock market that is more heavily exposed towards exchange rates. This is easily explained by the fact that open economies have more foreign trade than closed ones. It also gives a possible explanation to why so many studies fail to significantly measure how exchange rate risks are priced; the majority of studies have been made on the US market, which is fairly closed.

Doukas et al. (2003) investigated if the exchange rate risk is priced in asset returns across the Japanese stock market. He and Ng (1998) influenced their work but their methods differed quite a bit. Doukas et al. (2003) included a set of instrumental variables, which contained different macroeconomic variables. Their results were significant and they found a relationship between contemporaneous stock returns and unanticipated yen fluctuations

against other currencies. Their paper confirmed a risk pricing for exchange rate fluctuations in the Japanese stock market.

Sweden and Japan are in several ways alike. Both are open economies and heavily dependent on both export and import. Both have their own currency with a good liquidity and both countries have large and well-functioning stock markets. Also, we found the research question and methodology in Doukas et al. (2003) to be interesting and challenging. Because of this, our paper will be heavily influenced by the work of Doukas et al. (2003). An attempt to apply their method on the Swedish stock market will be made and the authors found a lot of their inspiration for currency risks through Doukas et al (2003).

2. THEORY

This chapter presents the theories that lay the foundation on which the thesis will be built.

2.1 FOREIGN EXCHANGE RATE EXPOSURE

According to previous studies and theories, the exposure to foreign exchange rate changes can be defined as three different sorts of exposure: transaction exposure, translation exposure and finally operating exposure (Nydahl, 1999).

2.1.1 TRANSACTION EXPOSURE

The most obvious exposure towards another currency is when a company has a future transaction in a foreign currency. An example of transaction exposure could be illustrated as follows: The Swedish company SWE AB buys products from the German company GER GmbH today. The payment for the goods is supposed to take place in six months time. From the day of the purchase until the day of the payment, SWE AB is exposed to a transaction risk. The Swedish krona could depreciate against the Euro, meaning that you get fewer Euros for every Swedish krona. If this would be the case, and the Swedish company does not hedge their payment, the Swedish company would have to pay more for their products than they initially planned for. (Nydahl, 1999)

2.1.2 TRANSLATION EXPOSURE

This exposure arises when a company translates assets from one currency to another. It is common that large companies have assets in other countries than their home country. PP&E assets, for example a factory in another country, are good examples of foreign assets. When these assets are funded it might be done with debt in the company's home currency. In these cases, when assets and debt are held in different currencies, a translation exposure is identified. This kind of exposure is often a risk that can be treated with some patience. Assets and debt in different currencies are not part of the operating activities and hence have a longer time horizon than invoices or other operating cash flows (Nydahl, 1999). Hagelin and Pramborg (2005) even state that this exposure does not need to be hedged due to its flexible time period.

2.1.3 OPERATING EXPOSURE

If a company already operates in several countries with different currencies, operating exposure addresses the future changes in production-, sales-, and trading costs because of changes in the foreign exchange rates. This exposure is of course a trivial factor if a company

has established its business in other countries than their home country since it is such an obvious exchange rate risk. (Nydahl, 1999)

2.2 Currency hedging

There are several ways to hedge an exposure towards foreign currency. The most common way to hedge a transaction in foreign currency is to use futures. When companies import or export goods they become subjected to transaction exposure and this kind of exposure is the most common and the easiest to hedge. Asphage and Lidén (2013) made an extensive survey on this topic and give a detailed description of ways to hedge against currency fluctuations, also a well-described topic in Bodie, Kane and Marcus (2011) for the interested reader.

Other than futures, the instruments used to hedge currency exposure are options, swaps and swaptions. An extensive description of these instruments can be found in Bodie et al. (2011) but in table 1 follows a short summary.

Instrument	**Function**
Future	A contract between two parties where one commits to buying an asset for a given price at a specific time in the future. The buyer has a long position in the contract. The other party commits to selling the same asset to the given price at the time of maturity.
Call option (Put option)	A contract between two parties where one has the option to buy (sell) an asset for a given price at a specific time in the future. This is where the option differs from a future. The party with a long position is not obligated to buy (sell) the asset; it gives the opportunity to buy (sell) it. The buyer has to pay a premia for this option, which is why options are more expensive that futures. The party with a short position is obligated to sell (buy) the asset if the buyer wants to exercise the option.
Swaps	A swap is an OTC-traded contract where two parties agree to switch cash flows with each other. Interest rate swaps are very common and the idea is that one party with fixed interest rate on their debt switches interest rate cash flows with a party that pays floating interest rate of their debt. The same logic can be applied to the currency market.
Swaptions	Revealed by its name, this is an option on a swap. It gives the party with a long position the option to enter a swap contract at a given time in the future.

TABLE 1

The reason for currency hedging is simple; it allows a company to exchange an amount of a currency into another at a known exchange rate. Hedging eliminates the risk of currency movements that could potentially be negative for the company's cash flow. However, it also

eliminates the possibility of a currency movement that could benefit the cash flow. (Bodie et al., 2011)

2.3 The international foreign exchange rate system

A country can choose to handle its exchange rate in different ways, which gives the country different means of directing their standing in the international economic environment. Nowadays it is most common, according to Fregert and Jonung (2010), to have a floating exchange rate together with some predetermined rule of how to handle this floating rate. Yet it is also possible to have a floating rate without a predetermined rule where the exchange rate could be handled differently depending on each situation. Sweden's exchange rate is floating with the predetermined rule to target inflation and keeping it stable around 2 %. There is also the possibility of having a fixed exchange rate within a currency union or where the exchange rate is fixed against another currency or a commodity such as gold or copper. There is also an alternative option of keeping a fixed exchange rate with the possibility to change the exchange rate through devaluation or revaluation. (Fregert and Jonung, 2010)

The Euro is a floating currency but through the perspective of a specific country using the Euro it is a fixed exchange rate since it is the currency of a monetary union. The value of a currency towards another currency is important for international trading. A weak currency means that the currency is cheap in relation to other currencies, which leads to the weak currencies export being cheaper and thus more desirable. However, as a result the import becomes more expensive. It is the supply and demand for a floating currency that determines the price of the currency. This supply and demand is determined by information given to investors at that given time. (Fregert and Jonung, 2010)

2.4 Asset-pricing models

Traditional portfolio theory, illustrated by the well-known capital asset pricing model CAPM, uses only one variable to determine the return of a given stock: the excess return of the market. The algebraic version of CAPM is illustrated below (Bodie et al., 2011).

$$r_i = r_f + \beta * (r_m - r_f)$$

In this equation r_i is the return of any stock *i*, r_f the risk-free rate of return, β the sensitivity of the stock against the market portfolio and $(r_m - r_f)$ the excess return of the market. The CAPM expression is the very foundation of modern portfolio theory. It is arguable that this model lacks many important explanatory variables and that it relies on a number of

assumptions that, at least to some extent, do not apply in the real world. Therefore there have been many other models that built upon CAPM, for example the International CAPM and the Fama-French three-factor model. The International CAPM adds variables for foreign currency risk and sensitivity. This is mainly done in order to standardize assets in different countries so that risks in firms are valued in the same manner over borders and so that investors can correctly estimate expected returns in their domestic currency for assets in foreign currencies. (Adler and Dumas, 1983)

Eugene Fama and Kenneth French extended the CAPM-model by including two additional explanatory variables in their three-factor model. Their research found that two classes of stocks tended to outperform the market over time. Small cap companies (small market capitalization relative to the whole market) and high book-to-market ratio companies did better than the market and they therefore concluded that these observations needed to be included in a stock-pricing model. To increase the explanatory power of the CAPM, Fama and French constructed two variables in the form of factor-mimicking portfolios. These portfolios are meant to capture a firms sensitivity to size and book-to-market. This resulted in the following model (Fama & French, 1996):

$$r_i = r_f + \beta * (r_m - r_f) + s_i * SMB + h_i * HML$$

The first part of the Fama-French three-factor model is the same as the CAPM, but the second part containing SMB and HML is different. The SMB is a portfolio of **S**mall **M**inus **B**ig market capitalized companies and is the factor-mimicking portfolio meant to capture the sensitivity to firm size. The SMB is constructed as the historical excess return of small-cap companies minus the historical excess return of large-cap companies. HML on the other hand is a factor-mimicking portfolio of **H**igh **M**inus **L**ow book-to-market ratio companies and is meant to capture the sensitivity to book-to-market. It is the excess returns of value stocks minus the excess returns of growth stocks. s_i and h_i are the coefficients for SMB and HML respectively. Fama and French found that by using this model it was possible to capture many of the variations in the cross-section of average stock returns that CAPM misses. (Eraslan 2013)

2.5 Econometric theory

2.5.1 Ordinary least-squares

Econometrics is the foundation of quantitative economic analysis. It investigates the relationship between a dependent variable and its explanatory variables. Through applying

mathematical and statistical methods on economic data it tries to find a relationship between different variables. To estimate a regression there are a lot of methods, for example the generalized method of moments, maximum likelihood or the ordinary least squares estimator. The most common and also the simplest of all estimators is the ordinary least squares, known as the OLS.

A multiple regression contains more X-variables than one and could for instance look like the regression below.

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i$$

The number of X-variables varies from model to model. Although the general idea is that a greater number of variables will improve the explanatory power of the model, it is important that the variables included have a reasonable connection to the dependent variable. In a model like the one above an econometrician tests how much of variable Y that is explained by the X-variables by using the input observations for Y_1, X_1, X_2 and so on. The beta-coefficient (β) tells us how much Y change as X changes and the alpha (α) is the intercept, which tells us what Y is given that all X-variables are zero. Epsilon (ε_i), which can take both positive and negative values, is the residual or the error term that arises in the model when X cannot explain Y perfectly. Epsilon is an important variable since the explanatory variables often fails to explain the dependent variable completely. The OLS squares these residuals in order to get only positive values and then estimates the model so as to minimize the sum of all squared residuals. How well the model does in minimizing the sum of squared residuals, or explaining the model, can be interpreted from the R^2 (R-squared). R^2 is a percentage number between 0 and 1 that measures the explanatory power of a model. If R^2 for example is 0.57, the variables included in the regression explain 57% of the changes in the dependent variable. (Dougherty, 2011)

2.5.2 HETEROSKEDASTICITY

Heteroskedasticity occurs when the variance in a series is not the same over time or over different drawings from a cross-sectional distribution. This is a common problem when analyzing asset pricing series since risks in different assets tends to vary over time. Homoskedasticty, the opposite of heteroskedasticity, is an important assumption upon which OLS rests. If the model does not live up to the assumption of homoskedasticity it will have severe implications for the OLS estimator. The OLS estimator is, based upon some statistical assumptions, BLUE (**B**est **L**inear **U**nbiased **E**stimator). However, if the important assumption

of homoskedasticity is violated the OLS is no longer BLUE. It is still an unbiased estimator but there is a problem of efficiency which means that it does not estimate with the lowest variance among all unbiased estimators. This is because the OLS gives equal weights to all observations and has no means of controlling for changes in variance, i.e it values less informational observations equal to more informational observations. (Verbeek, 2012)

2.5.3 MULTICOLLINERAITY

The phenomenon of multicollinearity in econometrics is a problem that arises if two explanatory variables are highly correlated with each other. If for example variable X and Z are used to explain Y and either X or Z can be linearly estimated from the other, multicollinearity arises. The problem is not the explanatory power of Y since it is not affected by multicollinearity. The problem is instead that it is hard to say how much each predictor contributes to the total explanatory power since the explanatory variables are linked to each other through a high correlation. Perfect multicollinearity occurs if two explanatory variables are perfectly correlated, which they are when the correlation between them is either 1 or -1. This is however a rare condition and if a regression suffers from multicollinearity it is probably of some degree where the correlation between the explanatory variables is lower than 1 or higher than -1. (Verbeek, 2012)

2.5.4 INSTRUMENTAL VARIABLES

Instruments are generally used when you cannot obtain the variables needed for a regression. An example of this is when social scientists want to regress pay grade on a person's individual ability, which is not possible to obtain. Other variables are therefore used to tell us something about the ability, for example years of education. Education does not automatically lead to a high working ability but one could hopefully assume that there exists a correlation and that education tells us something about ability. In asset pricing theory it is popular to create models that are conditional on information available to investors. Yet as there are uncountable different sources of information available to investors, which are all summarized in the price, it becomes impossible to even try to include all information available in a model. Therefore a few instruments are used as instrumental variables in order to proxy for all information. Instead of seeing the instruments as variables in a regression they are a measure of the current information available to investors. (Cochrane, 2000)

2.5.5 WHITE'S VARIANCE-COVARIANCE MATRIX OF ESTIMATES

According to econometric theory, as well as to White (1980), it is well known that heteroskedasticity in a model will lead to consistent but inefficient estimates of the parameters

included in a properly specified linear model. Also, heteroskedasticity will lead to inconsistent estimates of the covariance matrix. Heteroskedasticity can lead to misguiding interpretations of results obtained in a regression and could therefore potentially imply incorrect conclusions.

What White (1980) suggests is a variance-covariance matrix estimator that is consistent in the presence of heteroskedasticity and which allows us to draw conclusions from the covariance matrix even though the regression suffers from heteroskedasticity. White's estimator does not require a formal modeling of the structure of heteroskedasticity. White's variance-covariance matrix only requires the OLS estimated residuals and the dependent variables, making it easy to implement. Instead of modeling the heteroskedasticity, and trying to do it perfectly to be able to eliminate it in upcoming conclusions, one can use the White heteroskedasticity-consistent covariance matrix estimator. (White, 1980) This matrix is illustrated below.

$$\begin{pmatrix} \hat{u}_1^2 & \cdots & \rho_{1,n} \\ \vdots & \ddots & \vdots \\ \rho_{n,1} & \cdots & \hat{u}_n^2 \end{pmatrix}$$

When estimating the betas of a regression, the important part of White's covariance matrix is the diagonals. They contain $\hat{u}$, which is an estimation of the standard errors of the error terms. As long as the error terms from the linear regression are independent and have observable variances this method is applicable. The estimations of beta are shown below.

$$\hat{\beta}_{OLS} = (X'X)^{-1}(X'(\hat{u}_1^2, \dots, \hat{u}_n^2)X)(X'X)^{-1}$$

This coefficient will be a consistent and efficient estimator. (Verbeek, 2012)

3. METHODOLOGY

In this chapter the framework used to analyze the research problem is presented.

3.1 THESIS APPROACH

There are two ways of approaching a research question. This is basically because there are two ways of coming up with the problem that needs to be looked at. One of these approaches is the inductive one. In this approach, a phenomenon or a problem in the real world is observed and the researcher then turns to existing theories on the subject to try and explain the problem. The deductive approach on the other hand is the exact opposite; the researcher first turns to existing theories and tries to come up with a hypothesis on a particular question. The researcher asks what is expected to happen with a specific problem according to the current theories and then collects data and analyzes it. From that, conclusions can be drawn and the analysis will either support the existing theories or not. (Eriksson, 2001)

In this paper, theories regarding foreign exchange risk and stock prices formed the foundation of the research question before the analysis was performed. That being said, this paper follows the deductive approach.

3.2 DATA COLLECTION

This study includes all companies listed on NASDAQ OMX First North, Small Cap, Mid Cap and Large Cap that fulfils the limitations described earlier. This allows our sample of 103 firms to include a wide variety of different sectors, market capitalizations and size of foreign sales. This wide variety of firms is important in order to sort the sample into three different categories of portfolios depending on their relative market capitalization, foreign to total sales ratios and sector. The data has mainly been collected from Thomson Reuters Datastream, but also from Thomson Reuters EIKON and the OECD (Organisation for Economic Co-operation and Development) statistical database.

3.3 DATA DESCRIPTION

Both the market capitalization and foreign sales categories consist of four portfolios respectively. Depending on the size of each company's foreign to total sales ratio and market capitalization, the smallest quarter, second smallest quarter, second biggest quarter and biggest quarter of the companies are sorted into four different portfolios respectively. For the sector categorization the ICB-classification used by NASDAQ OMX was applied to arrive at

portfolios for materials, consumer goods, consumer services, medicine, technology and industry. All portfolios were weighted according to the companies' market capitalization. All stock prices, as well as the macroeconomic and financial variables, are monthly observations between January 2000 and December 2012. Three additional sector-based portfolios were created; medicine without AstraZeneca, technology without Ericsson and consumer services without H&M. These portfolios were created because the original portfolios were heavily dependent on these firms.

Five companies fell out of the sector portfolios due to a non-possible classification. In addition of using all forty-five industry companies in one portfolio, we are also including two portfolios of the 50% smallest and largest companies within the industry respectively. An overview of the portfolios is shown in table 2 below. A complete view of the portfolios and the included companies is presented in Appendix 1.

Portfolio	**Determining factor**	**Portfolio content**	**# of firms**
FSTS1	Foreign sales as % of total sales	0-25% of determining factor	12
FSTS2	Foreign sales as % of total sales	26-50% of determining factor	34
FSTS3	Foreign sales as % of total sales	51-75% of determining factor	30
FSTS4	Foreign sales as % of total sales	76-100% of determining factor	26
MKTCAP1	Market capitalization	0-25% of included companies	25
MKTCAP2	Market capitalization	26-50% of included companies	26
MKTCAP3	Market capitalization	51-75% of included companies	26
MKTCAP4	Market capitalization	76-100% of included companies	25
CONG	Consumer goods	All consumer goods companies	11
CONS	Consumer services	All consumer services companies	8
IND	Industry	All industry companies	45
INDS	Industry	Smallest 50% of industry companies	23
INDB	Industry	Largest 50% of industry companies	22
MAT	Materials	All material producing companies	6
MED	Medical	All medical companies	13
TECH	Technology	All technology companies	18

TABLE 2

3.4 METHODICAL FRAMEWORK

According to Adler and Dumas (1980, 1984), a firm's exposure to exchange rates is described by its systematic relationship with unexpected changes in the exchange rate while accounting for market movements. This is somewhat a crude description since both market and exchange rate movements are driven by common macroeconomic factors, such as inflation rates, bond yields and trade balances. Since there are joint explanatory variables for market movements and exchange rates the problem of multicollinearity is introduced. In order to account for problems arising through multicollinearity both the market and exchange rate series should be controlled for the effect of the common factors. (Doukas et al., 2003)

This is done through expressing the time-series for both market and exchange rates as functions of these macroeconomic factors. Doing this produces orthogonal unanticipated changes in both the market and the exchange rates. This allows firms' exposure towards the exchange rate to be researched without the problem of multicollinearity and with the assumption that investors have access to all information. Orthogonalization is achieved through estimating both the exchange rate's and the market return's residual factors. The exchange rate's residual factor is the part of movements in exchange rates that cannot be explained by the common macroeconomic variables. In the same way, the market return's residual factor is the part of movements in the market that cannot be explained by neither the common macroeconomic variables nor the exchange rate's unexpected changes. This is done through the following equations[1]: (Doukas et al., 2003)

$$R_{st} = \emptyset_{0s} + \sum_{j=1}^{7} \emptyset_{js} IV_{jt-1} + \sum_{i=1}^{2} \beta_{is} FF_{it-1} + \varepsilon_{st} \quad (1)$$

$$R_{mt} = \emptyset_{0m} + \sum_{j=1}^{7} \emptyset_{jm} IV_{jt-1} + \sum_{i=1}^{2} \beta_{im} FF_{it-1} + \beta_{sm} \hat{\varepsilon}_{st-1} + \varepsilon_{mt} \quad (2)$$

where R_{st} is the rate of change in the $\frac{EUR}{SEK}$ exchange rate and R_{mt} is the market rate of return on our NASDAQ OMXS PI index. The $\emptyset_j$s are the coefficients for the instrumental variables IV_j, which are instruments for the common macroeconomic variables described in table 3. FF_{it-1} is the Fama-French financial variables described in table 4. Subscript t indicates which time period the observation represents, t=0, 1, 2… T. The important part from equation 1 is

[1] All regressions are estimated in Eviews 8.0.

the $\hat{\varepsilon}_{st}$, which is the exchange rate's estimated residual. It tells us how much of the movements in the $\frac{EUR}{SEK}$ currency pair that cannot be explained by the instrumental variables and the Fama-French financial variables. It therefore represents the unexpected movements in the $\frac{EUR}{SEK}$ exchange rate. This residual is saved and used in equation 2 to help explain the movements in the market index. This is due to the general view that it is more likely that the foreign exchange market influences the stock market than the other way around. (Doukas et al., 2003)

The choice of instrumental variables is no easy task and is indeed worthy of its own study but in this thesis the model used by Doukas et al. (2003) is applied on Swedish firms. The authors therefore choose to use variables corresponding to their model, which are presented in table 3.

Variable	**Explanation**
IP	The industrial production growth series in Sweden constructed by and obtained from the OECD.
UI	The difference between the official rate of inflation in Sweden and the expected inflation from surveys. Data obtained through DataStream.
UTS	The difference between the 10-year Swedish government bond yield and last periods 1-month Swedish treasury bill yield. Data obtained through Datastream.
UJS	The difference between Swedish and German treasury bill yields. Data obtained through DataStream.
MS	The change in Swedish money supply constructed with the Swedish measure of M3. Data obtained through OECD.
XM	The net balance of Swedish export and import. Data obtained through OECD.
Lagged variable	A lagged value of the series is also included as an instrumental variable.

TABLE 3

In addition, the Fama-French (1996) financial variables FF_{it-1} have been included. The financial variables used have been constructed by Stefano Marmi and obtained through his website (Stefano Marmi Data Library, 2014), these are presented in table 4.

Variable	Explanation
HmL	High minus Low - the stock returns in Swedish value firms minus the stock returns from Swedish growth firms.
SmB	Small minus Big - the stock returns in small Swedish firms minus the stock returns in big Swedish firms.

TABLE 4

When both equations have been performed and the residual estimates, $\hat{\varepsilon}_{st}$ and $\hat{\varepsilon}_{mt}$, have been obtained they are used in equation 3 (Doukas et al., 2003).

$$R_{it} = \beta_{0i} + \beta_{1i}\hat{\varepsilon}_{st} + \beta_{2i}\hat{\varepsilon}_{mt} + \sum_{j=1}^{7} \rho_{jp} IV_{jt} + \varepsilon_{it} \quad (3)$$

where R_{it} is the rate of return in portfolio i. It is with equation 3 that the model ultimately tests the sensitivity of each portfolio to unexpected changes in the $\frac{EUR}{SEK}$ exchange rate. The interpretation of the third and final equation is the following; the return of portfolio *i* should be explained by the residuals from the exchange rate's regression and from the market movement's regression as well as by the instrumental variables discussed previously. This is important since firm's exposure is already priced. To be able to measure this pricing it is necessary to observe how the pricing changes with unexpected changes in the exchange rate, as all expected currency changes already have been incorporated in the price of the stock.

A key advantage in this model is the use of orthogonalized variables that validates it as a statistically valid model. However, this also creates a trade-off since the coefficient for the exchange rate gets a greater standard error while the standard error in the coefficient for the market becomes smaller. It is with these coefficients we measure the systematic relationship between stock returns and unexpected changes in the foreign exchange market.

When performing our regressions, the model produced heteroskedasticity in many cases. In those cases the White's variance-covariance matrix of estimates was used in order to obtain both consistent and efficient estimates. This was made to secure that the results could be interpreted correctly.

3.5 INSTRUMENTS

In order to research the sensitivity of firms toward unexpected changes in the $\frac{EUR}{SEK}$ exchange rate the model needs to accommodate for all the expected changes, which builds on the

information available to investors. This is why some asset pricing models include instrumental variables and also why this particular study does so. Information is a broad concept and holds an uncountable number of variables. Therefore it is important to find variables that hold key insights about the information at any point in time. There are a few studies that research how to build suitable instruments for information. Chen, Roll and Ross (1986) did a prominent study on the US market where they tested the amount of information in a number of variables. Some of these were found useful and were implemented by Doukas et al. (2003) and by the authors of this thesis.

4. RESULTS

In this chapter the reader is introduced to the results from the regressions performed.

4.1 FOREIGN SALES PORTFOLIOS

The regression outputs shown in table 5 are from the foreign sales portfolios where the firms have been sorted by their ratio of foreign to total sales. These four portfolios were tested to see if the amount of foreign sales is a factor that affects a company's sensitivity to unexpected changes in the $\frac{EUR}{SEK}$ exchange rate. The $\hat{\varepsilon}_{st}$ variable is the residuals from equation 1 and its coefficient determines each portfolio's sensitivity against unexpected currency fluctuations.

Portfolio	Regression R^2	Variable	Coefficient	Std. error	Probability	Significance (10% level)
FSTS1	0,5338	$\hat{\varepsilon}_{st}$	0,1584	0,2247	0,4859	No
FSTS2	0,7137	$\hat{\varepsilon}_{st}$	0,0515	0,1819	0,7777	No
FSTS3	0,5487	$\hat{\varepsilon}_{st}$	0,2090	0,2238	0,3520	No
FSTS4	0,6521	$\hat{\varepsilon}_{st}$	0,3349	0,1823	0,0682	Yes

TABLE 5

In the first three portfolios, including all the firms with a foreign to total sales ratio of 0-75%, there is no statistical significance in the foreign exchange variable. In the fourth portfolio, including the companies with the biggest foreign to total sales ratio, the model found that the coefficient for the foreign exchange was positive and significant at the 10% level.

4.2 MARKET CAPITALIZATION PORTFOLIOS

These portfolios were tested to see if a company's size is a factor that affects the sensitivity to unexpected changes in the foreign exchange. $\hat{\varepsilon}_{st}$ is still the variable of interest and each regression result is shown in table 6 below.

Portfolio	Regression R^2	Variable	Coefficient	Std. error	Probability	Significance (10% level)
MKTCAP1	0,5846	$\hat{\varepsilon}_{st}$	-0,6348	0,2867	0,0284	Yes
MKTCAP2	0,6621	$\hat{\varepsilon}_{st}$	-0,2637	0,2591	0,3105	No
MKTCAP3	0,6934	$\hat{\varepsilon}_{st}$	-0,2821	0,2354	0,2327	No
MKTCAP4	0,7691	$\hat{\varepsilon}_{st}$	0,2735	0,1547	0,0792	Yes

TABLE 6

Two out of the four market capitalization portfolios were found to produce statistically significant coefficients for the $\hat{\varepsilon}_{st}$ variable. While the largest companies had a positive significant sensitivity at the 10% level, the smallest were found to have a negative sensitivity even at the 5% level. However, for the two portfolios with medium sized firms the model failed to find any statistically significant sensitivity towards unexpected changes in the $\frac{EUR}{SEK}$ exchange rate. The regression standard errors are slightly larger in the market capitalization portfolio regressions than in the foreign sales portfolios.

4.3 Sector specific portfolios

When dividing the companies according to their specific sectors we end up with mixed results for the $\hat{\varepsilon}_{st}$ variable. Half of the currency exposure variables were significant while the others were not. Looking further, one could see that it is the three industry portfolios and the TECH portfolio that are significantly exposed to unexpected changes in the $\frac{EUR}{SEK}$ exchange rate. The large industrial firms, the aggregated industrial firms and the technology firms have a positive sensitivity while the small industrials have a negative sensitivity.

Portfolio	Regression R^2	Variable	Coefficient	Std. error	Probability	Significance (10% level)
CONG	0,4370	$\hat{\varepsilon}_{st}$	-0,1255	0,2341	0,5929	No
CONS	0,3738	$\hat{\varepsilon}_{st}$	-0,0336	0,2912	0,9082	No
IND	0,6293	$\hat{\varepsilon}_{st}$	0,3686	0,2065	0,0764	Yes
INDS	0,6836	$\hat{\varepsilon}_{st}$	-0,0069	0,0039	0,0778	Yes
INDB	0,6229	$\hat{\varepsilon}_{st}$	0,3741	0,2059	0,0713	Yes
MED	0,1178	$\hat{\varepsilon}_{st}$	-0,0236	0,3110	0,9397	No
MAT	0,5626	$\hat{\varepsilon}_{st}$	-0,2986	0,3411	0,3828	No
TECH	0,5545	$\hat{\varepsilon}_{st}$	1,1481	0,6059	0,0601	Yes

TABLE 7

What we can see here is that the INDS, the industry portfolio with the smallest half of the companies, is significant at the 10% level with a very small standard error. However, the coefficient for the INDS portfolio is almost equal to zero and therefore lacks any relevant economic significance. Consumer goods and services, materials and medicals were sectors where the model failed to find any significant exposure.

Some sector specific portfolios were mainly driven by one firm with a large market capitalization. The CONS portfolio was driven by H&M, MED by AstraZeneca and TECH by Ericsson. When regressing these sector-based portfolios without these companies, only the consumer services portfolio produced a statistically significant sensitivity. The coefficient in the CONS portfolio without H&M was -0,5165 and had a standard error of 0,2655. This gave a probability of 0,0537, which means that it was significant at the 10% level. Furthermore the regression had an R^2 equal to 0,6267.

5. ANALYSIS

This chapter discusses the results in relation to the theoretical framework presented in chapter 2.

5.1 ECONOMIC INTERPRETATION

The results presented in the previous chapter will be evaluated from an economic point of view. An initial interpretation of the meaning of a negative or positive coefficient for the currency exposure variable is needed. And most importantly, we shall also interpret the relationship between stock returns and unexpected currency fluctuations.

Starting with the sign of the $\hat{\varepsilon}_{st}$-coefficient we can conclude that it is positive for some portfolios while it is negative for others. A positive coefficient should be interpreted as follows: a 1% unexpected increase in the $\frac{EUR}{SEK}$ exchange rate leads to a positive portfolio return equal to the size of the coefficient. When the $\frac{EUR}{SEK}$ exchange rate increases the SEK becomes lower valued and a buyer has to pay slightly more SEK for every EUR. This is generally a good case for exporting companies since their European customers have to pay less for the goods purchased in SEK. The opposite is also true for importing firms, as they have to pay more SEK for every EUR. This means that their cost for importing goods from Europe increases.

5.1.1 FOREIGN TO TOTAL SALES RATIO PORTFOLIOS

In the first three foreign to total sales ratio portfolios, FSTS1-3, the sensitivities were all positive but lacked statistical significance in the model. The fourth portfolio, containing companies with foreign to total sales ratios ranging between 76-100%, has a positive significant coefficient of 0,3349. This implies that a 1% unexpected increase in the $\frac{EUR}{SEK}$ exchange rate would result in a 0,3349% increase in the portfolio return, meaning that firms with a high ratio of foreign sales profit from a weaker currency. With such a high amount of foreign sales exposure in these firms the result is in line with what one would expect with regard to Nydahls (1999) theories on transaction exposure. At least 76% of these companies' sales are generated outside Sweden and this leads, as expected, to a currency sensitivity that is priced in the portfolio. The portfolios with smaller foreign to total sales ratios lack significance which could depend on many factors. One possibility is that these companies use hedging instruments in such a way that their currency exposure gets hedged away. If the company policy says that all foreign sales deals should be hedged then the company will not

be directly sensitive towards changes in the $\frac{EUR}{SEK}$ exchange rate. Another possibility is that these companies' international cash flows are being put in a currency account without being exchanged into SEK. With the help of these accounts a company can translate their payments into SEK whenever they feel that the exchange rate is profitable.

5.1.2 MARKET CAPITALIZATION PORTFOLIOS

In the four portfolios where the sample firms are sorted according to their market capitalization our model proved two out of four portfolios to have a significant sensitivity to the $\frac{EUR}{SEK}$ exchange rate but with different signs. The portfolio with the smallest firms, MKTCAP1, generated a negative coefficient for the $\hat{\varepsilon}_{st}$-variable. This means that the returns in small firms are negatively affected when the SEK drops in value. It might be the case that these small companies have a larger import than export and thus becoming negatively affected by a lower SEK. This is supported by the general opinion that the probability of a firm having export is positively related to its size (Wagner, 2001). However, the result is in line with the findings of Doukas et al. (2003) with regard to sensitivity. They also found that the smallest Japanese companies in their sample were significantly sensitive to unexpected currency fluctuations.

The portfolio with the largest firms, MKTCAP4, shows a positive coefficient for $\hat{\varepsilon}_{st}$. This portfolio contains many large industrial companies and the result is in line with those of the IND portfolio, which will be discussed shortly. Large Swedish companies enjoy benefits from a weaker SEK due to their often large export. They earn even higher returns if they are small importers and large exporters, i.e firms that produce their products with a high degree of Swedish input materials such as Boliden, Atlas Copco and Volvo.

5.1.3 SECTOR SPECIFIC PORTFOLIOS

The IND and INDB portfolios showed both economic and statistical significance and were found to have a positive sensitivity. This means that these firms would, as expected, benefit from a weaker Swedish krona. The coefficient for INDS, the small industry portfolio, is very close to zero and thus lacks any economic significance even though it is statistically significant. One possible explanation for this could be that these companies are fairly small and that their import and export might cancel each other out. It could also be the case that these companies mainly operate in the domestic Swedish market and therefore are less exposed to fluctuations in the $\frac{EUR}{SEK}$ exchange rate. This result is somewhat contradictive to Doukas et.al (2003) who found that the returns in small companies were more sensitive

towards currency fluctuations than larger firms. However, while they have performed a firm-level analysis and can draw conclusions concerning the sensitivity of single firms, we have performed an analysis on the portfolio-level. This means that we might have a problem of sensitivities within the portfolio cancelling each other out. There are also general differences between Sweden and Japan that might explain the contrasting results. Furthermore, the fact that the aggregated industrial portfolio is positively significant is probably because it is mainly driven by large industrial firms.

We found the materials portfolio to have a negative coefficient but with no significance and high standard errors. With the resemblance between industry companies and materials companies in mind, this result is a bit surprising. One would expect the materials portfolio to behave similar to the industry portfolios and thus have the same sign on the coefficient for the ε_{st} variable. One possible explanation for this anomaly could be that materials producers mainly work with refinement of raw materials and that these raw materials to some extent comes from Swedish producers which would eliminate any currency exposure. On the other hand, the negative sign on the coefficient could indicate that these companies import raw materials for refinement and that their return would suffer from a weakening SEK due to increasing import costs.

Looking at the two consumer companies' portfolios, CONS and CONG, the model failed to show a significant sensitivity towards the $\frac{EUR}{SEK}$ exchange rate. However, when excluding H&M from the CONS portfolio we see that there is a significant sensitivity. It is negative and it seems that the CONS portfolio, H&M excluded, would benefit from a stronger Swedish krona relative the Euro. Consumer services and consumer goods are according to Näringslivets ekonomifakta (2014) sectors with low export compared to other sectors such as industry and technology. It is difficult to see why the ICB classifies H&M as a consumer services company instead of a consumer goods company. This might be the reason why the consumer services portfolio gets a significant sensitivity when excluding this firm. However, for the CONG portfolio we conclude that these companies lack a significant sensitivity to unexpected currency fluctuations.

The medical industry has been a jewel in Sweden for at least a century. With great companies such as Pharmacia and AstraZeneca Sweden has a history of being one of the leading countries when it comes to biotechnology and pharmaceutical research. Today, Pharmacia is long gone (it was acquired by Pfizer in 2002) and AstraZeneca has become UK based. Our model found no significant exposure towards currency fluctuations for the MED portfolio,

even when excluding AstraZeneca. When looking at the companies in the portfolio we can see that most firms are small and have a strong focus towards research. This could imply that they have both low levels of import and export, thus making them less exposed to fluctuations in the $\frac{EUR}{SEK}$ exchange rate.

The technology sector, represented by the TECH portfolio, shows a large and positive coefficient with significance at the 10% level. A 1% unexpected increase in the $\frac{EUR}{SEK}$ exchange rate would yield an increased return of 1,1481% on the total portfolio. This is an unusually large sensitivity and it raises the question of why, specifically, the technology sector has such a high exposure towards currency fluctuations. Ericsson represents a majority of the portfolio and it is a company with a highly international business. Looking at their business map we found that Ericsson has presence in 99 countries of the world. As the significance disappears when excluding Ericsson from the portfolio, it is likely that the TECH portfolios large sensitivity towards currency fluctuations was spurious and was due to Ericsson foreign dependency.

5.2 Implications for asset pricing models

Like the International CAPM we have been successful in finding sensitivities to the risks posed in the foreign exchange market, more precisely in the $\frac{EUR}{SEK}$ exchange rate. Both the Fama-French three-factor model and the International CAPM have previously found that by adding variables the CAPM would improve and expected returns would become more precise. The importance of models like these, and ours, is that they teach us about the value of a firm and the returns one could expect. In the simple CAPM we only have one factor telling us what to expect from the firm in relation to the market. When going from a one-factor perspective to a multi-factor perspective we can draw conclusions on what to expect from a firm in relation to a wider range of factors instead of just the behavior of the market. Both the International CAPM and the Fama-French three-factor model are important. Like our model they somewhat changes the perspective from just calculating expected returns in CAPM into analyzing them in relation to different risks. When dealing with multi-factor models we can analyze sensitivities to different factors and draw conclusions on how these sensitivities should change our expectations on future returns.

However, there is an important point to be made when including additional factors. Because even though it has become increasingly popular to criticize the CAPM it is still a well-known and very useful asset-pricing model. This is because in many cases simplicity has a greater value than precision. This thesis has not made an attempt to create a new asset-pricing model but merely shown that exchange rate sensitivity is a factor to be accounted for when estimating asset returns.

5.3 Sensitivity and currency exposure

As we have observed in our results and discussed earlier, both the smallest quarter of firms and the biggest quarter of firms show a statistical significant sensitivity to unexpected changes in the $\frac{EUR}{SEK}$ exchange rate. Small firms are found sensitive in many studies and we therefore expected the same result in this thesis. However, the fact that big firms can be found sensitive is both unusual and interesting. Big firms are usually hard to prove sensitive to changes in exchange rates. Not because they lack exposure but because they are very skilled in handling it. This seems to be different in Sweden and could be explained by the fact that the biggest firms in Sweden have a lot of long term translation exposure, which is difficult to hedge.

Furthermore we find that the firms with the biggest ratios of foreign to total sales have a statistically significant exposure towards $\frac{EUR}{SEK}$ exchange rate. Foreign sales are precisely what transaction exposure is and it is easy for any firm to hedge. Yet, as the ratio grows towards 100% it becomes more of an operational exposure and thus increasingly costly to hedge. This could explain why firms with a large proportion of their sales abroad are found to be sensitive towards this exposure.

Lastly we find all three industrial portfolios, the consumer services portfolio without H&M and the technological portfolio including Ericsson significantly sensitive towards the $\frac{EUR}{SEK}$ exchange rate. However, it is important to note that the portfolio consisting of small industrial firms have an economically insignificant sensitivity. Many of the firms found in the portfolio of large industrial firms can also be found in the portfolio of the firms with biggest market capitalization. Furthermore the return in the technology is mainly driven by Ericsson, which is also found in the portfolio of biggest market capitalization. Regarding the consumer services portfolio we can assume that the firms left after excluding H&M are net importers and are sensitive to their transaction risk.

6. CONCLUSION

In this chapter the reader is presented with a concluding discussion and the research question is answered with regard to the results obtained.

We found that industrial firms, mainly large industrial firms, as well as big firms and firms with a large foreign to total sales ratio are positively sensitive towards unexpected changes in the $\frac{EUR}{SEK}$ exchange rate for large companies. The consumer services sector and firms with small market capitalization on the other hand are found to be negatively sensitive.

There are a number of possible explanations to why we failed to find significant sensitivities for some portfolios. The extensive use of hedging instruments in firms limits the risks they take when doing business abroad and the small amount of foreign sales could be two factors that affects firm's sensitivity. Medium-sized firms lacked a significant sensitivity towards unexpected currency fluctuations and in their case it could very well depend on their size. They're big enough to handle their transaction exposure but too small to be sensitive to translation and operating exposure. However, regarding small industry firms it could be that they lack sensitivity because their import and export potentially cancel out each other, or they might lack a currency exposure large enough to make them sensitive to fluctuations. The change in domestic demand for their products discussed earlier might not be enough to make them sensitive.

We found that there exists sensitivity towards the $\frac{EUR}{SEK}$ exchange rate in portfolios of Swedish stocks. This sensitivity was different both in size, sign and significance depending on sector classification, firm size and foreign involvement. From this we conclude that some sectors are more sensitive to unexpected currency fluctuations than others. Firm's market capitalization and foreign to total sales ratios are also factors that make the sensitivity differ.

7. FUTURE RESEARCH

With our results in mind, together with its implications for investors and the stock market, we look forward to further research on the subject from a Swedish perspective. We would like to present two ideas that would be interesting to investigate.

First, applying the method in this thesis on portfolios of Swedish firms' in a similar way but with a larger sample of foreign exchange observations. We only used one currency pair and it would be interesting to see how the portfolios would behave if a basket of currencies would be used. Apart from the Euro, Sweden has an extensive trade with countries such as Norway, Denmark, Poland, USA and China. A trade-weighted basket of currencies would be an interesting and perhaps a more accurate foreign exchange variable to use in research like this and we would be happy to see a paper doing that.

Secondly, applying our model on a firm level to see how specific firm's sensitivity towards unexpected changes in foreign exchange rates behaves. This could potentially have implications for an analyst who looks at a specific firm and tries to value the company's stock. The firm level analysis could support the results found on the portfolio level or help explain why a portfolio level analysis fails to find sensitivity.

8. REFERENCE LIST

Adler, Michael. & Dumas, Bernard. (1980). *The exposure of long-term currency bonds*. Journal of Financial and Quantitative Analysis 15, Vol. 15, No.4, 973-994.

Adler, Michael. & Dumas, Bernard. (1983). *International portfolio choice and corporation finance: a synthesis.* Journal of Finance, Vol. 38, No. 3, 925-984.

Adler, Michael. & Dumas, Bernard. (1984). *Exposure to currency risk: definition and measurement*. Financial Management 13, Vol. 13, No. 2, 41-50.

Asphage, Hampus. & Lidén, Adam. (2013). *Valutariskhantering – en studie över huruvida volatilitet i nyckeltal påverkas av valutariskhantering i små och medelstora företag.* Lund University.

Bartov, Eli. & Bodnar, Gordon. (1994). *Firm valuation, earning expectations and the exchange rate exposure effect.* Journal of Finance, Vol. 49, No. 5, 1755-1785.

Bloomberg. (2013). *Warren Buffet market-beating skills revealed: cutting research.* www.bloomberg.com/news, 2014-05-21.

Bodie, Zvi., Kane, Alex. & Marcus, Alan J. (2011). *Investments and portfolio management.* Ninth edition, McGraw Hill Higher Education.

Chen, Nai-Fu., Roll, Richard. & Ross, Stephen. (1986). *Economic forces and the stock market*. The Journal of Business, Vol. 59, No. 3, 383-403

Cochrane, John. (2000). *Asset pricing.* Princeton University Press, United States of America.

Dougherty, Christopher. (2011). *Introduction to Econometrics.* Fourth edition, Oxford University Press.

Doukas, John.A., Hall, Patricia.H. & Lang, Larry.H.P. (2003). *Exchange rate exposure at the firm and industry level*. Financial Markets, Institutions & Instruments 12, 291-346.

Dumas, Bernard. (1978). *The theory of the trading firm revisited*. Journal of Finance, Vol. 33, No.3, 1019-1029.

Eraslan, Veysel. (2013). *Fama and French three-factor model: Evidence from Istanbul stock exchange*. Business and Economics Research Journal, Vol. 4, No. 2, 11-22.

Eriksson, Lars Torsten. (2001). *Att utreda, forska och rapportera.* Seventh edition, Liber Ekonomi.

Fama, Eugene. & French, Kenneth. (1996). *Multifactor explanations of asset pricing anomalies*. The Journal of Finance, Vol. 51, No. 1, 55-84.

Fregert, Klas. & Jonung, Lars. (2010). *Makroekonomi: teori, politik och institutioner.* Third edition, Studentlitteratur, Lund.

Friberg, Richard. & Nydahl, Stefan. (1999). *Openness and the exchange rate exposure of rational stock markets.* International Journal of Finance & Economics, Vol. 4, No. 1, 55-62

Hagelin, Niclas. & Pramborg, Bengt. (2005). *Foreign exchange exposure, risk management and quarterly earnings announcements.* Journal of Multinational Financial Management, Vol. 15, 15-30.

Hansen, Lars Peter. (1982). *Large sample properties of generalized method of moments estimators.* Econometrica, Vol. 50, No. 4, 1029-1054.

He, Jia. & Ng, Lilian. (1998). *The foreign exchange exposure of Japanese multinational corporations.* Journal of Finance, Vol. 53, No. 2, 733-753.

Holme, Idar Magne. & Solvang Krohn, Bernt. (1997). *Forskningsmetodik: om kvalitativa och kvantitativa metoder.* Second edition, Studentlitteratur Lund.

Jorion, Philippe. (1991). *The pricing of exchange rate risk in the stock market.* Journal of Financial and Quantitative Analysis, Vol. 26, No. 3, 363-376.

Koller, Tim., Goedhart, Marc. & Wessels, David Wessels. *Valuation – Measuring and managing the value of companies.* Fifth edition, McKinsey & Company, Wiley.

Marmi, Stefano. (2014). *Data library – developed markets – Sweden.* http://homepage.sns.it/marmi/data_library.html#sweden, 2014-04-13.

Nydahl, Stefan. (1999). *Exchange rate exposure, foreign involvement and currency hedging firms: some Swedish evidence.* European Financial Management, Vol. 5, No. 2, 241-257.

Näringslivets Ekonomifakta. (2014). *Utrikeshandel.* www.ekonomifakta.se/sv/faka/ekonomi/utrikeshandel/, 2014-05-23.

Sercu, Piet. (1980). *A generalization of the international asset pricing model*. Journal of Revue de l'Association Francaise de Finance, Vol. 1, 91-135.

Solnik, Bruno. (1974). *An equilibrium model of the international capital market.* Journal of Econometric Theory, Vol. 8, No. 4, 500-524.

Verbeek, Marno. (2012). *A guide to modern econometrics*. Fourth edition, Wiley, United Kingdom.

Wagner, Joachim. (2001). *A note on firm size – export relationship.* Small business economics, Vol. 17, No. 4, 229-237.

White, Halbert. (1980). *A heteroskedasticity consistent covariance matrix estimator and a direct test for heteroskedasticity*. Econometrica, Vol. 48, No. 4, 817-838.

APPENDIX 1

FOREIGN TO TOTAL SALES PORTFOLIOS

FSTS1

ACTIVE BIOTECH AB	KNOW IT AB
AXFOOD AB	MULTIQ INTL AB
CYBERCOM GROUP AB	PEAB AB
HIQ INTERNATIONAL AB	PREVAS AB
IMAGE SYSTEMS AB	VITEC SOFTWARE GRP
INTELLECTA AB	ÅF AB

FSTS2

ACANDO AB	NORDIC SERVICE
ADDNODE GROUP AB	OEM-INTERNATIONAL AB
B&B TOOLS AB	ORTIVUS AB
BILIA AB	PARTNERTECH AB
BIOGAIA AB	POOLIA AB
CLAS OHLSON AB	PROBI AB
CTT SYSTEMS AB	PROFFICE AB
DORO AB	PROFILGRUPPEN AB
DUROC AB	REDERI AB TRANS
ELANDERS AB	RORVIK TIMBER AB
ENEA AB	SCANIA AB
GUNNEBO AB	SEMCON AB
IND & FIN SYSTEMS	SWECO AB
KABE HUSVAGNAR AB	SVEDBERGS I DALSTORP
MALMBERGS ELEKTRISKA	SVENSKA CELLULOSA AB
MIDSONA	TIETO OYJ
NCC AB	XANO INDUSTRI AB
NIBE INDUSTRIER AB	

FSTS3

AB GEVEKO	MEDA AB
ABB LTD	MODERN TIMES GRP MTG
BEIJER ALMA AB	NEW WAVE GROUP AB
BERGS TIMBER AB	NOLATO AB
BETSSON AB	OPCON AB
BONG LJUNGDAHL AB	PROACT IT GROUP AB
ELECTROLUX AB	READSOFT AB
ELEKTA PUBL AB	SAAB AB
FAGERHULT AB	SANDVIK AB
FENIX OUTDOOR AB	SAS AB
HALDEX AB	SECTRA AB

HEXAGON AB	SKF AB
HOLMEN AB	SSAB SVENSKT STAL AB
IAR SYSTEMS	SWEDISH MATCH AB
LAMMHULTS	TELE2 AB

FSTS4

AB VOLVO	LM ERICSSON TELE
ASSA ABLOY AB	MEDIVIR AB
ASTRAZENECA PLC	NET INSIGHT AB
ATLAS COPCO AB	NOVOTEK AB
BOLIDEN AB	PA RESOURCES AB
CISION AB	PRECISE BIOMETRICS
CONCORDIA MARITIME	PRICER AB
CONSILIUM AB	RAYSEARCH LAB
ELOS AB	ROTTNEROS AB
FINGERPRINT CARDS AB	SECURITAS AB
GETINGE AB	SKANSKA AB
HENNES & MAURITZ AB	TRELLEBORG AB
KARO BIO AB	VBG GROUP PUBL

MARKET CAPITALIZATION PORTFOLIOS

MKTCAP1

BERGS TIMBER AB	MIDSONA AB
CONSILIUM AB	MULTIQ INTL AB
CTT SYSTEMS AB	NORDIC SERVICE AB
DORO AB	NOVOTEK AB
DUROC AB	OPCON AB
ELOS AB	ORTIVUS AB
FINGERPRINT CARDS AB	PRECISE BIOMETRICS AB
GEVEKO AB	PREVAS AB
IAR SYSTEMS AB	PROBI AB
IMAGE SYSTEMS AB	PROFILGRUPPEN AB
INTELLECTA AB	RORVIK TIMBER AB
LAMMHULTS AB	VITEC SOFTWARE GRP AB
MALMBERGS ELEKTRISKA AB	XANO INDUSTRI AB

MKTCAP2

ACANDO AB	NET INSIGHT AB
ADDNODE GROUP AB	OEM-INTERNATIONAL AB
BIOGAIA AB	PARTNERTECH AB
BONG LJUNGDAHL AB	POOLIA AB
CONCORDIA MARITIME AB	PRICER AB
CYBERCOM GROUP AB	PROACT IT GROUP AB

ELANDERS AB	RAYSEARCH LAB AB
FENIX OUTDOOR AB	READSOFT AB
HIQ INTERNATIONAL AB	REDERI AB TRANS AB
KABE HUSVAGNAR AB	ROTTNEROS AB
KARO BIO AB	SEMCON AB
KNOW IT AB	SVEDBERGS I DALSTORP AB
MEDIVIR AB	VBG GROUP PUBL AB

MKTCAP3

ACTIVE BIOTECH AB	IND & FIN SYSTEMS AB
AXFOOD AB	MEDA AB
B&B TOOLS AB	NCC AB
BEIJER ALMA AB	NEW WAVE GROUP AB
BETSSON AB	NIBE INDUSTRIER AB
BILIA AB	NOLATO AB
CISION AB	PA RESOURCES AB
CLAS OHLSON AB	PEAB AB
ELEKTA PUBL AB	PROFFICE AB
ENEA AB	SAS AB
FAGERHULT AB	SECTRA AB
GUNNEBO AB	SWECO AB
HALDEX AB	ÅF AB

MKTCAP4

ABB LTD AB	SANDVIK AB
ASSA ABLOY AB	SCANIA AB
ASTRAZENECA PLC AB	SECURITAS AB
ATLAS COPCO AB	SKANSKA AB
BOLIDEN AB	SKF AB
ELECTROLUX AB	SSAB SVENSKT STAL AB
GETINGE AB	SWEDISH MATCH AB
HENNES & MAURITZ AB	SVENSKA CELLULOSA AB
HEXAGON AB	TELE2 AB
HOLMEN AB	TIETO OYJ AB
LM ERICSSON TELE AB	TRELLEBORG AB
MODERN TIMES GRP AB	VOLVO AB
SAAB AB	

SECTOR SPECIFIC PORTFOLIOS

CONG

ELECTROLUX	NEW WAVE GROUP
FENIX OUTDOOR	OPCON
HALDEX	SCA
KABE HUSVAGNAR	SWEDISH MATCH

LAMMHULTS DESIGN GROUP	VBG GROUP
MIDSONA	

CONS

AXFOOD	HENNES & MAURITZ
BETSSON	MTG
BILIA	NORDIC SER.PTNS.HDG
CLAS OHLSON	SAS

IND

ABB	OEM INTERNATIONAL
ASSA ABLOY	PARTNERTECH
ATLAS COPCO	PEAB
B&B TOOLS	POOLIA
BEIJER ALMA	PRECISE BIOMETRICS
BONG	PRICER
CISION	PROFFICE
CONCORDIA MARITIME	REDERI AB TNSAT.
CONSILIUM	RORVIK TIMBER
CTT SYSTEMS	SAAB
DUROC	SANDVIK
ELANDERS	SCANIA
FAGERHULT	SECURITAS
FINGERPRINT CARDS	SEMCON
GEVEKO	SKANSKA
GUNNEBO	SKF
HEXAGON	SVEDBERGS I DALSTORP
IMAGE SYSTEMS	SWECO
INTELLECTA	TRELLEBORG
MALMBERGS ELEKTRISKA	VOLVO
NCC	XANO INDUSTRI
NIBE INDUSTRIER	ÅF AB
NOLATO	

INDS

BONG	NOLATO
CONCORDIA MARITIME	OEM INTERNATIONAL
CONSILIUM	PARTNERTECH
CTT SYSTEMS	POOLIA
DUROC	PRECISE BIOMETRICS
ELANDERS	PRICER
FAGERHULT	REDERI AB TNSAT.
FINGERPRINT CARDS	RORVIK TIMBER
GEVEKO	SEMCON
IMAGE SYSTEMS	SVEDBERGS I DALSTORP
INTELLECTA	XANO INDUSTRI
MALMBERGS ELEKTRISKA	

INDB

ABB	PROFFICE
ASSA ABLOY	SAAB
ATLAS COPCO	SANDVIK
B&B TOOLS	SCANIA
BEIJER ALMA	SECURITAS
CISION	SKANSKA
GUNNEBO	SKF
HEXAGON	SWECO
NCC	TRELLEBORG
NIBE INDUSTRIER	VOLVO
PEAB	ÅF AB

MED

ACTIVE BIOTECH	MEDA
ASTRAZENECA	MEDIVIR
BIOGAIA	ORTIVUS
ELEKTA	PROBI
ELOS	RAYSEARCH LABS
GETINGE	SECTRA
KARO BIO	

MAT

BERGS TIMBER	PROFILGRUPPEN
BOLIDEN	ROTTNEROS
HOLMEN	SSAB

TECH

ACANDO	KNOW IT
ADDNODE	MULTIQ INTERNATIONAL
CYBERCOM GROUP EUROPE	NET INSIGHT
DORO	NOVOTEK
ENEA	PREVAS
ERICSSON	PROACT IT GROUP
HIQ INTERNATIONAL	READSOFT
I A R SYSTEMS GROUP	VITEC SOFTWARE GROUP
INDL.& FINL.SYS.	TIETO CORPORATION