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Arbitrage Pricing Theory: A study on the Stockholm Stock Exchange

- *A closer look at the macroeconomic factors that drives the Stockholm Stock Exchange*

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Abstract

Title: Arbitrage Pricing Theory: A study on the Stockholm Stock Exchange
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This thesis analyzes which macroeconomic factors that is affecting the Stockholm Stock Exchange using Stephen Ross theory, The Arbitrage Pricing Theory, from 1976. Macroeconomic factors lie as a basis and is analyzed through regressions against four generated portfolios containing stocks from the Stockholm Stock Exchange lists: Large Cap, Mid Cap and Small Cap. The thesis uses a quantitative strategy with a deductive method with the help of secondary data. The purpose of this thesis is to analyze a random sample of stocks and chosen macroeconomic factors to see which of the macroeconomic factors that is affecting the Stockholm Stock Exchange and the different lists on Stockholm Stock Exchange. The results show that ten out of the twelve chosen macroeconomic factors are significant for at least one the significance levels in at least one of the portfolios.

Keywords: Arbitrage Pricing Theory, APT, Stockholm Stock Exchange, Macroeconomic Factors, Multi Factor Mode

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Introduction

During this part, the source of interest is presented together with previous studies and what the research question is.

Background

For the past decades, one of the most popular investment strategies has been to go to the stock exchange in hope of a great return. There have been endless discussions concerning which macroeconomic factors that influence the pricing of stocks and the stock exchange. What kind of information in the market should you as an investor be extra observant of and if it is affecting the pricing of stocks on the stock exchange?

Previous studies concerning this subject (A.A. Azeez & Y. Yonezawa, 2013) analyzed which macroeconomic factors that had affected the Japanese Stock Exchange, the Nikkei Index, between 1973-1998. Based on their article, this thesis is continuing their path with interest on analyzing what macroeconomic factors that is affecting the Stockholm Stock Exchange. This thesis focus on analyzing the years 2002-2017.

The *Arbitrage Pricing Theory, APT*, lies as a basis for this thesis. APT was introduced by Stephen Ross in 1976. This thesis uses Multi Factor Models consisting of macroeconomics factors to identify which of the factors that are significant. There are two advantages of using macroeconomic factors in the model. The first advantage is that the factors and the APT prices can give an economic interpretation that can be used for analyses. The second advantage is that the macroeconomic factors present new information that can be used to explain differences in asset pricing that is related to macroeconomic events. (A.A. Azeez & Y. Yonezawa, 2003)

In this thesis, 77 randomly selected Swedish stocks are chosen. The stocks are placed into different portfolios containing the different stocks depending on where they are listed at the Stockholm Stock Exchange. For example, if a stock is traded in the Large Cap, it is included in the Large Cap Portfolio. The thesis analyzes if there is any difference in significance of macroeconomic factors that is affecting the price of an asset in the different lists on the Stockholm Stock Exchange.

Purpose

The market is in a constant change, which makes this subject still up-to-date. With internet's introduction on the stock market, people today have a whole new way of getting information then they used to. It is getting faster and easier to comprehend new information that might have an effect on the stock exchange. With that in mind, it is important to understand what macroeconomic factors that should be analyzed and used for maximizing the return of the portfolio. Therefore, the purpose of this thesis is to analyze and discuss what kind of macroeconomic factors that is affecting the Stockholm Stock Exchange.

Research question

To reach the purpose, this thesis is examining the different chosen macroeconomic factors and analyze them against different four generated portfolios consisting of randomly selected stocks. Using the results from this thesis regressions to find out if the factors have any significant effect on the Stockholm Stock Exchange will help investors to know which of the macroeconomic factors that is more important than others to look at before investing.
This leads to the research question of this thesis:

- *"Which macroeconomic factors affect the expected returns on the Stockholm Stock Exchange?"*

Limitations

This thesis only focuses on the Large Cap, Mid Cap and Small Cap lists on the Stockholm Stock Exchange. This thesis is not looking at other countries or stock exchanges outside of these three. Another limitation is that the analysis only examines whether the chosen macroeconomic factors have an effect on the expected return on the portfolios or not. To avoid doublets, only one share from each company is allowed in the random sample of stocks, therefore eliminating B, C and D-shares if the A-share is available. Stocks that did not reach the qualification to have historic monthly prices from 2002 and forward are also removed from the sample of stocks.

Target audience

This thesis targets mainly private investors that are interested and have little to some knowledge about the macroeconomic factors that affects the Stockholm Stock Exchange.

Disposition

The structures of this thesis are according to:

In the next section, a presentation of the APT theory and earlier studies is explained. The theory is followed by section three which is the methodology section, it explains which methods is being used in this thesis to make the analyses. Section four explains how data has been collected to this thesis and the fifth sections present the results from the regressions with an analysis regarding this thesis research question. Lastly, a conclusion is summing everything up briefly.

Theory

This part describes how the theory is structured and how it is relevant to the result and analysis part.

Arbitrage Pricing Theory

The *Arbitrage Pricing Theory* (APT) was first introduced by Ross in 1976. APT is a model which uses the return and risk relationship to get an estimation of assets expected return in portfolios. The word *Arbitrage* is the method of earning riskless profits by trying to take advantage of assets and securities that are mispriced. An asset being mispriced is by definition, the knowledge that an asset can be bought at one market at a specific price and sold at another market for a different price. By definition, arbitrage is riskless. Therefore, according to the theory, all investors who discover arbitrage will try to take advantage of the opportunity. The mispriced asset will attract investors and eventually the pricing will be corrected and the riskless profit opportunities will be eliminated (W. Sharpe & G. Alexander & J. Bailey, 1998).

The APT-model uses three assumptions in its model:

1. Capital markets are perfectly competitive,
2. Investors always prefer more than less wealth,
3. Price-generating process is a K factor model.

The APT uses the expected return of a financial asset and can be modelled as a linear function of different macroeconomic factors to investigate if there is a possibility to increase the expected return of an asset without increasing any risk nor needing to add any additional funds from the investor. Each macroeconomic factor has an estimated factor-specific beta coefficient (b_{ik}). (J. Zhang, 2018)

The APT-model is a factor asset pricing model. The different factors are individually chosen macroeconomic variables that capture systematic risk, in other words market risk. The APT-model is considered a useful tool to analyze portfolios from a value investing perspective and from the results identify if the specific securities may be temporarily under- or overpriced. However, in the real world, a mispriced security does not mean it is risk-free (Investopedia, D, 2018)

The two Multi Factor Models in the Arbitrage Pricing Theory is as follows:

1. **APT Factor Model**

$$r_i = \alpha_i + \sum_{k=1}^{K} b_{ik} F_k + e_i$$

Note: J. Zhang, 2018

i = 1…..N (securities)

k =1…..K (factors)

r_i= Security return

α_i= Constant for asset *"i"*

F_k= Systematic factor

b_{ik}= Sensitivity of the *"i"* asset to factor *"k"*, also called the beta coefficient

e_i = The risky assets idiosyncratic random shock with mean zero.

2. APT Pricing model

$$\bar{r}_i = r_f + \sum_{k=1}^{K} b_{ik} \lambda_k$$

Note: J. Zhang, 2018

i = 1…..N (securities)

k =1…..K (factors)

$\bar{r}_i$= Expected return

b_{ik}= Sensitivity of the *"i"* asset to factor *"k"*, also called the beta coefficient

λ = Risk premium of the factor

r_f= Risk-free rate

The APT pricing model is the model to use for calculating the expected return of the portfolio. Each macroeconomic factor has an individual beta coefficient that is multiplied with its individual macroeconomic expected return. All significant factors are included in the APT Multi Factor pricing model for each generated portfolio.

The APT-model is a model which only uses estimations. There are three different ways to estimate the λ and the b in the pricing model:

1. Estimating the λ and b simultaneously by using principal component analysis,
2. Specifying the attributes of the b, and then estimate the λ,
3. Specifying the factors in the model first to estimate the λ and b after.

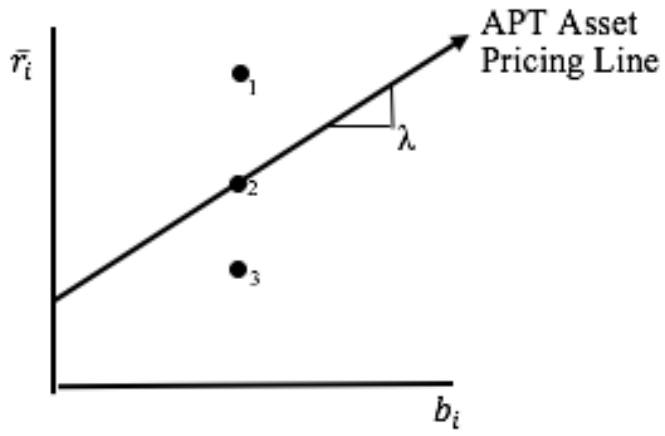
This thesis is using the third option and has first specified the macroeconomic factors that is analyzed and thereafter estimate the b. (J. Zhang, 2018)

APT in equilibrium

The APT claims that if there is multiple portfolios and securities that have identical returns and risks, they should sell for the same price (J. Zhang, 2018). In Figure 1, the return and risk relationship are displayed as the *APT Asset Pricing Line*. The Asset Pricing Line shows that with low risk comes a low expected return, and the more risk that is increased the expected return will increase as well, explaining a positive correlation between the risk and return (Investopedia, G, 2018).

Portfolios with different macroeconomic variables will generate different risk and return for each portfolio. Figure 1 below illustrates three different assets with different expected returns and arbitrage possibilities, but with same risk. In order to make arbitrage in the APT-model the assets need to be above or below the APT Asset Pricing Line. If an asset is on the APT Asset Pricing Line it is in full equilibrium and there is no potential arbitrage opportunity. Asset 2 represents an asset with no arbitrage opportunities. Asset 1 is above the line and is therefore underpriced according to the APT theory. Any investor who gets presented the possible arbitrage opportunity will buy Asset 1, since the expected return is higher without needing to increase the investors risk nor funds. Asset 3 is below the line and is therefore also an arbitrage opportunity, but unlike Asset 1 this asset will instead be sold, since the expected return can be increased by buying Asset 1 instead without increasing risk nor funds. The assets will after every trade be one step closer to the APT Asset Pricing Line and eventually end up in equilibrium. (W. Sharpe & G. Alexander & J. Bailey, 1998)

Figure 1



Note: 1: Asset 1; 2: Asset 2; 3: Asset 3

Literature review

According to A.A. Azeez and Y. Yonezawa (2004) "*There is no formal theoretical guidance in choosing the appropriate group of economic factors to be included in the APT-model."* the exchange rates and the inflation rate are significant macroeconomic factors in pricing assets on the Japanese stock exchange. During E.J. Elton & MJ. Gruber's test using the Multi Factor Model on the Japanese market in 1988, they used six different macroeconomic factors that have come to be common while using the APT Multi Factor Model: inflation rates, interest rates, foreign trade, economic conditions (production index, household disposable income etc.), petroleum prices and the U.S. interest rate and inflation (E.J. Elton & MJ. Gruber, 1988). Another study done by K. Sawyer & M. Nandha in 2006 tested whether the changes in oil price affected the expected returns on the global stock market. Their conclusion was that the significant correlation between the oil price and stock prices on a global level was not as certain as earlier studies stated.

The APT does not specifically mention which macroeconomic factors that should be included in the model, neither does it specify the number of factors that are relevant (W. Sharpe & G. Alexander & J. Bailey, 1998). Stephen Ross, Nai-Fu Chen and Richards Roll did statistical tests in 1986 to examine which macroeconomic factors that have significance on the New York Stock Exchange Index. Ross, Chen and Roll determined that the factors of significance on the New York Stock Exchange were the unanticipated inflation, industrial production, yield curve and the default risk premium. Neither of their result shows that the changes in oil price have any significance affect on asset pricing on the New York Stock Exchange (N. Chen & R. Roll & S. Ross, 1986).

Methodology

This section explains how the collecting of data is made, what methods, measurements and calculations are used and why they are relevant to this thesis.

Test method

Since this thesis proceeds from a theory to examine and analyze how the theory works in practice, a deductive method is chosen. A deductive method approaches from a theory and moves into observations connected with that specific theory. In a thesis using a deductive method, one start with a theory that has been confirmed and acknowledged to deduct a hypothesis from the theory about what will be analyzed. (Bryman & Bell, 2017)
According to Bryman & Bell (2017), a deductive study is the most common representation of examining how the theory and the real world works together in reality.
This thesis is analyzing which different macroeconomic factors have influenced the Stockholm Stock Exchange, and its lists, Large Cap, Mid Cap and Small Cap, between 2002 - 2017. To answer this, secondary data has been collected from the chosen macroeconomic factors and the randomly chosen stocks. This thesis needed a large amount of data collection, therefore, a quantitative data collection with focus on secondary data is chosen. Since this analysis consist of historical values that is already available in different databases, this thesis focus on working with secondary data.
This thesis is focusing on a quantitative study and a deductive method, which according to Bryman & Bell (2017) is often used together, these methods raise the reliability in this thesis since it is using the appropriate data collection method.
The writers of a quantitative study often want to generalize the results of the analysis to the whole population by using a smaller sample. To do this, a presentable sample of the population is needed. The most important technique to get a reliable smaller sample is to use a random sample. Using the technique to randomly choose the sample eliminates the risk of a bias result. (Bryman & Bell, 2017)

In this thesis, the sample of the stocks from the Stockholm Stock Exchange are randomly chosen. This gives the sample of the thesis a higher credibility to be a presentable sample of the population.
In this case, due to the requirement that every chosen stock needs to have a monthly price history from 2002 and forward, stocks that did not qualify are removed from the sample.

Approach

The analysis of the significant macroeconomic factors is made by generating a number of four portfolios based on which of the lists on the Stockholm Stock Exchange the stocks are traded at (Large Cap, Mid Cap and Small Cap) together with one portfolio combining all of the randomly chosen stocks.

The analysis can therefore provide information if there is any significant deviation between the chosen macroeconomic factors from the different chosen lists on Stockholm Stock Exchange. The analysis has been through several regression analyses with given significance levels to determine if the chosen macroeconomic factors are significant or not. If the macroeconomic factors are significant, they are included in the Multi Factor Model for their specific portfolio to determine the expected return of that portfolio. The macroeconomic factors and stocks in this thesis results are based on their monthly percentage change.

Financial measurement

Rate of return

$$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$$

The rate of return calculation is used to measure the return of the different macroeconomic factors, stocks and portfolios. The rate of return is calculated through taking the difference between the historic monthly price of a macroeconomic factor, portfolio or stock period t and period t-1, divided by the previous month's historic price (period t-1). Using this calculation, the factors, stocks and portfolios shows changes in percentage from one month to another.

Econometric models

Using econometric models in this thesis helps the understanding between the Single Index Model and the Multi Factor Model whether which model explains the return of the portfolio best. This thesis is analyzing the Adjusted R^2 between the different models. In the Single Index Model, the OMXSPI is the only macroeconomic factor in the model.

Single Index Model:

$$Return_i = \alpha + \beta_1 R_{OMXSPI} + e_i$$

Note: $i = All\ Stock, Large\ Cap, Mid\ Cap$ & $Small\ Cap\ Portfolio$

Multi Factor Model:

$$\begin{aligned} Return_i = \alpha &+ \beta_1 R_{OMXSPI} + \beta_2 R_{Swedish\ CPI} + \beta_3 R_{Oil\ Price} + \beta_4 R_{USD/SEK} + \beta_5 R_{EUR/SEK} \\ &+ \beta_6 R_{Copper\ Price} + \beta_7 R_{Gold\ Spot\ Price} + \beta_8 R_{Swedish\ export\ of\ goods} \\ &+ \beta_9 R_{Swedish\ import\ of\ goods} + \beta_{10} R_{GDP\ of\ U.S.} + \beta_{11} R_{GDP\ of\ Germany} \\ &+ \beta_{12} R_{VIX} + e_i \end{aligned}$$

Note: $i = All\ Stock, Large\ Cap, Mid\ Cap, Small\ Cap\ Portfolio$

Econometric measurements

Adjusted R^2

The R^2 is used in regressions and represents how much of the independent macroeconomic factor/factors that explains the expected return of the portfolio. After a regression is done, a value between 0 and 1 is displayed. A value close to 0 explains that the independent variable/variables does not explain the result very good. On the other hand, a value closer to 1 explains that the independent variable/variables explain the return of the portfolio very well (Investopedia, B, 2018).

The R^2-value is increased by each and every extra independent variable added that is included in the model and cannot be decreased. Since all new variables included in the model may not be significant, it should not always increase the R^2. Therefore, the Adjusted R^2 is introduced to take into consideration the additional information of what each new independent variable brings to the regression model (Corinthas, Carlos and Black, Ken, 2012).

P-value

$$P - Value < Significance\ level$$

To test whether a variable is statistically significant for the model or not, the P-value in the regression analysis can be used. If the tested variables P-value are greater than the given significance level, the variables has no statistically significance for the model. If the P-value on the other hand is lower than the given significance level, the variable is statistically significant for the model. The P-value determine whether a variable is significant or not, depending on what significance level is given in the regression analysis (Investopedia, C, 2018). In this thesis the authors have chosen to work with three different significance levels: 10%, 5% and 1%. The different levels of significance represent a P-value, whether the P-value for the variable is bigger or smaller than the P-value for the significance level decides if the variable is significant.

The statistical significance levels explain what level of risk one is willing to accept to make a wrong assumption about the population using a sample. For example, if there is a significance level of 10%, you are willing to make the wrong assumptions of the population in 10% of your statistical tests. (Bryman & Bell, 2017)

Data

This section provides a description of how the data is collected and used, including information about the different macroeconomic factors, portfolios & stocks.

Data

The secondary data is based on randomly choosing 120 stocks (40 stocks from each list: Large Cap, Mid Cap, Small Cap) on the Stockholm Stock Exchange and 12 macroeconomic factors. Chosen stocks that did not meet the qualifications to have monthly prices from 2002 and forward are removed from the sample. This thesis therefore focusses on analyzing 77 stocks on the Stockholm Stock Exchange (32 stocks from Large Cap, 25 from Mid Cap and 20 from Small Cap) and 12 macroeconomic factors. The time span is set between 2002-01-01 until 2017-12-31 in order to get as much data as possible, since the more data that is collected, the more precise the result will be. Data from December 2001 lies as a basis for January 2002. All data is used and calculated in Microsoft's program *Excel*, this is also where the regressions, figures and diagrams are from.

Regressions

Using regressions as a statistical measurement is commonly used in economics and finance. Regressions determine how powerful a relationship between one dependent variable and a numerous of independent variables are. This tool is meant to help investors to better value stocks and commodities. There are two different types of regressions, Single- and multi linear regressions. The single linear regressions only use one independent variable to predict the dependent variable. Multi linear regressions uses two or more independent variables to predict the dependent variable, in this thesis the authors have chosen to use both versions. This thesis uses the macroeconomic factors as independent variables and the expected return of the portfolio as the dependent variable. After completing a regression, the excel program displays the relationship between the different variables as a form of a coefficient, in this thesis's case the beta coefficient (Investopedia, A, 2018). A coefficient of a value of -1 represents a perfect negative correlation, meaning, if the independent variable goes up by one percent, the dependent variable decreases by one percent. On the other hand, a coefficient of +1 represents a perfect positive correlation, meaning, if the independent variable goes up by one percent, the dependent variable increases by one percent.

Stocks

In order to make good represented portfolios the authors choose 32 stocks from the Large Cap, 25 from the Mid Cap and 20 from the Small Cap on the Stockholm Stock Exchange. Chosen stocks that did not meet the qualifications to have monthly prices from 2002 and forward are removed from the sample.

All data is collected from *Yahoo Finance* using their "historical prices" tool and choosing the prices to be shown monthly. All historic prices from Yahoo Finance are collected in SEK and shows the monthly percentage change using the rate of return calculation. The sample of stocks can be found in the appendix.

Macroeconomic factors

The APT-model is constructed of a number of unspecified macroeconomic factors to affect the expected return of the portfolio. This thesis uses 12 macroeconomic factors to test if there is any significance against the four generated portfolios on the individual level. These factors are tested against three different significance levels to examine their significance on the different lists on the Stockholm Stock Exchange. If a factor is significant with the expected return of a portfolio, the macroeconomic factor is, according to the statistically test, affecting the expected return of that portfolio (Nationalencyklopedin, 2018).

The macroeconomic factors that this thesis is analyzing are:

OMXSPI

OMXSPI also called the "Stockholm All-Share" represents all shares listed on the Stockholm Stock Exchange. This is a value weighted index that tracks the Swedish market and all of its stocks. This index gives a good overall image of the wellbeing of the Stockholm Stock Exchange. (Avanza, F, 2018)

Gold Spot Price

According to the Swedish Central bank (Riksbanken), gold makes the Swedish foreign exchange reserve more stable (Statistiska Centralbyrån, 2018). Compared to other commodities gold is not only bought to be used in the industry or sold as jewelry, it also functions as an investment. Gold is often used as an insurance against instability during political and economic disturbances. (Handelsbanken, 2018)

Oil Price

Oil is considered the most traded commodity because of its usefulness. Oil is still with ease the most common fuel for cars, boats and airplanes. The biggest producer of oil is The U.S., the Russian Federation and the Kingdom of Saudi Arabia. The U.S. is also the biggest consumer together with The People's Republic of China and Japan (Handelsbanken, 2018).

Copper Price

Copper is considered the oldest and most useful metal. About 70% of the copper that is produced is being traded to be included in electronic devices. Since copper is considered the most useful metal in the world, it is a good indicator for the health state of the world economy (Handelsbanken, 2018).

Exchange rates, USD/SEK & EUR/SEK

Sweden is dependent on their export and import. The exchange rate between other countries' currencies and the Swedish Krona affect both the Swedish export and import. If the Swedish Krona rise in value, other countries need to pay more importing Swedish goods and services. This decreases the Swedish export, but the goods and services in other countries gets cheaper for Swedish companies to import. Therefore, (Statistiska centralbyrån, B & C 2018)

Chicago Board Options Exchange Volatility Index, (VIX)

The CBOE Volatility Index (VIX) or "Fear Index" is a market index representing the 30-day forward-looking volatility. The VIX provides a measure of market risk. Some investors look at this index in consideration before investing as a way to measure the market risk (Investopedia, E, 2018). The VIX is based of options from the American index S&P500. The VIX estimates the 30-day forward-looking volatility by calculating the aggregated weighed prices of puts and calls from the S&P500 index. (CBOE, 2019)

Swedish Consumer Price Index (CPI)

The Swedish Consumer Price Index (CPI) measures the average price development for the Swedish private consumption. It is a common measurement for future inflation calculations (Statistiska Centralbyrån, A, 2018). To calculate the CPI, a basket containing of different prices of goods and services are collected. The CPI is therefore a commonly used economic indicator for businesses and governments to make decisions about their upcoming economic alternatives. (Investopedia, F, 2018)

Gross Domestic Product (GDP) of Germany

GDP is an important measurement for a country's economic health. It measures the value of all the goods and services that is produced in a country. If unemployment is low, the demand grows and results with an increasing GDP. Since Germany is the biggest importer and exporter of Swedish goods and services, the health state of the German economy is of importance to Swedish businesses (Statistiska Centralbyrån, B & C, 2018).

Gross Domestic Product (GDP) of The United States (The U.S.)

The U.S. have the biggest economy on earth and represents one-fourth of the world's economy (World Economic Forum, 2018). The U.S. is the most important trading partner to Sweden excluding the Europe region. The U.S. import Swedish goods for about 75 billion SEK every year while Sweden import American goods for approximately 30 billion SEK every year. Also, about 1'200 businesses in the U.S. have a link to Swedish businesses, while there are 1'500 American companies registered in Sweden. The U.S. stands for approximate 200 billion in foreign direct investment into Sweden. (Regeringskansliet, 2018)

Swedish Export of Goods

The Swedish export of goods is based on other countries economic health and them buying the Swedish goods. Prices of the Swedish goods, exchange rates and each country's economic health are big factors that affect other countries export and import towards Sweden. If the Swedish Krona rise in value, the Swedish export of goods has a tendency to decrease. About 70% of the Swedish export is goods and the most important group of products is vehicles and products for industry. Export of goods contributes to an increasing GDP of Sweden (Statistiska Centralbyrån, B, 2018).

Swedish Import of Goods

The Swedish import of goods is also based on the prices of goods in other countries, exchange rates and each country's economic health. If prices of goods in other countries decrease relative to Swedish goods, or the Swedish Krona rise in value the Swedish import will benefit. Import of goods is necessary for Sweden since the production within the country cannot meet all the demand of goods from its consumers. Also, the import of goods is of utmost importance for some companies, because of its dependence on importing goods first to be able to export their goods afterwards. Also here the European region is the biggest trading partner of imported goods. (Statistiska Centralbyrån, C, 2018)

Data for the macroeconomic factors are collected from the following sites:

OMXSPI → Monthly index collected from *Nasdaq*
Gold Spot Price → Monthly Gold Spot Price (USD/troy oz) collected from *Avanza*
Oil Price → Monthly Oil Price for Brent Crude Oil collected from *Avanza*
Copper Price → Monthly Copper Price (3 months, USD/ton) collected from *Avanza*
USD/SEK → Monthly price US Dollar/Swedish Krona collected from *Avanza*
EUR/SEK → Monthly price Euro/Swedish Krona collected from *Avanza*
VIX → Monthly index collected from *Yahoo Finance*
Swedish CPI → Monthly Swedish CPI collected from *Statistiska Centralbyrån*
GDP of Germany → Quarterly data collected from *OECD Data*
GDP of The U.S.→ Quarterly data collected from the *Federal Reserve Bank of St. Louis*
Swedish Export of goods → Monthly export of Swedish goods collected from *Statistiska Centralbyrån*
Swedish Import of goods→ Monthly import of Swedish goods collected from *Statistiska Centralbyrån*

The quarterly percent change of a country's GDP is shown individually monthly as the same percentage change (Example: If quarter 1 shows a percentage change of +2.7% from the previous quarter; January, February and March all show +2.7% individually).

Portfolios

There are four different portfolios generated in this thesis. They are each and individually analyzed and discussed together with the 12 different macroeconomic factors. The portfolios are generated with the randomly chosen stocks from the Large Cap, Mid Cap and Small Cap on the Stockholm Stock Exchange and are equally weighted.

The generated portfolios are:

All Stock Portfolio: Includes all of the 77 randomly chosen stocks from the lists: Large Cap, Mid Cap and Small Cap on the Stockholm Stock Exchange.

Large Cap Portfolio: Includes the 32 randomly chosen stocks from the lists: Large Cap on the Stockholm Stock Exchange.

Mid Cap Portfolio: Includes the 25 randomly chosen stocks from the lists: Mid Cap on the Stockholm Stock Exchange.

Small Cap Portfolio: Includes the 20 randomly chosen stocks from the lists: Small Cap on the Stockholm Stock Exchange.

Table 1

Expectations for the chosen macroeconomic factors: If they are expected to be significant and their expected sign. A comparison with the results from the regressions are displayed in the conclusion.

	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
OMXSPI	+	+	+	+
Gold Sport Price	-	-	-	-
Swedish CPI	+	+	+	+
Oil Price	+	+	+	+
Copper Price	+	+	+	+
EUR/SEK	+	+	+	+
USD/SEK	+	+	+	+
VIX	-	-	-	-
GDP of Germany	+	+	+	+
GDP of the U.S.	+	+	+	+
Swedish Export of Goods	+	+	+	+
Swedish Import of Goods	-	-	-	-

Note: + & - signs represent the expected sign of each coefficient for the respective portfolio.

Results & Analysis

During this part, the results from the regressions are displayed and explained together with the analysis. This thesis only displays a maximum of three decimals for the results part in the text (except if there is not a value until the forth decimal).

Table 2

Correlation matrix between the portfolio's monthly returns.

	All Stock Port.	Large Cap Port.	Mid Cap Port.	Small Cap Port.
All Stock Portfolio	1			
Large Cap Portfolio	0.564	1		
Mid Cap Portfolio	0.277	0.208	1	
Small Cap Portfolio	0.847	0.892	0.268	1

Table 2 displays the correlation between the generated portfolios in this thesis. The highest correlation between two portfolios are between the Large Cap Portfolio and the Small Cap Portfolio with a correlation of 0,892. Also, the All Stock Portfolio and the Small Cap Portfolio have a high correlation of 0,847. The lowest correlation identified are between the Mid Cap Portfolio and the Large Cap Portfolio with a correlation of 0.208.

Table 3

Correlation matrix between the macroeconomic factor's monthly returns.

	OMX SPI	CPI	Oil Price	USD /SEK	EUR /SEK	Copper	Gold	Export	Import	GDP of the U.S.	GDP of Germany	VIX
OMXSPI	1											
CPI	-0.095	1										
Oil Price	0.124	0.185	1									
USD/SEK	-0.191	-0.057	-0.391	1								
EUR/SEK	-0.187	-0.058	-0.174	0.411	1							
Copper	0.324	0.123	0.434	-0.407	-0.295	1						
Gold	-0.035	-0.087	0.253	-0.331	-0.054	0.293	1					
Export	-0.093	0.302	-0.033	0.038	0.051	0.017	-0.019	1				
Import	-0.115	0.316	-0.021	0.079	0.043	-0.001	-0.031	0.874	1			
GDP of the U.S.	0.218	0.113	0.246	-0.135	-0.224	0.230	0.047	0.055	0.050	1		
GDP of Germany	0.072	0.083	0.068	-0.165	-0.147	0.045	0.059	0.008	0.015	0.384	1	
VIX	0.045	0.035	0.002	0.038	0.094	0.028	0.022	-0.174	-0.160	-0.007	0.031	1

Note: Gold: Gold spot price; CPI: Swedish CPI; Copper: Copper price; Import & Export consists only of Swedish goods. The correlation matrix is based on the percentage change of the macroeconomic factors.

Table 3 shows the correlation between the macroeconomic factors that this thesis is analyzing. As displayed in the table 3, many of the factors have a relative weak correlation to each other, except for a few ones. The strongest correlation between two macroeconomic factors are between the Swedish import of goods and the Swedish export of goods with a correlation of 0,874. Other relatively strong positive correlations can be found between the oil price and the copper price with a correlation of 0,434, USD/SEK and EUR/SEK with a correlation of 0,411, GDP of the U.S. and GDP of Germany with a correlation of 0,384. Other relatively strong negative correlations are USD/SEK with the oil price with a value of -0,391, and the USD/SEK and copper price with -0,407.

Diagrams show the monthly return for each portfolio and their significant factors.

Diagram 1:

All Stock Portfolio & Significant Factors (monthly percentage change)

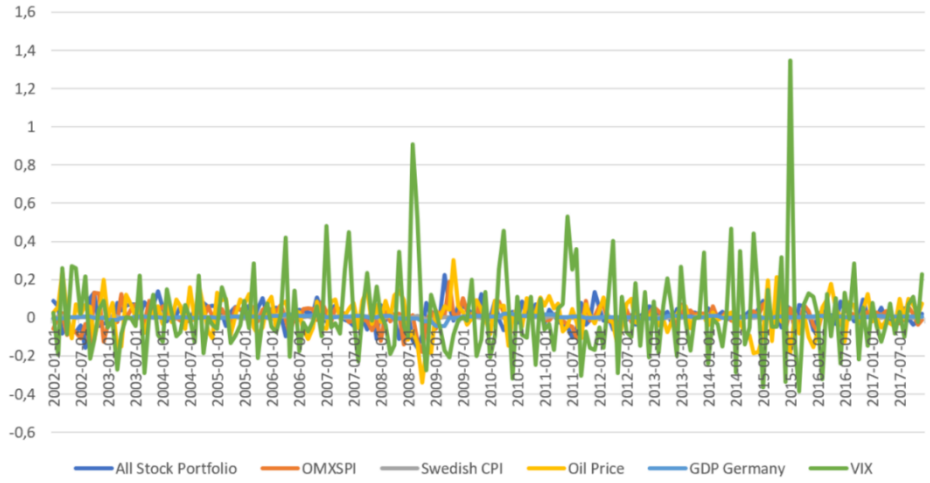


Diagram 2:

Large Cap Portfolio & Significant Factors (monthly percentage change)

Diagram 3:

Mid Cap Portfolio & Significant Factors (monthly percentage change)

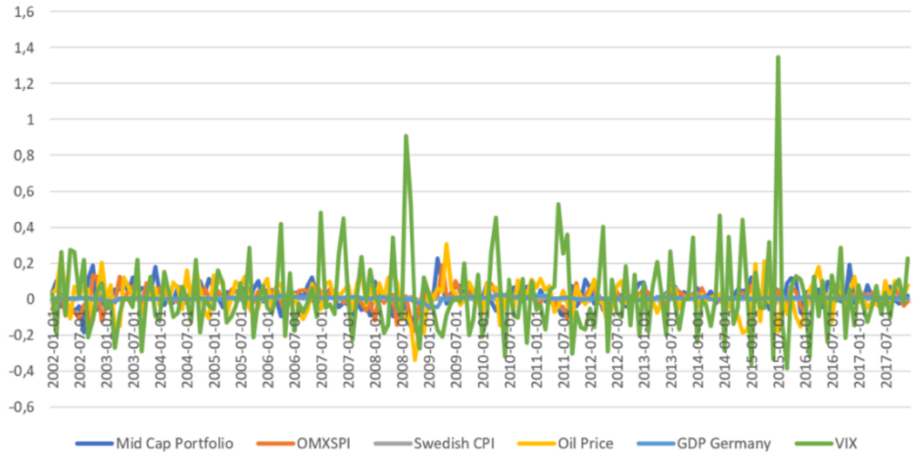


Diagram 4:

Small Cap Portfolio & Significant Factors (monthly percentage change)

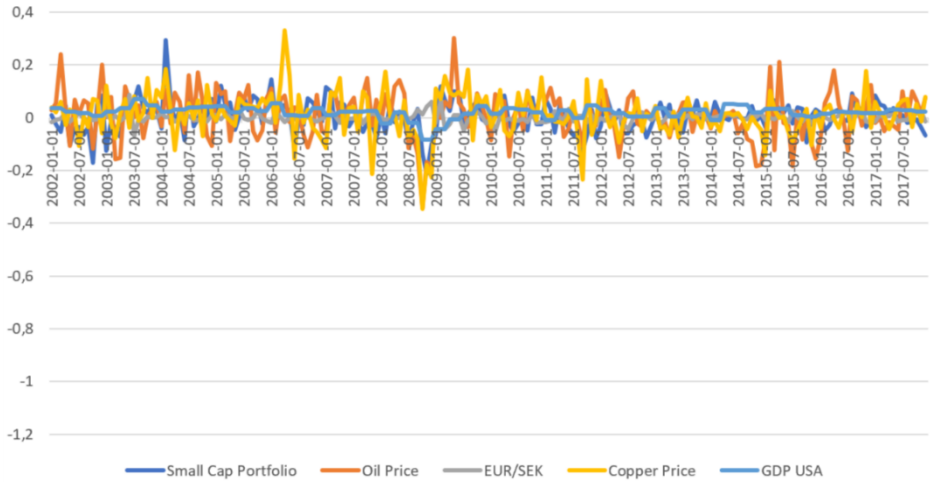


Table 4

Summarized descriptive statistics for the generated portfolios.

	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
Mean	0,014	0,020	0,016	0,006
Standard Error	0,045	0,065	0,051	0,057
Minimum	-0,158	-0,164	-0,185	-0,212
Maximum	0,223	0,298	0,227	0,294
Observations	192	192	192	192

Note: Data is based on the stock sample of each portfolio's monthly returns.

Table 4 displays the descriptive statistics for the generated portfolios in this thesis. As seen in the table 4, the Large Cap Portfolio has the highest maximum value (0,298) and mean value (0,020). The Small Cap portfolio also has a quite high maximum value (0,294) and the lowest of the minimum values (-0,212). The Large Cap Portfolio has the highest standard error (0,065) of all the portfolios. The All Stock Portfolio receives the lowest of the maximum values (0,223) and the highest minimum value (-0,158) and the lowest of all the standard errors (0,045). The mean value of the Large Cap Portfolio is the highest (0,020), while the Small Cap Portfolio has the lowest mean value (0,006) of all the portfolios.

Table 5

Estimated coefficients of the macroeconomic factors combined for each specific generated portfolio.

	All Stock	Large Cap	Mid Cap	Small Cap
Intercept	**0.015** (3.331)	**0.009** (1,342)	**0.016** (3.158)	**-0.008** (-1.389)
OMXSPI	**0.206***** (2.924)	**-0.132** (-1.284)	**0.234***** (2.886)	**-0.039** (-0.434)
Swedish CPI	**-1.719*** (-1.934)	**0.228** (0.176)	**-2.682***** -2.620	**-1.200** (-1.053)
Oil Price	**-0.095**** (-2.178)	**0.069** (1.087)	**-0.100**** (-2.002)	**0.128**** (2.308)
USD/SEK	**-0.180** (-1.498)	**0.276** (1.582)	**-0.204** (-1.479)	**0.004** (0.028)
EUR/SEK	**-0.136** (-0.656)	**0.379** (1.236)	**-0.332** (-1.392)	**0.447*** (1.682)
Copper Price	**0.025** (0.492)	**0.147**** (2.029)	**0.059** (1.031)	**0.144**** (2.243)
Gold Spot Price	**-0.001** (-0.02)	**-0.070** (-0.662)	**-0.041** (-0.498)	**-0.090** (-0.969)
Swedish Export of Goods	**-0.032** (-0.486)	**0.225**** (2.338)	**-0002** (-0.023)	**-0.023** (-0.276)
Swedish Import of Goods	**0.095** (1.265)	**-0.229**** (-2.097)	**0.064** (0.744)	**0.090** (0.941)
GDP of the U.S.	**0.257** (1.612)	**0.483**** (2.080)	**0.283** (1.542)	**0.557***** (2.719)
GDP of Germany	**-0.851**** (-2.070)	**0.134** (0.223)	**-0.794*** (-1.679)	**0.215** (0.407)
CBOE Volatility Index	**-0.111***** (-7.218)	**-0.022** (-0.996)	**-0.097***** (-5.487)	**0.011** (0.563)
Adjusted R^2	**0,300**	**0,061**	**0,256**	**0,106**
Observations	**192**	**192**	**192**	**192**
Stocks	**77 (378)**	**32 (129)**	**25 (151)**	**20 (98)**
Time Period	**2002 – 2017**	**2002 – 2017**	**2002 – 2017**	**2002 – 2017**

Note: * Significance at 10%. ** Significance at 5%. *** Significance at 1%. *T-value* is displayed in the brackets for each coefficient. Firms: number of firms included in generated portfolio. Number of firms on each specific list are displayed in the brackets after each generated portfolio number of firms.

Table 5 displays the summarized results for the macroeconomic factors and the portfolios. The oil price stands out as it is the only macroeconomic factor that is significant for three portfolios, it is significant for the All Stock Portfolio, Mid Cap Portfolio and the Small Cap Portfolio.

The portfolios with the most significant macroeconomic factors are the All Stock Portfolio and the Mid Cap Portfolio, both with a total of five macroeconomic factors. The Adjusted R^2 for the four Multi Factor Models gives relatively low values. The highest value is the Adjusted R^2 for the All Stock Portfolio, which gives a value of approximate 0,300. The Large Cap Portfolio only receives an Adjusted R^2 of 0,061, which is the lowest value of the generated portfolios.

Macroeconomic Factors

OMXSPI

The OMXSPI is a Swedish index which includes every stock at the Stockholm Stock Exchange (Avanza, F, 2018). In the results part of this thesis the OMXSPI shows significance in the All Stock Portfolio and the Mid Cap Portfolio. The expectations for the OMXSPI were that there should have been a positive relationship between all of the four generated portfolios with significance for at least on significance level. However, the OMXSPI is only significant in two of the four portfolios, the All Stock Portfolio and the Mid Cap Portfolio. On the other hand, in the All Stock Portfolio and the Mid Cap Portfolio where the factor are significant, it has a positive correlation with each respective portfolio.

Swedish Consumer Price Index (CPI)

The Swedish consumer price index shows that it is a significant macroeconomic factor for the Mid Cap Portfolio and the All Stock Portfolio. According to N. Chen, R. Roll & S. Ross (1986), the expected inflation is a significant macroeconomic factor for asset pricing on the New York Stock Exchange. Their results displayed that the inflation has a significant negative relationship to the New York Stock Exchange. Also, according to a newer study made by A.A. Azeez & Y. Yonezawa (2004), the consumer price index is a significant macroeconomic factor for pricing an asset on the Japanese stock exchange. Their studies also showed a negative correlation between the inflation and the stock exchange. The same conclusion can also be partly drawn according to this thesis result, at least for the All Stock Portfolio and the Mid Cap Portfolio where the Swedish CPI is a significant macroeconomic factor. The sign of the Swedish CPI in this thesis shows a negative correlation for both the portfolios exactly as both Chen, Roll and Ross (1986) and Azeez and Yonezawa (2004) alleged, which matches the expectations.

Oil Price

The oil price is proven to be a significant macroeconomic factor according to its significance in three out of the four generated portfolios, the All stock Portfolio, Mid Cap Portfolio and the Small Cap Portfolio. It did not however show any significance for the Large Cap Portfolio. The expectations were that there should have been a positive correlation between the asset's price and the oil price for all four portfolios. However, according to a more recent study the correlation between the oil price and stock prices on a global level is not as certain as earlier

studies have told, their results displayed a negative relationship. (K. Sawyer & M. Nandha, 2006). The same conclusion could be partly drawn according to this thesis results, because of the oil price's significance and the signs for the All Stock Portfolio and the Mid Cap Portfolio shows a negative correlation while the Small Cap Portfolio shows a positive correlation.

Exchange Rates

The statistical tests from the thesis show that the two exchange rates did not show any great significance. The exchange rate EUR/SEK is the only significant factor for all the portfolios, it is located in the Small Cap Portfolio with a significance level of 10%. The USD/SEK is not significant for any of the generated portfolios.
These findings did not match the expectations, since Sweden is very dependent on their foreign trade which is affected by the exchange rates. (Statistiska centralbyrån, B & C, 2018). According to A.A. Azeez and Y. Yonezawa (2004) the exchange rates on the Japanese stock exchange were significant factors both with negative coefficients. That same conclusion cannot really be drawn from this thesis results, since only one of the portfolios has the EUR/SEK as a significant macroeconomic factor. Neither did the sign of the coefficient, which was positive, match the results that A.A. Azeez and Y. Yonezawa received in their results.

Copper price

According to the statistical tests in this thesis, the copper price is a significant macroeconomic factor for the Large Cap Portfolio and the Small Cap Portfolio. Copper is one of the most useful metals in the world. It is an important metal in the industry, especially in the electronic devices industry (Handelsbanken, 2018). Many of the companies in the All Stock Portfolio and Small Cap Portfolio consists of companies which operate within the industry. Therefore, it is not a surprise that these two portfolios are correlated with the copper price. The findings are as the expectations alleged, that the copper price is significant. However, our expectations were that the copper price also should have been significant for the All Stock Portfolio and Mid Cap Portfolio. The expectations for the copper price were that it should have a positive relationship to the four portfolios since it works as an indicator for the wellbeing on the Swedish Stock Exchange. Therefore, the results match the expectations regarding its positive correlation, but expectations concerning its significance for the other portfolios, did not meet the expectations.

Gold Spot Price

According to Gagan Deep Sharma's (2010) article "*Impact of macro-economic variables on stock prices in India"*, Sharma draws the conclusion that there is positive "high correlation" between the gold spot price and stock prices on the Indian stock exchange. On the other hand, according to Handelsbanken (2018) the gold spot price is considered a hedge against political and economic disturbances. The results from this thesis regressions shows that the gold spot price is not significant for any of the three levels of significance in any of the four generated portfolios. Even though the variable is not significant for any of the portfolios, the variable shows a negative correlation between portfolios and the gold spot price. The results matched the expectations for the correlation for the spot price change of gold, but did not meet the expectation regarding its significance.

Swedish Export of Goods

The results from this thesis shows that only one of the four portfolios display the Swedish export of goods variable as significant within the 5% significance level in the Large Cap Portfolio. Expectations regarding the sign of the coefficients were expected to be positive with the portfolios. Expectations of this may be due to that the Large Cap Portfolio consists of 56.25% export and import heavy companies. The export variable has a positive correlation to the Large Cap Portfolio as expected.

Swedish Import of Goods

According to Statistiska Centralbyrån (2018), in order to be able to export Swedish goods, Swedish companies may first have to import goods. The expectations were therefore that the correlation between import and export of Swedish goods should look quite similar. According to table 1, the correlation is as expected relatively strong (0.874). In the results of this thesis, both export and import are significant at the same 5% significance level in the same portfolio, the Large Cap Portfolio. Also, here 56.25% of the companies are export and import dependent companies. In the Large Cap Portfolio where the variable is significant, it has a negative correlation as expected.

GDP of the U.S.

The U.S. having the biggest economy on earth and being Sweden's third biggest importer of Swedish goods, the expectations were that the GDP of the U.S. should have a positive correlation with the portfolios (Statistiska Centralbyrån, B & C, 2018). According to this thesis results it is challenging to draw one general conclusion. The GDP of the U.S. is significant in both the Large and Small Cap Portfolios, but not for the All Stock and Mid Cap Portfolios. The Small Cap portfolio shows significance at the 1% level while the Large Cap Portfolio shows significance at the 5% level. Since the GDP of the U.S. is the only significant in two out of four generated portfolios, the result did not meet the expectations. The significant variables in the Large Cap Portfolio and the Small Cap Portfolio shows positive correlation, which did match the expectations.

GDP Germany

Germany being the biggest importer and exporter of Swedish goods (Statistiska Centralbyrån, B & C, 2018), the expectations were that the health state of the German economy should influence the generated portfolios. In the Mid Cap Portfolio there is significance at the 10% level and at the 5% level in the All Stock Portfolio, while there is none in the Large or Small Cap Portfolios. The portfolios that have the GDP of Germany as a significant variable have as expected a rather strong correlation with the portfolios. But to our surprise the correlation is negative with a value of -0.85 for the All Stock Portfolio and -0.79 for Mid Cap Portfolio which did not meet the expectations.

CBOE Volatility Index (VIX)

In Alessandro Cipollini's article *"Can the VIX signal market direction? An asymmetric dynamic strategy"* (2007), Cipollini analyzed if the VIX was a statistically good driver for the American index S&P500. According to Cipollini's results, the VIX can signal where the market is heading. In his analyze, Cipollini found out that the VIX had a negative relationship to S&P500. Cipollini also mentions that it is a better indicator when the volatility is higher compared to when it is low. The expectations were that the Mid Cap Portfolio and especially the Small Cap Portfolio should have a strong negative correlation to their respective portfolio. According to this thesis results, the VIX shows great significance in the All Stock Portfolio and the Mid Cap Portfolio, therefore partly agreeing with Cipollini's results since only two out of four portfolios are significant. Both portfolios show significance within the 1% level and have a negative correlation, as expected, of respectively -0.111 and -0.097.

Portfolios

All Stock Portfolio

The All Stock Portfolio together with the Mid Cap Portfolio are the portfolios with the most amount of significant macroeconomic factors within the significance level of 10%. The significant factors for the portfolio are the OMXSPI, Swedish CPI, Oil Price, GDP of Germany and the VIX. The OMXSPI is the only factor that receives a positive estimated coefficient of 0,206 which means that for every percent the OMXSPI increases. The Swedish CPI receives a rather strong negative coefficient together with the GDP of Germany of respectively -1,719 and -0,851. The coefficients for the oil price and the CBOE Volatility Index is somewhat weaker with values of -0,095 and -0.111 respectively.

The All Stock Portfolio receives the following Multi Factor Model to pricing assets on the Stockholm Stock Exchange at a significance level of at least 10%:

$$R_{All\ Stock\ Port.} = 0,015 + 0,206 \triangle OMXSPI - 1,719 \triangle Swedish\ CPI - 0,095 \triangle Oil\ Price - 0,851 \triangle GDP\ of\ Germany - 0,111 \triangle CBOE\ Volatility\ Index$$

Note: R=return, ∆=percentage change of the factor. T-statistics: OMXSPI: 2.924, Swedish CPI: -1.934, Oil Price: -2.178, GDP of Germany: -2.070, CBOE Volatility Index: -7.218.

The All Stock Portfolio is the represented sample for the whole Stockholm Stock Exchange since it includes stocks from the Large Cap, Mid Cap and Small Cap. Therefore, the expectations were that the Swedish Index OMXSPI, which tracks all stocks on the Stockholm Stock Exchange, should be a significant factor for the All Stock Portfolio. The results display that the expectations were correct. Sweden being reliant on their export and import and Germany being the largest exporter and importer of Swedish goods, the expectation was that the GDP of Germany should have a significant positive correlation with the All Stock Portfolio (Statistiska Centralbyrån, B & C, 2018). The expectations match some of the results, GDP of Germany is significant but with the unexpected negative correlation to the All Stock Portfolio. According to Statistiska Centralbyrån (2018), an increase in the German GDP should result in an increase of export and import of Swedish goods and services. The Swedish CPI is also a significant factor that matched the expectations, but has the wrong sign of the estimated coefficient according to the expectations.

Large Cap Portfolio

The Large Cap Portfolio have four significant macroeconomic factors which all are within the 5% significance level. The macroeconomic factors that are significant is the copper price, Swedish export of goods, Swedish import of goods and the GDP of The U.S.
The copper price receives a positive coefficient together with the Swedish export of goods and the GDP of The U.S. with coefficients of 0,147, 0,225 and 0,483 respectively.
However, the Swedish import of goods receives a negative coefficient of -0,229.

The Large Cap Portfolio receives the following Multi Factor Model to pricing assets on the Stockholm Stock Exchange at a significance level of at least 10%:

$$R_{Large\ Cap\ Port.} = 0,009 + 0,1473 \triangle Copper\ Price + 0,2248 \triangle Swedish\ Export\ of\ goods - 0,2288 \triangle Swedish\ Import\ of\ goods + 0,4834 \triangle GDP\ of\ the\ U.S.$$

Note: R=return, ∆=percentage change of the factor. T-statistics: Copper Price: 2.029, Swedish Export of goods: 2.338, Swedish import of goods: -2.097, GDP of the U.S.: 2.080.

Since 56,25% of the stocks in the Large Cap Portfolio are companies who depend on their export and import to other countries, the expectations were that the GDP of Germany, Swedish export and import of goods should be significant factors for the Large Cap Portfolio. However, the GDP of Germany is not a significant factor compared to Swedish the import and export of Swedish goods which are significant factors. However, the GDP of the U.S. is a significant factor for the Large Cap Portfolio which is as expected since the U.S. is the biggest economy in the world and Sweden's third largest export-country (Statistiska Centralbyrån, 2018).
Copper, which is one of the most useful metal in the industry according to Handelsbanken (2018), is also significant. Copper being significant may be due to the large amount of industry companies in the sample for the Large Cap Portfolio.

Mid Cap Portfolio

The Mid Cap Portfolio is the one portfolio with the greatest number of macroeconomic factors that have a significance level within the 1% significance level; the OMXSPI, Swedish CPI and the VIX. The other two variables that are significant are the oil price and GDP of Germany. Both the All Stock and Mid Cap Portfolios have exactly the same significant factors but at different significance levels. The OMXSPI receives a positive estimated coefficient value of 0,234 which is the only coefficient with positive correlation in the model for the Mid Cap Portfolio. The Swedish CPI and the GDP of Germany revives rather strong negative correlation with the Mid Cap Portfolio with values of -2,682 and -0,790 respectively. The other two variables, the oil price and the VIX do have weaker negative correlations with the portfolio, with values of -0.1 and -0.097 each.

The Mid Cap Portfolio receives the following Multi Factor Model to pricing assets on the Mid Cap list on the Stockholm Stock Exchange at a significance level of at least 10%:

$$R_{Mid\ Cap\ Port.} = 0,016 + 0,234 \triangle OMXSPI - 2.680 \triangle Swedish\ CPI - 0,1 \triangle Oil\ Price - 0,79 \triangle GDP\ of\ Germany - 0,097 \triangle CBOE\ Volatility\ Index$$

Note: R=return, ∆=percentage change of the factor. T-statistics: OMXSPI: 2.886, Swedish CPI: -2.620, Oil Price: -2.002, GDP of Germany: -1.679, CBOE Volatility Index: -5.487.

When examining the sample in the Mid Cap Portfolio, about 40% of the companies sell products and services directly to customers, which could explain the Swedish CPI's significance for the Mid Cap Portfolio. The Mid Cap Portfolio consists of a lot of international businesses. Since Germany is Sweden's largest trading partner (Statistiska Centralbyrån, B & C, 2018), it is not a surprise that the GDP of Germany is a significant factor for the Mid Cap Portfolio. Also, since there are a lot of international businesses in the Mid Cap Portfolio, the expectations for EUR/SEK, GDP of The U.S. and the import and export of Swedish goods were that they also should be significant factors, but the results did not match the expectations.

Small Cap Portfolio

The Small Cap Portfolio is the only portfolio that has an exchange rate variable that is significant, the EUR/SEK. The only factor within the 1% significance level in the Small Cap Portfolio is the GDP of the U.S. The significant factors in the Small Cap Portfolio all have positive estimated coefficients. The variables GDP of the U.S. and the exchange rate EUR/SEK both have a rather strong positive correlation with the Small Cap Portfolio with values of 0.,57 and 0,447 respectively. Also, the oil price and the copper price receives a positive correlation with values of 0,128 and 0,144 each.

The Small Cap Portfolio receives the following Multi Factor Model to pricing assets in the Stockholm Stock Exchange at a significance level of at least 10%:

$$\boldsymbol{R_{Small\ Cap\ Port.} = -0,008 + 0,129 \triangle Oil\ Price + 0.447 \triangle EUR/SEK + 0.144 \triangle Copper\ Price + 0.557 \triangle GDP\ of\ the\ U.S.}$$

Note: R=return, ∆=percentage change of the factor. T-statistics: Oil Price: 2.308, EUR/SEK: 1.682, Copper Price: 2.243, GDP of the U.S.: 2.719.

The Small Cap Portfolio is the only portfolio where the exchange rate EUR/SEK is significant. The explanation that the exchange rate EUR/SEK being significant may be because of approximate 70% of the stocks in the Small Cap Portfolio are businesses which operate all over the world. However, the exchange rate USD/SEK is not a significant factor for the portfolio. On the other hand, the GDP of the U.S. is a significant factor which also could be explained by the vast amount of business operating between the two countries. The significance for the oil price could be explained by the amount of international businesses in the Small Cap Portfolio sample that are affected by the industry in some way were the oil is an important source of energy (UKOG, 2018). The CBOE Volatility Index is not a significant factor for the Small Cap Portfolio which did not match the expectations since smaller companies have a tendency to be more volatile.

Conclusion

This thesis is analyzing which macroeconomic factors that has affected the Stockholm Stock Exchange with the help of historic prices during the time between 2002-01-01 and 2017-12-31. Four different portfolios are generated from a total of 77 stocks collected from the lists Large Cap, Mid Cap and Small Cap on the Stockholm Stock Exchange. This thesis uses Multi Factor Models to examine which macroeconomic factors are significant on the Stockholm Stock Exchange. The analyzed macroeconomic factors are: the OMXSPI, Swedish CPI, Oil Price, USD/SEK, EUR/SEK, Copper Price, Gold Spot Price, Swedish Export of Goods, Swedish Import of Goods, GDP of the U.S., GDP of Germany and the CBOE Volatility Index.

Table 6

Summary of the significant factors that affects the return of the Stockholm Stock Exchange.

	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
Factor 1	OMXSPI (+)	Copper Price (+)	OMXSPI (+)	Copper Price (+)
Factor 2	Swedish CPI (-)	Swedish export of Goods (+)	Swedish CPI (-)	Oil Price (+)
Factor 3	Oil Price (-)	Swedish Import of Goods (-)	Oil Price (+)	EUR/SEK (+)
Factor 4	GDP of Germany (+)	GDP of the U.S. (+)	GDP of Germany (+)	GDP of the U.S. (+)
Factor 5	CBOE Volatility Index (-)		CBOE Volatility Index (-)	

Note: Sign of the correlation is shown in brackets; Green color: expectations match the results.; Red color: expectations do not match the results.

To answer the research question of this thesis *"What macroeconomic factors affect the expected returns on the Stockholm Stock Exchange?",* it is difficult to draw one simple conclusion. To start off with, ten out of the twelve chosen macroeconomic factors are significant for at least one significance levels in at least one portfolio, therefore making mostly of the chosen macroeconomic factors relevant on the Stockholm Stock Exchange. The two macroeconomic factors that do not have any significance are the gold spot price and the exchange rate between the USD/SEK. The macroeconomic factor oil price is the only factor that is significant in three of the four generated portfolios.

Comparing the different macroeconomic factors and significance levels between the different portfolios shows great variance in which macroeconomic factors that are significant depending on what list they are listed at. The Mid Cap Portfolio and the All Stock Portfolio have exactly the same significant macroeconomic factors. The Large Cap Portfolio and the Small Cap Portfolio on the other hand have less in common to the other portfolios and each other. Finally, making a conclusion about which factors that affect the whole Stockholm Stock Exchange may be difficult to determine since none of the factors show significance in all of the portfolios. With that in mind, making a conclusion which macroeconomic factors that affect the lists Large Cap, Mid Cap and Small Cap individually are easier to identify.

Suggestions for further research

There are several parts in this thesis that could be in need of further research. First off, the number of macroeconomic factors could be extended to widen the knowledge of what factors that affect the Stockholm Stock Exchange. There are many more macroeconomic factors that may affect the expected return on stock exchanges which could be of interest to analyze on the Stockholm Stock Exchange. This thesis only analyzes the different portfolios consisting of stocks on different lists on the Stockholm Stock Exchange, therefore, making portfolios consisting of sectors instead of lists may be of interest.

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Appendix

Tables

Table 1:

	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
OMXSPI	+	+	+	+
Gold Sport Price	-	-	-	-
Swedish CPI	+	+	+	+
Oil Price	+	+	+	+
Copper Price	+	+	+	+
EUR/SEK	+	+	+	+
USD/SEK	+	+	+	+
VIX	-	-	-	-
GDP of Germany	+	+	+	+
GDP of the U.S.	+	+	+	+
Swedish Export of Goods	+	+	+	+
Swedish Import of Goods	-	-	-	-

Table 2:

	All Stock Port.	Large Cap Port.	Mid Cap Port.	Small Cap Port.
All Stock Portfolio	1			
Large Cap Portfolio	0.564	1		
Mid Cap Portfolio	0.277	0.208	1	
Small Cap Portfolio	0.847	0.892	0.268	1

Table 3:

	OMX SPI	CPI	Oil Price	USD /SEK	EUR /SEK	Copper	Gold	Export	Import	GDP of The U.S.	GDP Germany	VIX
OMXSPI	1											
CPI	-0.095	1										
Oil Price	0.124	0.185	1									
USD/SEK	-0.191	-0.057	-0.391	1								
EUR/SEK	-0.187	-0.058	-0.174	0.411	1							
Copper	0.324	0.123	0.434	-0.407	-0.295	1						
Gold	-0.035	-0.087	0.253	-0.331	-0.054	0.293	1					
Export	-0.093	0.302	-0.033	0.038	0.051	0.017	-0.019	1				
Import	-0.115	0.316	-0.021	0.079	0.043	-0.001	-0.031	0.874	1			
GDP of The U.S.	0.218	0.113	0.246	-0.135	-0.224	0.230	0.047	0.055	0.050	1		
GDP Germany	0.072	0.083	0.068	-0.165	-0.147	0.045	0.059	0.008	0.015	0.384	1	
VIX	0.045	0.035	0.002	0.038	0.094	0.028	0.022	-0.174	-0.160	-0.007	0.031	1

Table 4:

Portfolio	All Stock	Large Cap	Mid Cap	Small Cap
OMXSPI	**0.206*** ** (2.924)	**-0.132** (-1.284)	**0.234*** ** (2.886)	**-0.039** (-0.434)
Swedish CPI	**-1.719*** (-1.934)	**0.228** (0.176)	**-2.682*** ** -2.620	**-1.200** (-1.053)
Oil Price	**-0.095** ** (-2.178)	**0.069** (1.087)	**-0.100** ** (-2.002)	**0.128** ** (2.308)
USD/SEK	**-0.180** (-1.498)	**0.276** (1.582)	**-0.204** (-1.479)	**0.004** (0.028)
EUR/SEK	**-0.136** (-0.656)	**0.379** (1.236)	**-0.332** (-1.392)	**0.447*** (1.682)
Copper Price	**0.025** (0.492)	**0.147** ** (2.029)	**0.059** (1.031)	**0.144** ** (2.243)
Gold Spot Price	**-0.001** (-0.02)	**-0.070** (-0.662)	**-0.041** (-0.498)	**-0.090** (-0.969)
Swedish Export (Goods)	**-0.032** (-0.486)	**0.225** ** (2.338)	**-0002** (-0.023)	**-0.023** (-0.276)
Swedish Import (Goods)	**0.095** (1.265)	**-0.229** ** (-2.097)	**0.064** (0.744)	**0.090** (0.941)
GDP of The U.S	**0.257** (1.612)	**0.483** ** (2.080)	**0.283** (1.542)	**0.557*** ** (2.719)
GDP of Germany	**-0.851** ** (-2.070)	**0.134** (0.223)	**-0.794*** (-1.679)	**0.215** (0.407)
CBOE Volatility Index	**-0.111*** ** (-7.218)	**-0.022** (-0.996)	**-0.097*** ** (-5.487)	**0.011** (0.563)
Adjusted R^2	**0,300**	**0,061**	**0,256**	**0,106**
Observations	**192**	**192**	**192**	**192**
Period	**2002 – 2017**	**2002 – 2017**	**2002 – 2017**	**2002 – 2017**

Table 5:

Portfolio	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
Mean	0,014	0,020	0,016	0,006
Standard Error	0,045	0,065	0,051	0,057
Minimum	-0,158	-0,164	-0,185	-0,212
Maximum	0,223	0,298	0,227	0,294
Observations	192	192	192	192

Table 6:

	All Stock Portfolio	Large Cap Portfolio	Mid Cap Portfolio	Small Cap Portfolio
Factor 1	**OMXSPI (+)**	**Copper Price (+)**	**OMXSPI (+)**	**Copper Price (+)**
Factor 2	**Swedish CPI (-)**	**Swedish export of Goods (+)**	**Swedish CPI (-)**	**Oil Price (+)**
Factor 3	**Oil Price (-)**	**Swedish Import of Goods (-)**	**Oil Price (+)**	**EUR/SEK (+)**
Factor 4	**GDP of Germany (+)**	**GDP of the U.S. (+)**	**GDP of Germany (+)**	**GDP of the U.S. (+)**
Factor 5	**CBOE Volatility Index (-)**		**CBOE Volatility Index (-)**	

Diagram 1:

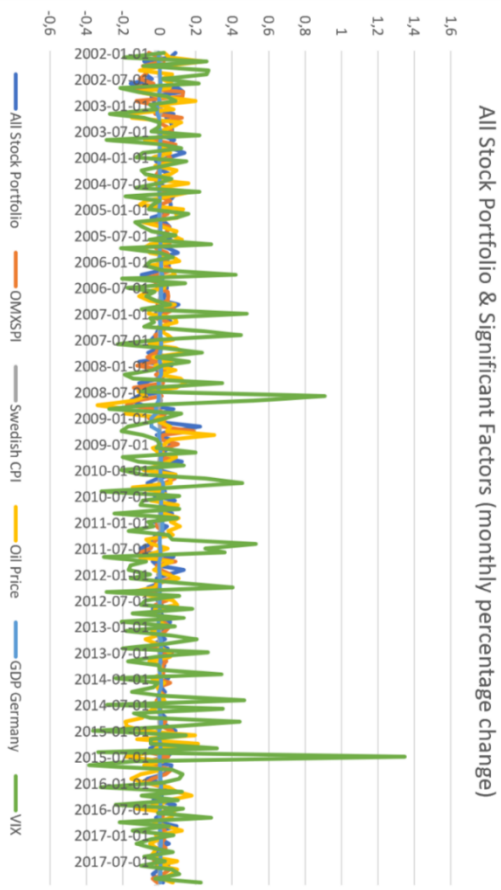


Diagram 2:

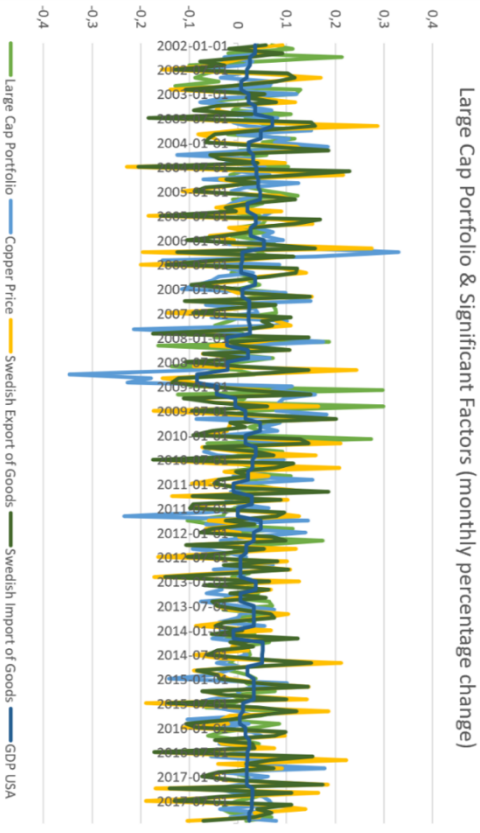


Diagram 3:

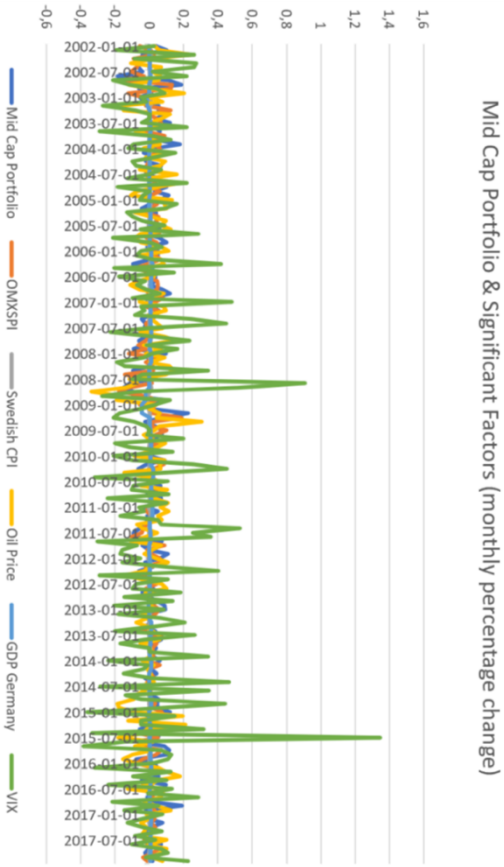


Diagram 4:

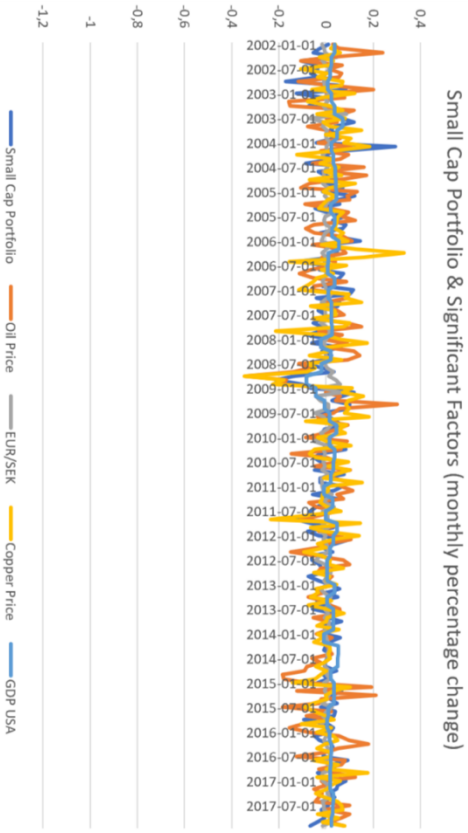
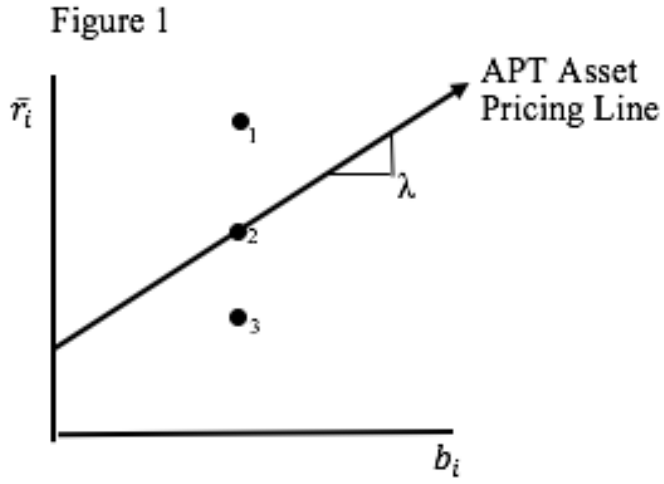


Figure 1:



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Portfolio samples:

Large Cap
Assa Abloy
Astra Zeneca
Atlas Copco B
Axfood
Betsson
Castellum
Elekta B
Ericsson B
Getinge
Handelsbanken B
Hexpol B
HM B
Holmen A
Industrivärden C
Investor B
Kinnevik B
Latour
Lundin Petrolium
MTG B
Nibe
Ratos
SAAB B
SEB A
Securitas B
Skanska
SSAB A
Swecon B
Swedbank A
Swedish match
Trelleborg B
Volvo B
ÅF

Mid Cap
Acando B
Beijer Alma B
Bergman & Beving B
BioGaia B
Biotage
Bure Equity
Catella A
Clas Ohlson B
Cloetta
Fagerhult
Fast Partner
Gunnebo
KABE
Knowit
Mekonomen
Mycronic
Net Insight B
Nolato B
OEM International B
SAS
Sectra B
Skistar
Traction B
Vitrolife
Öresund

Small Cap
ICTA
Bergs timber B
Bioinvent International
Bong
BTS Group
Consilium AB
CTT Systems
Feelgood Svenska AB
Havsfrun Investment AB
Lammhults Design Group B
Midway B
multiQ International
Poolia B
Prevas AB
Profilgruppen AB
Semcon
Strax
Trention
Viking Supply ships B
Xano industri B