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Macroeconomic and Stock Market Relationships in Sweden During 2000 to 2015: a Co-integration Analysis of the OMXS30 and Macroeconomic Variables.

Bachelor Thesis in Economics.

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Abstract

This thesis investigates the macroeconomic and stock market relationship in Sweden during 2000 – 2015, focusing on the Swedish stock index OMXS30 and the influence from foreign and domestic macroeconomic variables. The analysis covers long-term relationships, causalities and the influence on OMXS30 from short-term shocks in the selected macroeconomic variables. The data is analysed with co-integration analysis. What we conclude is that foreign macroeconomic variables in terms of foreign stock prices and exchange rates do influence the OMXS30, both in the long-term and somewhat in the short-term. Foreign stock prices and the domestic yields are also found to Granger cause OMXS30. We further find that the long-term relationships between domestic macroeconomic variables and OMXS30 however have changed to some extent compared to the literature, and that the drivers of the stock market hence might continue changing in the future.

Key Words: OMXS30, Co-integration analysis, Macroeconomic relationships.

Table of Contents

1. INTRODUCTION	1
2. REVIEW OF LITERATURE	2
3. DATA	6
3.1 CHOICE OF MAIN VARIABLES	6
3.2 OMXS30	7
3.3 SEKEUR	8
3.4 SEKUSD	9
3.5 DAX30	9
3.6 DOW JONES INDUSTRIAL AVERAGE	10
3.7 INDUSTRIAL PRODUCTION	10
3.8 CONSUMER PRICE INDEX	11
3.9 SWEDISH 3-MONTH TREASURY BILL YIELD	11
3.10 SWEDISH 10-YEAR GOVERNMENT BOND YIELD	12
3.11 EXCLUSION OF VARIABLES	13
4. CRITIQUE AND LIMITATIONS OF THESIS	13
5. METHODOLOGY	14
5.1 EFFICIENT MARKET HYPOTHESIS	14
5.2 UNIT-ROOTS AND STATIONARY DATA	15
5.3 CO-INTEGRATION AND LONG-TERM RELATIONSHIPS	16
5.4 CAUSALITY AND IMPULSE RESPONSE	18
6. EMPIRICAL RESULTS AND ANALYSIS	19
6.1 RESULTS AND ANALYSIS FROM UNIT-ROOT TESTS	19
6.2 RESULTS AND ANALYSIS FROM JOHANSEN CO-INTEGRATION TEST	20
6.3 RESULTS AND ANALYSIS FROM GRANGER CAUSALITY	27
6.4 RESULTS AND ANALYSIS FROM IMPULSE RESPONSE	28
7. CONCLUSIONS	31
BIBLIOGRAPHY	33

1. Introduction

The relationship between macroeconomic variables and stock prices has been explored and analysed in various forms, with various methods and results such by Campbell and Ammer (1993), Nasseh and Strauss (2000) and Hussain, Aamir, Rasool, Fayyaz, and Mumtaz (2012) among others. Understanding what drives stock prices and to predict stock price movements is likely to be of interest for the investor in order to make qualified investment decisions. The stock market in turn also acts as a key pillar in the economy as capital is allocated from investors to firms, which enables investments and economic growth (Filer, Hanousek, & Campos, 1999). The existence of a stock market is thus essential for the economy in general since it helps to allocate resources in an efficient way between firms seeking capital, and investors willing to provide their capital to firms in turn. This relationship thus highlights the relevance of what influence stock prices. However as market conditions change rapidly and politics and monetary policy change, the drivers of the stock market might not be obvious. For the investors it may thus become more challenging to make qualified investment and therefore harder for companies to receive capital.

There exist a large number of papers on this topic regarding different macroeconomic variables, regions, stock indexes and time periods as mentioned. This thesis focus on Swedish stock prices first of all because it is written in Sweden. Secondly because the Swedish economy is small, yet it is likely that Swedish firms to a large extent are affected by international events, which could suggest Swedish stock prices to be influenced by international macroeconomic variables. The Swedish OMXS30 index (stock index) is investigated in previous bachelor and master theses such as Talla (2013) and Nielsen and Bodin (2012). There are however currently no papers or theses taking a more international approach and include foreign macroeconomic variables in the analysis on OMX30, as far as I am concerned. Therefore this thesis contributes to the literature by including foreign stock prices, DAX30 (DAX30) and the Dow Jones Industrial Average (DJI), in the analysis on domestic stock prices. It further contributes from including two exchange rates, Swedish Krona to Euro exchange rate (SEKEUR), and the Swedish Krona to USD exchange rate (SEKUSD). The international variables are also analysed together with the following domestic

macroeconomic variables; consumer price index (CPI), industrial production (IP), Swedish 3-month Treasury bill yield (TB) and Swedish 10-year Government bond yield (BOND), as they appear in the literature, see for example Chen, Roll, and Ross (1986) and Campbell and Ammer (1993). Based on the background the question that is the consistent frame of this thesis is “Are there any significant long-term relationships, short-term effects from shocks and causalities between the selected foreign and domestic macroeconomic variables, and OMXS30 during 2000 to 2015”?

Chapter 2 of this thesis looks at a review of the literature, addressing the field of research and its relevance to this thesis. Thereafter chapter 3 presents explanations, and descriptions of the data and from where and how it is retrieved. Chapter 4 gives a brief discussion on the potential limitations regarding the data and the thesis. The methodology and proceeding of this thesis is further presented in chapter 5 and the reader can follow each step of the process, including why and how certain approaches are made. All empirical test results are then presented, commented on and analysed through chapter 6. Chapter 7 presents the conclusions from the research of this thesis and suggestions to further research.

2. Review of literature

This section provides an overview on the literature and how the previous work by others is relevant to this thesis.

Fama and Schwert (1977) provide some of the early research on how macroeconomic variables and stock prices relate to each other. Like this thesis the authors explore the relationship between CPI and stock prices, however their paper focus on the US and does not target the relationships to stock prices specifically. Instead they look at the extent to which various assets are hedges against inflation and conclude, among other things that common stock returns are negatively related to expected inflation (Fama & Schwert, 1977). In contrast to Fama and Schwert (1977) Chen, Roll and Ross (1986) focus more explicitly on how macroeconomic variables influence stock returns, in relation to this thesis. They conclude a negative relationship between stock prices and inflation but also find that industrial production, changes in the risk premium and changes in the yield curve influence stock prices (Chen, Roll, & Ross, 1986). Also

Schwert (1990) investigates the effect of industrial production on US stock prices. On the other hand he uses a large data sample and concludes a strong long-term relationship between industrial production and stock prices that is consistent over 100 years (Schwert, 1990). In line with the two papers we also include industrial production and yields in this thesis and observe long-term relationships, but opposite to this thesis the authors explore other time periods and both papers target US data.

Campbell and Ammer (1993) on the other hand develop the econometrical approach and they apply a variance decomposition method on a Vector Autoregressive model (VAR) on US data. The authors conclude that it is important to use a VAR since bond prices and stock prices are determined simultaneously. We follow their approach and include econometrical methods such as the Johansen test, Granger Causality and impulse responses, which are based on the VAR approach (Sjö, 2008). Similarly to this thesis the authors also include real interest rates and they conclude that short-term interest rates can be used to determine stock prices (Campbell & Ammer, 1993).

Studies have also been made on the relationship between macroeconomic variables and stock prices beyond the US. An interesting study, which explores the influence of domestic macroeconomic variables on both US and Japanese stock prices is made by Humpe and Macmillan (2007). In relation to this thesis they use a co-integration analysis and perform Augmented Dickey Fuller tests (ADF), Johansen and finally generate the VECMs. Likewise this thesis the variables CPI, industrial production and long-term interest rates are included in the analysis. In contrast to their study however, we do not include money supply as we assume the effects will show up in TB. For the US they find that US stocks are positively related to industrial production and negatively related to CPI and long-term interest rates. For Japan they find two co-integrated vectors, and in the vector normalised on Japanese stocks, stock prices are positively influenced by industrial production and negatively by money supply (Humpe & Macmillan, 2007).

The long-term relationships between macroeconomic variables and Japanese stock prices are further analysed by Kurihara (2006). In relation to this thesis, foreign stock prices and the exchange rate are included in the analysis. The author, in relation to this thesis applies co-integration analysis and ADF tests, Granger Causality technique

and impulse response. The paper concludes that interest rates do not affect stock prices but the exchange rate and US stock prices have positive effects on the Japanese stock prices. In opposite to this thesis Kurihara (2006) also perform OLS, which is excluded from this analysis, where we instead focus on the coefficients from the Johansen test and impulse response (Kurihara, 2006).

Nasseh and Strauss (2000) and Masduzzaman (2012) study the relationship between macroeconomic variables and stock prices, and in their focus is on European economies. Nasseh and Strauss (2000) are in line with this thesis including foreign stock prices in their analysis on domestic stock prices in six European economies, and Masduzzaman (2012) analyse domestic stock prices in Germany and UK. Both papers conclude that industrial production has a positive long-run relationship with stock prices but find different results on the influence from interest rates. Nasseh and Strauss (2000) further find positive relationships between short-term interest rates and stock prices in five countries and negative relationships between long-term interest rates and stock prices in three countries. In opposite to the US results presented above, CPI is found to have positive relationships to stock prices in all six countries, suggesting different relationships between the two continents (Nasseh & Strauss, 2000) (Masduzzaman, 2012). In opposite to the two papers this thesis includes two foreign stock prices and two exchanges rates simultaneously.

The literature further shows evidence from countries, which could be considered small and open economies, and thus are relevant to this thesis. Maysami, Howe and Hamzah (2004) investigate the relationships between macroeconomic variables and stock prices in Singapore. They also apply a co-integration analysis and use the Johansen test like this thesis. In opposite to this thesis though, they focus on sector stock market indices in Singapore, but find results in line with both the US and Europe. The authors argue among other things that stock prices have long-term relationships that are positive between CPI, industrial production and the short-term interest rate and stock prices. Contrary to the findings in Europe, the exchange rate and one-year government bond are found to have negative influence on stock prices (Maysami, Howe, & Hamzah, 2004). Further Gan, Lee, Yong and Zhang (2006) examine the relationships between the New Zealand Stock Index and a set of seven macro variables with a Johansen Maximum likelihood and Granger Causality test.

They conclude that the NZSE40 is determined by the interest rate, but in contrast to this thesis they also include money supply and real GDP, which both influence stock prices. In relation to this thesis they further use an impulse response function, which shows that shocks in CPI and the long-term interest rate have negative effects on stock prices, while short-term interest rate have positive effects. This thesis differs however since we do not include GDP, oil prices or money supply (see chapter 3.11), but instead target foreign stock prices and exchange rates (Gan, Lee, Yong, & Zhang, 2006).

Since the literature suggest different long-term relationships in different regions as noted, evidence from the Middle East further give insight on the relationships between macroeconomic variables and stock prices. Hussain et al (2012) explores the impact of macroeconomic variables on stock prices of the Pakistani Karachi Stock Exchange on the time period of January 2001 to December 2010. The authors similarly to this thesis apply the Johansen approach and Granger Causality. Among other things they find that in contrast to the case of Japan, the exchange rate has a negative impact on the stock prices. Further in line with this thesis the paper investigates the domestic variables interest rates and industrial production, which both have positive relationships to stock prices. However the paper differs from this thesis since it also includes variables such as foreign exchange reserve, imports, money supply and wholesale price index. From the Granger Causality test they find uni-directional causalities from exchange rate, foreign exchange reserve and imports while money supply and wholesale price index have a bi-directional causality (Hussain, Aamir, Rasool, Fayyaz, & Mumtaz, 2012).

Sampath (2011) on the other hand investigates the effect of real effective exchange rate, wholesale price index and index of industrial production on the stock prices in India. He uses the ADF and Phillip-Perron (PP) approaches to test for unit-roots, but in contrast to this thesis applies an ARDL to analyse co-integration. The author concludes that the real exchange rate, wholesale price index and index of industrial production have a short-term relationship with the stock prices in India. He also finds that economic growth has a long-term relationship with the stock prices (Sampath, 2011).

In relation to this thesis, Talla (2013) and Bodin and Nielsen (2012) explore the relationships between a set of macroeconomic variables and the Swedish OMXS30. Unlike this thesis, Talla (2013) focuses on the different time period from 1993-2012 in his master thesis, and Bodin and Nielsen (2012) investigate the sub-indexes OMX-Industries, OMX-Paper and Wood Materials and OMX- Metal and Mining in their master thesis. More importantly however is that neither Talla (2013) nor Bodin and Nielsen (2012) include foreign stock prices or industrial production, which makes this thesis different. Talla (2013) however concludes that high inflation and Swedish Krona depreciation against the Euro have negative influence on OMX30 (Talla, 2013). Nielsen and Bodin (2012) on the other hand find that the long-term relationships between the selected variables are weak but significant (Bodin & Nielsen, 2012).

3. Data

In this section the economic framework for including the set of macroeconomic variables is briefly introduced. Each macroeconomic variable is then presented with its characteristics.

3.1 Choice of Main Variables

The selection of macroeconomic variables follows the framework of Chen, Roll and Ross (1986), and the approach is a discounted dividend value model (Chen, Roll, & Ross, 1986).

Consider the following simple Present Value Model (PVM):

$$P = \frac{E(c)}{k} \quad (1)$$

Where P is the price of the stock and c is the dividend stream, k is the discount rate. Chen, Roll and Ross (1986) develop equation (1) so that the actual return of a stock at any period can be written as:

$$\frac{dp}{p} + \frac{c}{p} = \frac{d[E(c)]}{E(c)} - \frac{dk}{k} + \frac{c}{p} \quad (2)$$

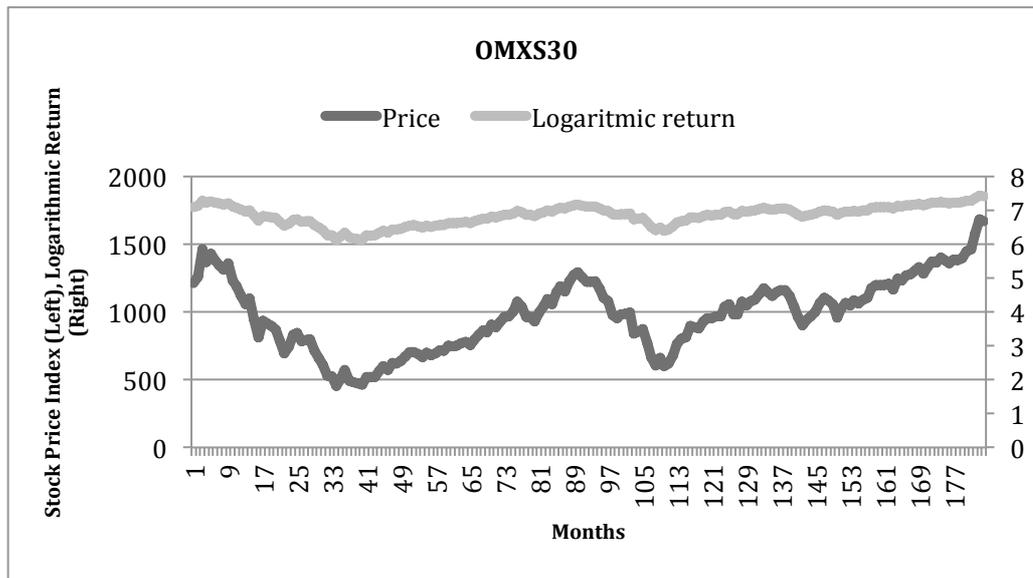
Following equation (2) the forces that influence returns are those that influence the discount rate, k and the expected cash flows, $E(c)$ (Chen, Roll, & Ross, 1986). Stock prices are therefore driven by macroeconomic variables affecting the discount rate and expected cash flows. Equations (2) therefore suggest that all macroeconomic variables that could influence expected dividends – meaning either the discount rate or the expected cash flows also influence stock prices (Chen, Roll, & Ross, 1986). Therefore the following main variables are selected:

3.2 OMXS30

The OMXS30 is a Swedish stock price index covering the 30 most actively traded stocks on the Stockholm Stock Exchange, and it is the leading index of the Stockholm Stock Exchange. We note however the existence of other Swedish stock indexes such as the OMXSPI and OMXS Large Cap (nasdaqomx, 2015). Nevertheless the OMXS30 is a market weighted price index and due to its high level of liquidity the index is used for other financial products such as derivatives, and we hence find it more appropriate to analyse (nasdaqomx, 2015). Since the index also is the most liquid, it is reasonable to assume that information more rapidly is incorporated in the stock prices of the OMXS30 (see chapter 4.1). Based on the characteristics of the OMXS30 and that both Talla (2013) and Bodin and Nielsen (2012) focus on the index when analysing Swedish stock prices, we find OMXS30 suitable for this thesis.

The data over historical prices of the OMXS30 is retrieved from DataStream on month-end observations over closing prices from the 31st of January 2000 to the 30th of April 2015. The data consist of a total of 184 observations, and the natural logarithm is used in all tests and regressions, the variable is called “OMXS30”.

Graph 1: Historic Prices of OMXS30, Real Prices (left) and Logarithmic Scale (right) from 2000-2015.



3.3 SEKEUR

Statistics over Swedish exports show that the EU (28), where among many countries are members of the euro (European commission, 2015), is where most of Swedish goods are exported (SCB, Statistics Sweden, 2015). The exchange rate Swedish Krona to Euro is therefore likely to be of high importance to many Swedish firms. If the exchange rate ratio increases *ceteris paribus*, (depreciation of Swedish Krona) Swedish goods hence become cheaper to import to the euro zone, which is likely to increase Swedish exports. From equation (2) in the section above exports influence the cash flow of firms and hence stock prices. Meanwhile, Swedish firms with costs in Euros benefits from a decline in the SEKEUR (appreciation of Swedish Krona). The variable SEKEUR is interpreted as the number of SEK paid for one EUR.

The data on the SEKEUR is retrieved from DataStream with the origin of WM/Reuters. It is measured as month-end closing prices from the 31st of January 2000 to the 30th of April 2015, resulting in 184 observations. We then transform the data into natural logarithm and the variable is called “SEKEUR” in all regressions and tests.

3.4 SEKUSD

The Exchange rate Swedish Krona to US Dollar is likely to affect stock prices considering many Swedish firms to be exposed to USD through trade. Particularly one reason for that is because the US is Sweden's third largest export partner after Germany and Norway as for 2014 and estimates for 2015 (SCB, Statistics Sweden, 2015). The variable SEKUSD is interpreted as the number of SEK paid for one USD, and an increase in the ratio indicates that the USD has become stronger relative to the SEK and vice versa.

The data is retrieved from DataStream with the source WM/Reuters and is measured on month-end closing prices from the 31st of January 2000 to 30th of April 2015, consisting of 184 observations. We also transform the data on SEKUSD into natural logarithm and the variable is called "SEKUSD" in all regressions and tests.

3.5 DAX30

Following the Efficient Market Hypothesis (see chapter 4.1), stock prices reflect all the available information (Fama, 1970). Europe is Sweden's largest regional destination for exports (SCB, Statistics Sweden, 2015), where Germany is the largest single destination of Swedish exports within Europe as of 2013 (SCB, 2013). The German stock index DAX30 consequently reflects the macroeconomic environment in Germany, and is therefore likely to influence cash flows of Swedish firms and hence stock prices. We also find the composition of the DAX30 suitable to include in this thesis before other German indices, since the index includes the 30 largest firms in Germany (Boerse Frankfurt, 2015), in relation to OMXS30.

The DAX30 prices are retrieved from DataStream and the origin from Deutsche Boerse. The data is measured on month-end closing prices from the 31st of January 2000 to the 30th of April 2015 and contains 184 observations. We further transform the data into natural logarithm and the variable is called "DAX30" in all regressions and tests.

3.6 Dow Jones Industrial Average

The US economy is of interest because the economic link between the US and Sweden should be of significance considering that America is the second largest regional destination for Swedish exports (SCB, Statistics Sweden, 2015), where the US is the country where most Swedish products are exported as of 2013 (SCB, 2013). Also the US economy is as of 2013 the largest in the World and thus plays a leading role in the global economy (World Bank, 2015) and is likely to influence Swedish exports, and therefore stock prices. In relation to the motivation for including the DAX30, the US stock index DJI is also assumed to reflect information on the economic condition in the US. The reason for choosing the DJI is because it consists of the 30 largest and most well known companies (S&P Dow Jones Indices, McGraw Hill Financial, 2015) and we hence find it comparable to the OMXS30 before other US stock indices.

The price of Dow Jones Industrial is retrieved from DataStream with the origin of Dow Jones. It consists of month-end closing prices from the 31st of January to the 30th of April 2015, resulting in 184 observations. Again, we use the natural logarithm and name the variable to “DJI” in all regressions and tests.

3.7 Industrial Production

The variable industrial production is included in a number of papers such as those by Fama and Schwert (1977), Schwert (1990), and Nasseh and Strauss (2000) use industrial production as a proxy for real economic activity in the economy. Industrial production therefore acts as a leading indicator for real economic growth in the economy. Industrial production is hence likely to influence the purchasing power of consumers and investments and thus influence future cash flows of firms.

The data on industrial production is retrieved from DataStream and the source is SCB- Statistics Sweden. The data is measured on monthly basis from the 15th of January 2000 to the 15th of February 2015 since there was no available data at the

time for March and April 2015. The sample hence consists of 182 observations. We transform the data on industrial production into natural logarithm and call the variable “IP” in all regressions and tests.

3.8 Consumer price index

The CPI is used as a proxy variable for inflation in Sweden (Sveriges Riksbank, 2011), and the first macroeconomic intuition to include CPI is that central banks balance the inflation rate by responding with changes in the interest rates. Secondly, changes in prices could in accordance to equation (2) influence cash flows of firms and hence stock prices until they adjust to the price level. In the literature Chen, Roll, and Ross, (1986) and Fama and Schwert (1977) find a negative relationship between inflation and stock prices. In this thesis we do not consider expected and unexpected inflation, but rather use CPI as the measure for inflation following existing literature.

The data on CPI is retrieved from DataStream and the data is provided by SCB-Statistics Sweden. The data is measured on monthly basis from the 15th of January 2000 to the 15th of February 2015 and result in 182 observations, since there was no available data on March and April at the time. The natural logarithm of the CPI is generated and the name of the variable “CPI” in all regressions and tests.

3.9 Swedish 3-month Treasury bill Yield

The authors Fama and Schwert, (1977) use short-term interest rates in their model when estimating the long-term influence with stock prices. The economic interpretation of the influence of TB (Swedish 3-month Treasury bill Yield) on stock prices is that it can affect the discount rates and therefore stock prices accordingly to equation (2).

The data on TB is retrieved from DataStream with origin from Sweden’s Riksbank. The data is measured on monthly basis from the 15th of January 2000 to the 15th of April 2015. We take the natural logarithm that we use through all tests in this thesis. However when we take the natural logarithm, two observations are lost because the 3-

month Treasury bill yield is negative for the 15th of February and March, resulting in 181 observations. The variable is named “TB” in all regressions and tests.

3.10 Swedish 10-year Government Bond Yield

The effects of the long-term interest rate are also explored in the literature by authors such as Nasseh and Strauss (2000), Kurihara (2006) and Campbell and Ammer (1993). We use BOND (Swedish 10-year Government bond yield) because domestic 10-year Government bond yield is used in the literature by Humpe and MacMillan (2008) for instance as the measure for long-term interest rate. We further include BOND because we assume it affects companies’ long-term borrowing costs and therefore dividends.

The data on Swedish 10-year Government bond yield is retrieved from DataStream with origin from Sweden’s Riksbank. The data is measured on monthly basis from the 15th of January 2000 to the 15th of April 2015 and consists of 183 observations. The data is converted into natural logarithm, which is used in all tests. We name the variable “BOND” in all regressions and tests.

Table 1: *Table over Main Variables.*

Variable	Description
OMXS30	Natural logarithm of the Swedish OMXS30 index on month-end closing prices.
BOND	Natural logarithm of the Swedish 10-year Government Bond yield measured on month end basis, resulting in observation from the 15 th each month.
CPI	Natural logarithm of consumer price index on month-end basis, resulting in observations from the 15 th each month. The data is measured as economics actual values.
DAX30	Natural logarithm of the DAX30 measured on month-end closing prices.
DJI	Natural logarithm of Dow Jones Industrial Average with month-end closing prices.
IP	Natural logarithm of industrial production on monthly- end basis, resulting in observations from the 15 th each month. The data is measured as actual values.
SEKEUR	Natural logarithm of the exchange rate Swedish Krona to Euro. The data is measured on month-end closing prices.
SEKUSD	Natural logarithm of the exchange rate Swedish Krona to USD. The data is measured on month-end closing prices.
TB	Natural logarithm of the Swedish 3-month Treasury Bill yield on month-end basis, resulting in observations from the 15 th each month.

3.11 Exclusion of Variables

The research of this thesis focuses on the single index OMXS30 and the selected set of macroeconomic mentioned above. Other potential variables that could influence stock prices have hence been excluded from this thesis since the main focus is the influence of international macroeconomic variables. However, the specific variable M1, which is included in the analysis on Sweden in the literature, has been excluded from this thesis. Even if M1 according to equation (2) can influence stock prices, we assume the effects will show up in TB. Also Oil prices is commonly analysed in the literature (see Gan, Lee, Yong, and Zhang, (2006)) but also excluded from this thesis. However we assume that the influence from oil prices show up in IP, since oil prices are likely to primarily influence industrial companies. We have therefore also excluded oil prices form the analysis. Finally, the variable GDP is used by Gan, Lee, Yong and Zhang (2006), but we follow the approach by Nasseh and Strauss (2000) and use IP as a measure for real economic growth. GDP is hence excluded from this thesis.

4. Critique and Limitations of Thesis

This thesis is based on historical observations and thus ex-post information in line with the literature as Chen, Roll and Ross (1986), Nasseh and Strauss (2000) and Maysami, Howe and Hamzah (2004) use the same approach. There is also another possible approach, which is to apply real time data rather that ex-post data. Orphanides (1997) examines the magnitude of the information problems using the Taylor rule. From reconstructing a data set on quarterly basis with the information available he finds that the real-time policy recommendations differ from those with ex-post data (Orphanides, 1997). The same might apply to this field of subject as well since in line with EMH, investors make investment decisions based on all currently available information. However, in order to be consistent with the literature we will disregard the potential problems with real-time data.

Also potential sources that could influence the results of this thesis relate to the use of the Johansen co-integration test. Since the test is built on a Vector Error Correction Model (VECM), that is transformed from a VAR (Sjö, 2008), it is sensitive to the number of lags. We use the Schwarz criterion in order to determine the lag length (see chapter 4.2), but there are also other methods that can be applied in order to determine the lag length. Another feature of the data to consider is that the time period 2000-2015 contains volatile stock prices (see graph 1 in chapter 3.2) such as the Dot-com crash starting in year 2000 (Geier, 2015) and the Subprime crisis of 2008 (Swift, 2011). After 2008 we see results from policies in terms of low yields, low inflation rates and volatile stock prices (see graph 3, 4 & 5 in appendix), whereas other studies might not have data including such events.

5. Methodology

In this section the methodology and the procedures of the tests are presented chronologically. The results of all tests are however presented and commented on throughout chapter 5 with appurtenant tables and graphs.

5.1 Efficient Market Hypothesis

The framework of this thesis is influenced by the Efficient Market Hypothesis (EMH), developed by Fama (1970). The EMH suggests that the prices of stocks at any time reflect all available information, and the investor can therefore not achieve any excessive return without taking on the proportional risk in an efficient market (Fama, 1970). Fama (1970) further distinguishes three forms in the hypothesis of efficiency;

- Weak form: the weak efficiency form states a condition where historical data is the available information. In weak form efficiency historical prices hence cannot be used in order to predict stock prices.

- Semi-strong form: prices adjust to all public information, thus public information is not useful in predicting stock returns in semi-strong efficiency, since all information available is incorporated directly in the pricing.
- Strong form: the strong form efficiency states a condition where insiders will not have an advantage in terms of insider information. Hence the insider info is already known and reflected in the price of the stocks (Fama, 1970).

Since Fama (1990) finds that the semi-efficient form supports the EMH this thesis takes on the semi-efficient form, which is also in line with Talla (2013). We therefore assume that the stock prices incorporate all available information at any time from the selected macroeconomic variables.

5.2 Unit-roots and Stationary Data

Further the data on the selected macroeconomic variables are downloaded from DataStream covering the time period 2000-2015. The specific time period is selected because studies on the relationship between macroeconomic variables and the OMXS30 do not cover the specific time period as mentioned (see chapter 2). The period is also interesting in the sense that it covers two severe financial crises (see graph 1 in chapter 3.2), and is near present. We hence believe this thesis will be appealing to investors and its readers. The observations are on month-end closing prices/values since measurements on variables such as CPI and IP are published once a month. To be consistent, monthly observations are used on all variables even though daily data is available on most variables. In order to make the data as comparable metrics the data on all variables are converted into natural logarithms (see section 3 on data).

The data is tested for unit-roots because it is of interest to determine if the data is stationary, meaning that it has a constant mean, constant variance and constant covariance (Ruppert, 2011, s. 202). Likewise, if the conditions are not fulfilled the data series is considered to be non-stationary, which often is characterised by the data following a trend over time. We test for unit-roots because non-stationary and stationary data is treated differently since a shock in a stationary process eventually

fades away, but that is not the case in a non-stationary process. Running a regression on non-stationary data can hence cause spurious regressions. It means that two variables that both are trending over time but are generated independently still “looks to be related” when regressed using standard measures such as R^2 . The regression thus looks like a good estimate to us, but is in reality incorrect (Brooks, 2014, p. 354).

In order to test for unit-roots we use the ADF test because it is according to Sjö (2008) viewed as the best method for testing for unit-roots. In the literature we find the ADF test to be a common unit-root test as Kurihara (2006), Humpe and Macmillan (2007) and Maysami, Howe and Hamzah, (2004) among others use this approach.

The test has the following nullhypothesis of a unit root:

$$H_0: \rho = 1: \text{Unit root.} \quad (4)$$

$$H_1: \rho < 1: \text{No unit root.} \quad (5)$$

When performing the ADF tests we follow the approach by Maysami, Howe and Hamzah (2004) and select the Akaike Information Criteria (AIC), which is an information criterion (Brooks, 2014, p. 275), in order to determine the ultimate number of lags. If we can accept the null hypothesis of a unit-root when the data is in levels, and then reject the null hypothesis when the data is in first difference, then the level of integration is $I(1)$. We can then test for co-integration, since our variables thus are stationary in first difference (Sjö, 2008). Once the ADF tests are run on each variable in levels, another ADF test is run in first difference to verify stationary variables in first difference. However the PP test, which is another unit-root test, is also applied in the case with CPI because the decision of $I(1)$ cannot be made from the ADF alone (see section 5.1).

5.3 Co-integration and Long-term Relationships

We apply the statistical framework of co-integration as mentioned to explore if there are any long-term relationships between the set of macroeconomic variables and the OMXS30. In the literature, testing for co-integration is common when analysing time-

series data and authors such as Nasseh and Strauss (2000), Maysami, Howe and Hamzah (2004) and Hussain et al. (2012) use the methodology. Co-integration is defined both by Sjö (2008) and Brooks (2014, p. 682) as “ a concept whereby time series have a fixed relationship in the long run”. Hence if we find co-integration, long-term relationships exists, which make the approach suitable for this thesis.

First, to test for co-integration we apply the Johansen test because it is more powerful than corresponding tests according to Nasseh and Strauss (2000). In the literature, authors such as Humpe and MacMillan (2008) and Hussain et al (2012), among others also perform the Johansen test. The test is based on a VAR transformed into a Vector Error Correction Model (VECM) (Sjö, 2008) (see equation 9 below for simple illustration), and therefore dependent on the selection of lags as previously mentioned. Here we generate a VAR and apply the lag order selection criteria (see table 6 in appendix) and analyse the characteristics from the VAR with different numbers of lags. By comparing the Schwarz criterion, which is an information criterion (Brooks, 2014, s. 275) we determine the number of lags. Here we choose the ultimate number of lags from the lag selection that has the lowest Schwarz value, and find that the ultimate lag is one (see table 6 in appendix). To test the robustness of the VAR we also make a correlogram on the residuals to test for autocorrelations. The p-values are larger than 0.05 on all lags, and in accordance to Brooks (2014, p. 276-277) we do not reject the null hypothesis of no autocorrelation. We are therefore ensured there is no autocorrelation and that both the VAR and the number of lags are robust (see table 7 in appendix). We then perform the Johansen test on the set of variables, the Schwarz criterion is selected and the number of lags is set to one in the settings.

Secondly, from the results of the Johansen test we are then able on statistical grounds to determine the number of linear combinations that are stationary. These linear combinations are also called “ranks”, meaning how many co-integrated equations exist. One can determine the number of ranks from two tests, the trace-test and the max-eigenvalue, which are both presented in the Johansen test. Sjö (2008) stresses that the trace-test is more robust, and we therefore select the number of ranks based on the trace-test.

Third, we observe the long-term effects in the Johansen test from the normalised coefficients on OMXS30. To give a simplified overview on the methodology on the VECM, consider equation (8) used by Brooks (2014, p. 375), which is a simple error correction model with two variables:

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma * x_{t-1}) + u_t \quad (8)$$

Where γ is the long-term relationship between the variables y and x . β_1 is the short-term relationship between changes in x and changes in y , and β_2 describes the speed of adjustment back to equilibrium. The expression $(y_{t-1} - \gamma * x_{t-1})$ is then the error correction term, provided that y and x are co-integrated (Brooks, 2014, p. 375). In very basic terms, we could say that the normalised coefficients in the Johansen test measures the variable γ , which we in line with Maysami, Howe and Hamzah (2004) interpret as the long-term elasticity measures.

5.4 Causality and Impulse Response

We further want to investigate the causalities between the OMXS30 and the set of macroeconomic variables to understand if, and how they cause each other. In relation to the approach by Kurihara (2006), Gan, Lee, Yong and Zhang (2006), Talla (2013) and Bodin and Nielsen (2012) the Granger Causality technique is applied. Assume variables X and Y . Then the implementation of the test is that variable X is said to granger cause Y if Y can be better predicted using history from both X and Y , than from using the history of Y alone (Granger, 1988). We apply the Granger Causality test and set the number of lags to three based on the assumption that it is unlikely that the causality can be better estimated from one lag than several. We reason that if no causality exist with three lags, it is unlikely that it would exist with only one lag and vice versa. The test is performed pair wise and the null hypothesis of no causality is rejected if the p-value is less than the 5 % significance level, and thus confirming uni or bi-directional causality.

This thesis also investigates the short-term effects of shocks in the macroeconomic variables on OMXS30. Because accordingly to EMH we assume that all available

information constantly affects the stock prices at different times and of different magnitude. In the literature Kurihara (2006), Masduzzaman (2012) and Bodin and Nielsen (2012) among others apply impulse responses. The technique is built on a VAR (Brooks, 2014, p. 336), and here we follow the approach by Kurihara (2006) on the interpretation of the impulse responses. The responses are thus interpreted as tracing the effects in the dependent variable from a shock of one standard deviation in each macroeconomic variable. Since the data is on monthly basis the number of time periods is set to 12 to see the effects during a whole year. We also set the lag length to one in accordance to Schwarz criterion (see chapter 4.4).

6. Empirical Results and Analysis

In this chapter the results are presented in combination with analyses, and an economical interpretation on most of the results.

6.1 Results and Analysis from Unit-root Tests

The results from the ADF tests are presented in table 2 below. Here one can observe the results from both the first ADF tests performed in levels, and the second round of ADF tests performed in first difference.

Table 2: *Augmented Dickey-Fuller test, Period; 2000-2015(Own construction).*

Variable	P-value Levels	P-value first difference	Decision
OMXS30	0.6149	0.0000 **	1(1)
BOND	0.9019	0.0000 **	1(1)
CPI *	0.3724	0.1224	1(1)***
DAX30	0.6727	0.0000 **	1(1)
DJI	0.4980	0.0000 **	1(1)
IP	0.6680	0.0000 **	1(1)
SEKUSD	0.9067	0.0000 **	1(1)
SEKEUR	0.4600	0.0000 **	1(1)
TB	0.0157 *	0.0470 *	1(1)

** Denotes significance at 1 % significance level.

* Denotes significance at 5 % significance level.

*** See test statistic in appendix.

Note however from table 2 that the variable TB does not have a unit-root and is thus stationary in levels, which can be observed from the p-value less than 0.05. All other variables have unit-roots in levels and p-values exceeding the significance level of 5 %. From the second round of ADF tests, which are performed in first difference, the null hypotheses are rejected for all variables except CPI because the p-values are less than 0.05. The variables are therefore stationary in first difference. To verify the characteristics of the variable CPI, a PP test is run in first difference on CPI. The test rejects the null hypothesis with a p-value of 0.000, and the decision is therefore that CPI is stationary in first difference (see table 9 in appendix). Consequently the decision of integration on all variables is $I(1)$, meaning that the variables have unit-roots in levels, but are stationary in first difference. The decision on level of integration is summarized in table 2.

The results of the unit-root tests, except the result from CPI, are consistent with the literature, and authors such as Talla (2013) and Kurihara (2006) find the variables to be $I(1)$. However, the high p-value from the ADF test run on CPI in first difference is not consistent with the literature. Authors such as Maysami, Howe, and Hamzah (2004) find CPI to be stationary in first difference when applying the ADF test. From observing graph 7 in appendix however we find no indication that CPI would be non-stationary in first difference. Hence there is no reasonable economical interpretation of why the ADF test fail to reject the null hypothesis.

6.2 Results and Analysis from Johansen Co-integration test

Results from the Johansen test are presented in the section below. However we present and analyse the coefficients on the foreign and domestic macroeconomic variables separately. The distinction is made in order to highlight the contribution of this thesis.

Table 4 below shows the results from the Johansen test on the number of ranks of co-integration. Note that there are p-values presented for each null hypothesis for each rank. We interpret the results in the table as for each null that is rejected, a co-integrated equation exist and thus a long-term relationship. The test shows that the null hypotheses of “none” and “at most 1” are rejected by both the trace-test and the

max-eigenvalue at a 1 % significance level. The maximum-eigenvalue test also rejects the null of “at most 2” at a 5 % significance level, however we focus on the results from the trace statistic (see chapter 4.3) and conclude that there are two co-integrated equations.

Table 3: *Johansen co-integration test, Lag selection; 1, (Own construction).*

	Trace test		Maximum Eigen
Number of ranks	P-value	Number of ranks	P-value
None **	0,0000	None **	0,0037
At most 1**	0,0028	At most 1**	0,0083
At most 2	0,1096	At most 2*	0,0365
At most 3	0,6486	At most 3	0,5812
At most 4	0,8493	At most 4	0,9497
At most 5	0,8031	At most 5	0,8607
At most 6	0,7912	At most 6	0,8512
At most 7	0,6878	At most 7	0,7306
At most 8	0,3231	At most 8	0,3231

** Denotes significance at 1 % significance level.

* Denotes significance at 5 % significance level.

Table 3 above thus confirms that there are two co-integrated equations as mentioned, however in line with the approach by Hussain et al (2012) we focus on the co-integrated equation that is normalised on OMXS30 because it is more relevant to this thesis. Table 3.1 below shows the coefficients on the co-integrated equation normalised on OMXS30, and in line with Maysami, Howe and Hamzah (2004) we interpret the coefficients as long-term elasticities measures, as mentioned. Note however that from equation (8) in section 4.3, γ is negative, and the effects from the coefficients in table 3.1 therefore have opposite signs.

Table 3.1: *Normalised coefficients on OMXS30, Lag selection 1, (Own Construction).*

OMX30	BOND	CPI	DAX30	DJI	IP	SEKEUR	SEKUSD	TB
1,0000	-1,786675**	-14,10795**	-1,302911**	1,266469*	-7,270651**	12,76256**	-4,220776**	0,688992**
	(0,30612)	(2,58047)	(0,29597)	(0,63949)	(1,13881)	(1,65439)	(0,73959)	(0,10772)
	[5,836518]	[5,4672017]	[4,402172]	[1,980435]	[6,384428]	[7,711982]	[5,408401]	[6,396138]

** Denotes significance at 1 % level, * denotes significance at 5 % level.

Standard errors are presented in () and t-values are presented in [].

In line with Hussain et al (2012) we therefore present a more straightforward interpretation of the coefficients and the influence on OMXS30. We thus adjust the signs of the normalised coefficients in equation (9) below:

$$\begin{aligned}
 OMXS30 = & \beta_0 + 1.786675 * BOND + 14.10795 * CPI + 1.302911 * DAX30 - \\
 & 1.266469 * DJI + 7.270651 * IP - 12.76256 * SEKEUR + 4.220776 * SEKUSD - \\
 & 0.688992 * TB
 \end{aligned}
 \tag{9}$$

Where β_0 is a constant.

Equation (9) verifies positive long-term relationships between BOND, CPI, DAX30, IP, SEKUSD and OMX30. From observing the t-values we find all coefficients to be significant at 1 % significance level. We also find that DJI, SEKEUR and TB have negative long-term relationships with OMXS30. From observing the t-values we see that DJI is significant at a 5 % significance level whereas SEKEUR and TB are both significant at 1%.

Foreign Stock Prices and Exchange Rates

From table 3.1 the relationship between DAX30 and OMXS30 is observed to be positive with the coefficient 1.302911, which is significant at a 1 % level. The result is consistent with the literature since Nasseh and Strauss (2000) find a positive long-term relationship between foreign and domestic stock prices in Europe (Nasseh & Strauss, 2000). Economically our similar result to Nasseh and Strauss (2000) on DAX30 is expected, since Germany is the second leading destination of Swedish exports (SCB, Statistics Sweden, 2015). The positive relationship we observe is also in line with what EMH suggests, because DAX30 then reflects all public information regarding the economic situation in Germany, which indicates the conditions for Swedish exports to Germany. Also Kurihara (2006) find foreign stock prices to have a long-term relationship with domestic stock prices. His analysis however focuses on Japan and US stock prices, but in relation to this thesis he concludes a positive influence from foreign stock prices on domestic stock prices. Our result hence shows

similarities between Sweden, Europe and Japan on the influences from foreign stock prices to domestic stock prices. The evidence might suggest that foreign stock prices of countries, which receives much of domestic exports influence domestic stock prices in the long-term. Evidence from Japan, where most exports are destined for the US (WTO, 2014), supports the hypothesis.

On the other hand, in contrast to what is found in Japan we discover US stocks to have a negative long-term relationship with OMXS30. The coefficient on DJI is -1.266469 , and with the critical value of 1.96 , the t-value of 1.9807 observed is barely significant at the 5% level. Kurihara (2006) finds US stocks to positively influence Japanese stock prices as mentioned, which is contrary to the results we find. Economically the negative long-term relationship between DJI and OMXS30 is less credible based on the t-value observed, and also since EMH then suggests that economic activity in the US has negative influence on Swedish stocks prices. However, the US is not as an important trading partner to Sweden as Germany, which could explain the difference compared to DAX30. Result in table 3.1 might instead be explained by when the Federal Reserve launched the QE programme in the US, which was introduced in in 2009 (The Guardian, 2015). If US stock prices hence rise, investors in Sweden might fear that easy monetary policies in US will end and hence risk slowing down the economy. This somewhat blurry sequence would then accordingly to equation (2) suggest lower expectations on dividends and therefore influence stock prices.

The approach of including international variables in this thesis also includes investigating the influence of exchange rates on OMXS30 as mentioned. In relation to the findings of Talla (2013), table 5 shows a negative and significant long-term relationship between the SEKEUR and OMXS30. The coefficient -12.76256 suggests that stock prices are sensitive to changes in SEKEUR. The result is different from what equation (2) in chapter 4.1 suggests, since the Euro-area is the primary destination for Swedish exports (SCB, Statistics Sweden, 2015). The result is however consistent with the findings by Maysami, Howe and Hamzah (2004) and Hussain et al (2012), and thus in line with evidence from Singapore and Pakistan. Opposite influences are however discovered by Kurihara (2006) and Sampath (2011), which display different effects from exchange rates on domestic stock prices in

Sweden compared to India and Japan. It might therefore be the case that firms in Sweden have much cost in EUR, hence an increase in SEKEUR could lower cash flows in accordance to equation (2). In India and Japan costs might instead be denoted in domestic currency, which could explain the different result.

Results on SEKUSD on the other hand show that the coefficient is positive but barely significant. The coefficient of 4.220776 indicates that a 1 % increase in the exchange rate results in a 4.22 % increase in OMXS30. Here the positive relationship supports the findings of Kurihara (2006) and Sampath (2011), who both find positive relationships between the exchange rate (USD) and stock prices in Japan and India as discussed. On the other hand Hussain et al (2012) find that Pakistani stock prices are negatively influenced by the exchange rate as mentioned. In opposite to the case with SEKEUR, the similarities between Sweden and Japan could instead depend on that firms could have much of their income in USD. Judging from the results, Swedish firms could have much of its costs to subcontractors in EUR, but revenues in SEKUSD.

Domestic Macroeconomic Variables

The long-term positive relationship between BOND and OMXS30 with the coefficient 1,786675 is consistent with the findings of Hussain et al (2012) who focus on the Pakistani stock prices. Our result on the other hand is not consistent with evidence from neither Europe, the US or Japan, as Nasseh and Strauss (2000), and Humpe and MacMillan (2007) both find negative relationships. Campbell (1993), Kurihara (2006) and Masduzzaman (2012) find no significant relationship.

Our result is quite contradictive to the present value model in equation (2) since lower yields (see graphs 3 & 4 in appendix) suggest lower borrowing costs. That would in turn have a positive effect on corporate cash flows. Here our result rather suggests that an increase in BOND could indicate expectations on economic activity. The result hence can be supported by the Fisher equation, which states that nominal interest rates equal real interest rates plus inflation (Crowder & Hoffman, 1996), since investors then might demand a higher yield to compensate for future inflation. EMH then suggests that an increase in BOND could increase stock prices from expectations

on higher dividends. However it does not explain the different effect compared to the US and Japan.

Instead the different result compared to Japan and the US regarding the long-term interest rate might be a result from Quantitative Easing (QE), which was introduced in 2001 in Japan and 2008 in USA (The Guardian, 2015). Purchases of government debt by the central banks is likely to influence stock prices, because equation (2) suggests that artificially low yields lower borrowing costs and hence increases cash flows. On the other hand equation (2) also suggests stock prices in Sweden should be influenced in line with the effects in Japan, US and Europe as mentioned. It is hence instead possible that the difference could come from that investors in Sweden consider fixed income investments safer compared to OMXS30. When yields then are falling it might indicate that liquidity is being moved out from the stock market and instead invested in fixed income securities. Maybe these flows of capital are stronger in the case of Sweden and Pakistan, compared to Japan, US and Europe and therefore have a positive influence.

The strong positive long-term relationship between CPI and the OMXS30 with the coefficient 14.10795 observed in equation (9) has the greatest influence on the OMXS30 among the macroeconomic variable. The outcome is consistent with findings in Europe and Singapore since the papers by Nasseh and Strauss (2000) and Maysami, Howe and Hamzah (2004) find positive long-term relationships between CPI and stock prices. On the other hand our results are not in line with the findings of Fama and Schwert (1977), Chen, Roll and Ross (1986) or Humpe and MacMillan (2007). They, in opposite to this thesis, find negative relationships between CPI and stock prices. The result on CPI is thus different compared to the US. In addition, Talla (2013) finds a negative relationship between CPI and OMXS30, which makes our results deviate from evidence from Sweden as well. Following the approach of Nasseh and Strauss (2000) the positive relationship could suggest price neutrality and that stock prices thus adjust to the inflation rate in Sweden. Another possible explanation to the different influence from CPI could be due to the current level of low inflation (see graph 5 in appendix). A rise from a low inflation level could in accordance to EMH signal economic growth, and hence influence stock prices.

Further we find a positive long-term relationship between IP and OMXS30 in table 3.1 with the coefficient 7.270651, which is significant at 5 %. The result is similar to evidence from the literature and authors such as Schwert (1990), Chen, Roll and Ross (1986), Nasseh and Strauss (2000) and Maysami, Howe and Hamzah (2004) find positive relationships between IP and domestic stock prices. What we find is thus consistent with findings in the US, Europe, Japan, Middle East and in Singapore. The result in table 3.1 is also in line with what equation (2) suggests, since IP indicates higher expected dividends, which influence stock prices. Interpreting the coefficient, a 1 % increase in IP results in a 7.27 % increase in stock prices. From the result we expect data on IP to be of importance for investors when analysing long-term movements of the OMXS30. The influence of IP is also of interest because the strong positive relationship is confirmed several times covering a long period of time (see Schwert (1990)).

Finally the negative long-term relationship between TB and OMXS30 is observed with the coefficient of -0.6889920, which is significant at a 5 % significance level. The negative relationship between TB and stock prices is inconsistent with what Nasseh and Strauss (2008) finds, suggesting a different relationship in Sweden compared to Europe. The result is also inconsistent with the evidence from Hussain et al (2012) and Maysami, Howe and Hamzah (2004). The influence from TB on OMXS30 is hence also different from Pakistan and Singapore. Further, Campbell and Ammer (1993) conclude that the short-term interest rates have no significant influence on stock prices in the US, and Talla (2013) come to the same conclusion in the case of Sweden. Our results are also different compared to evidence from Japan, as Kurihara (2006) finds no significant influence from short-term interest rates on stock prices. Considering equation (2) in chapter 4.1 it is likely that TB to a large extent influences the discount rate and thus stock prices in this thesis. In the case of Europe, Pakistan and Singapore on the other hand, short-term interest rates might instead to a larger extent effect borrowing costs and thus cash flows.

6.3 Results and Analysis from Granger Causality

Table 4 below displays the results from the Granger Causality test, focusing on the causalities between the variables and OMXS30. Arrows indicate the directions of the causalities and that the causality is significance at 5 % level.

By observing the direction of the arrows we find a uni-directional relationship from BOND to OMXS30, a bi-directional causality between OMXS30 and DAX30, a bi-directional causality between DJI and OMXS30 and a uni-directional causality from TB to OMXS30. The interpretation is thus that the movements in BOND and TB can be used to better predict OMXS30. The bi-directional causality between DAX30 and OMXS30 plus the causality between DJI and OMXS30 are interpreted as each variable can be used to predict the other.

Table 4: *Granger Causality, Lag selection; 3, 2000-2015 (Own construction).*

	OMXS30	BOND	CPI	DAX30	DJI	IP	SEKEUR	SEKUSD	TB
OMXS30	NA	←	X	↔	↔	x	x	x	←

Table 4 shows that there exist bi-directional causalities from foreign stock prices to domestic stock prices as mentioned. The results suggest that both the DAX30 and DJI can be used to better predict the movements of OMXS30, which could be important information for investors. The result is in line with evidence from Japan as Kurihara (2006) also find that US stock prices influence domestic stock prices. The causality from foreign stock prices to domestic can be motivated from EMH, and equation (2). Information regarding foreign economic activity hence influences expectations on future dividends through exports, as previously discussed.

The exchange rates SEKEUR and SEKUSD on the other hand, have no causality with OMXS30 and the result is in line with the results of Talla (2013), and thus in line with evidence from Sweden. However the results is different compared to evidence from New Zealand, where Gan, Lee and Yong (2006) conclude that the exchange rate

causes stock prices. Considering the volumes of Swedish exports to both Europe and the US our result is different from what equation (2) suggests. Increased exports due to depreciating exchange rates are anticipated to influence expected dividends and stock prices. However we find no apparent economical suggestion to why the exchange rates are insignificant for Sweden.

On the other hand, we find additional causalities in table 4, which are not consistent with previous evidence for Sweden. First, in opposite to this thesis Talla (2013) find CPI to have causality with OMXS30. Secondly in contrary to Talla (2013) we find BOND and TB to have causalities with OMXS30. The results in table 4 are neither consistent with the findings by Bodin and Nielsen (2012), but on the other hand the causality from TB to OMXS30 is similar to what Gan, Lee and Yong (2006) find for New Zealand. Our results for Sweden could thus imply that the decline in yields observed in graphs 3 and 4 in appendix, affect the discount rate and thus stock prices in accordance to equation (2). The changes in yields thus seem to be more influential on stock prices compared to what is found by Talla (2013) and Bodin and Nielsen (2012). This could suggest that investors in Sweden, in accordance to investors in New Zealand pay much attention to the discount rate.

6.4 Results and Analysis From Impulse Response

The results from the impulse response test can be observed in table 5 and graph 2 below. They show the influence on OMXS30 from a shock in each variable and we can follow the effects over a 12- month period.

Table 5: *Impulse Response, Time periods; 12, 2000-2015 (Own construction).*

Perid	OMXS30	BOND	CPI	DAX30	DJI	IP	SEKEUR	SEKUSD	TB
1	0.053649	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.049320	0.000334	0.001443	-0.006245	0.001534	0.001569	0.000862	-0.001070	0.000814
3	0.050407	-0.004080	0.000536	-0.014525	0.001752	-0.001915	0.006204	-0.000606	0.002913
4	0.050464	-0.009535	-0.001629	-0.020990	0.001624	-0.004208	0.010968	-0.000523	0.004759
5	0.050380	-0.015115	-0.003699	-0.026807	0.001483	-0.007190	0.015505	-0.000580	0.006567
6	0.050240	-0.020329	-0.005821	-0.031855	0.001224	-0.009673	0.019708	-0.000814	0.008147
7	0.050056	-0.024999	-0.007747	-0.036213	0.000964	-0.012020	0.023366	-0.001056	0.009539
8	0.049877	-0.029110	-0.009489	-0.039951	0.000710	-0.014050	0.026598	-0.001319	0.010748
9	0.049711	-0.032683	-0.011019	-0.043151	0.000476	-0.015842	0.029390	-0.001572	0.011793
10	0.049561	-0.035769	-0.012356	-0.045884	0.000264	-0.017390	0.031807	-0.001810	0.012694
11	0.049430	-0.038422	-0.013515	-0.048216	7.60E-05	-0.018730	0.033883	-0.002028	0.013469
12	0.049315	-0.040697	-0.014516	-0.050203	-8.97E-05	-0.019882	0.035666	-0.002224	0.014133

Foreign Stock Prices and Exchange Rates

We see from table 5 above, and graph 2 below that a shock in DAX30 has a relatively large negative effect on the OMXS30, suggesting Swedish stock prices are sensitive to German stock movements over the 12 periods. We also conclude that a shock in the DJI results in an almost insignificant effect on OMXS30, in opposite to DAX30. Kurihara (2006) finds that a shock in US stocks has a positive influence on Japanese stocks, but unlike this thesis he uses daily data and we do therefore not compare the results.

We also see a strong positive influence from a shock in SEKEUR on OMXS30, which is consistent and increasing over the 12 periods. Masuduzzaman (2012) finds that a shock in the exchange rate has a small positive effect on German stock prices, and that UK stock prices at first are influenced negatively, but the response then turns positive. The effect of a shock in the exchange rate is thus found to have a positive influence on stock prices in Europe. Our result on SEKEUR is hence in line with the literature. However we further observe that a shock in SEKUSD is insignificant, but we lack evidence from the literature to make any comparison. In the short-term, a shock in the SEKEUR hence could increase exports and thus stock prices in accordance to equation (2).

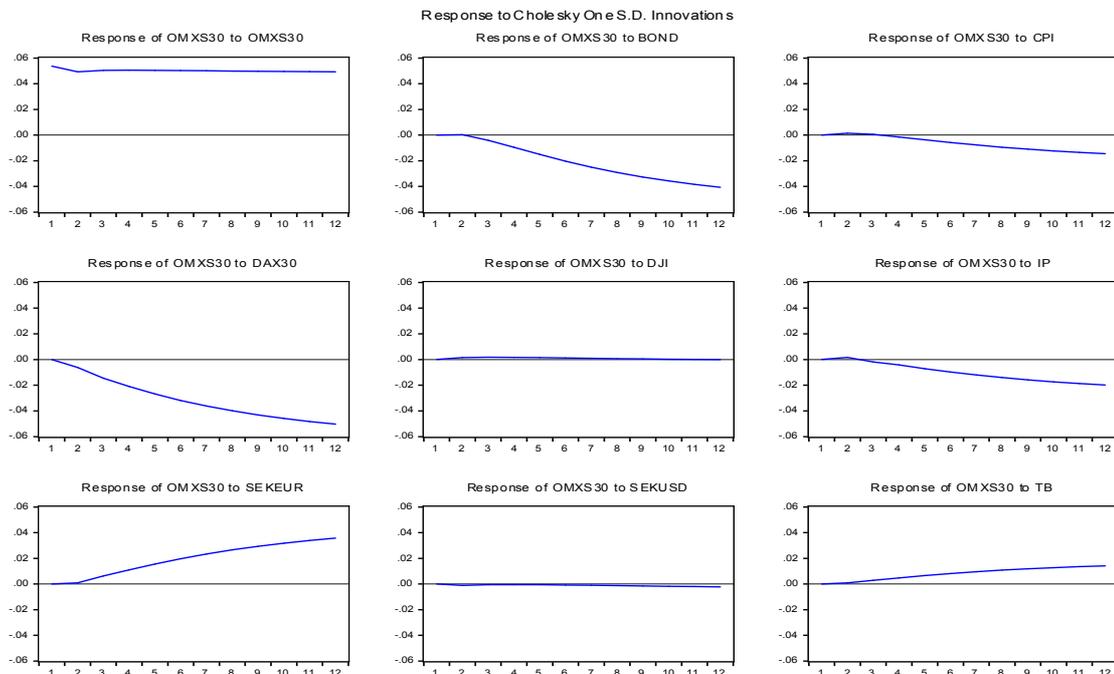
Domestic Macroeconomic Variables

By observing the effects after each period in table 9 and graph 2, we find that the OMXS30 reacts negatively to a shock in BOND. The effect increases over the 12 periods and is continuous. The observation is in line with what Bodin and Nielsen (2012) find in the case for Sweden, however Masuduzzaman (2012) finds no effect on German stock prices from a shock in the long-term interest rate. It might therefore be

the case for Sweden that investors assume increasing borrowing costs in the short run, which lowers expected dividends in accordance to equation (2).

We can further observe the effects of a shock in CPI of one standard deviation and results show it has a negative impact on the OMXS30. The shock influence stock prices after four months and is continues throughout the 12 periods. The effect is consistent with the results from Bodin and Nielsen (2012) and our result is hence in line with what others have found for Sweden. Additionally, Masuduzzaman (2012) finds that German stock prices are affected negatively by a shock in CPI. UK stock prices on the other hand responds with a short positive effect, which however fades away (Masuduzzaman, 2012). Our results on a shock in CPI is thus in line with evidence from both Europe and Sweden. Evidence therefore suggests that in the short-term, Swedish stock prices responds in line with what Fama and Schwert (1990) find for the US. The influence might be explained from that rising inflation could result in higher costs for firms. That would explain a negative influence on stock prices in the short-term, until firms adjust their own prices.

Graph 2: *Impulse Response Test with 1 lag and 2 co-integrated equations, Individual Graphs over effects on OMXS30 from shocks, time period 12 months.*



We also look on how the OMXS30 reacts to a shock in IP. From graph 2 above we see a negative influence, which erupts in period 3, but is then consistent throughout the 12 periods. Masuduzzaman (2012) in opposite finds both German and UK stocks to respond positively to shocks in IP. Our result from a shock in IP is therefore inconsistent with findings in Europe. From EMH and equation (2) we rather expect a positive influence on OMXS30 from a shock in IP. We therefore have no qualified economical suggestion that could explain the opposite effect in Sweden compared to Europe.

From graph 2 above we finally notice a consistent positive effect on OMXS30 from a shock in TB. The result is opposite to what Bodin and Nielsen (2012) find. Masuduzzaman (2012) finds UK stock prices to respond positively to a shock in the short-term interest rate, but the effect fades away. The influence on OMXS30 from a shock in TB thus seems to some extent be consistent with evidence from Europe. Our result could hence suggest a change in how information on short-term interest rates affects stock prices in Sweden, but the result is not in line with what equation (2) suggests. On the other hand, in accordance to EMH, a higher yield in TB might signal expectations on growth and therefore also influence stock prices as previously discussed.

7. Conclusions

In this thesis we have investigated the long-term relationships, causalities and the short-term effects from shocks between the set of macroeconomic variables and the OMXS30.

Most notable the results on the international macroeconomic variables showed to have significant long-term relationships with the OMXS30. The foreign stock prices DAX30 and DJI however show different long-term influences where the DAX30 has a positive long-term influence and DJI a negative influence on OMXS30. We further conclude that the two stock indexes do have causalities with the OMXS30 and can be used in order to better predict the movements of the OMXS30. Further, in the short-term the OMXS30 is positively influenced by shocks in DAX30, while a shock in DJI has no effect. The exchange rates also show different long-term influences on the

OMXS30. The effect from SEKEUR is negative and strongest, while the effect from SEKUSD is positive but barely significant. We can further conclude that there are no causality between the exchange rates and OMXS30, and Swedish stock prices can thus not be better predicted from the exchange rates. In the short-term the OMXS30 respond positive to a shock in SEKEUR that is consistent for a year, while a shock in SEKUSD has no effect.

The results on the domestic macroeconomic variables are also found to all have significant long-term relationships with OMXS30. The results on BOND, CPI and TB are not consistent with previous findings in the case of Sweden but have support from other geographical areas except for TB. The variables BOND and TB have causalities with OMXS30 and can be used to better predict movements in OMXS30. We further conclude that OMXS30 responds positively to shocks in IP and TB while BOND and CPI results in a negative response.

What we therefore conclude from this thesis is that foreign stock prices and exchange rates do influence the OMXS30, both in the long-term and somewhat in the short-term, and foreign stock prices can be used to better predict OMXS30. For investors it can be advised to include information on foreign stock movements and the exchange rates when considering long-term investments. Investors should also consider that the long-term relationships between domestic macroeconomic variables and OMXS30 however have changed to some extent compared to the literature, and that the drivers of the stock market thus might continue changing in the future. In the short-term perspective, DAX30 and SEKEUR are in particular to consider among the international variables, and to also considering IP, CPI, BOND and TB among the domestic.

We suggest future research on the topic of co-integration between macroeconomic variables and stock prices since we find that the relationships seem to change with time. In order to bring further light on the long-term relationships, causality and response to shocks, we think the concept of information bias from real time is an interesting approach in the future. We believe that to investigate these relationships based on real time data instead of ex-post data is likely to influence how we can better understand the behaviour of stock prices and economical connections.

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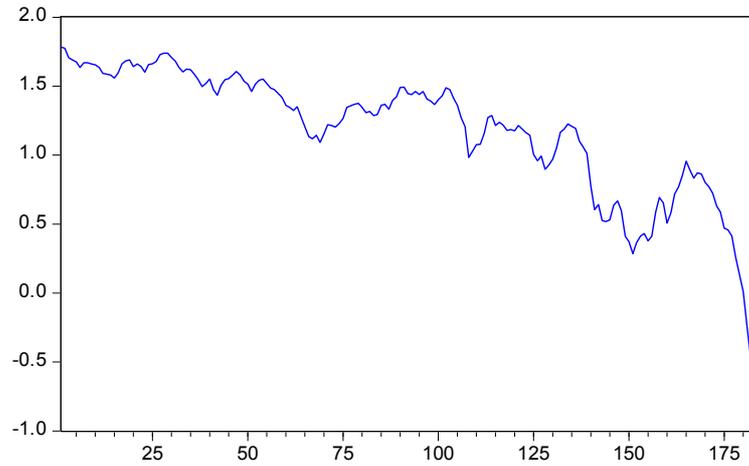
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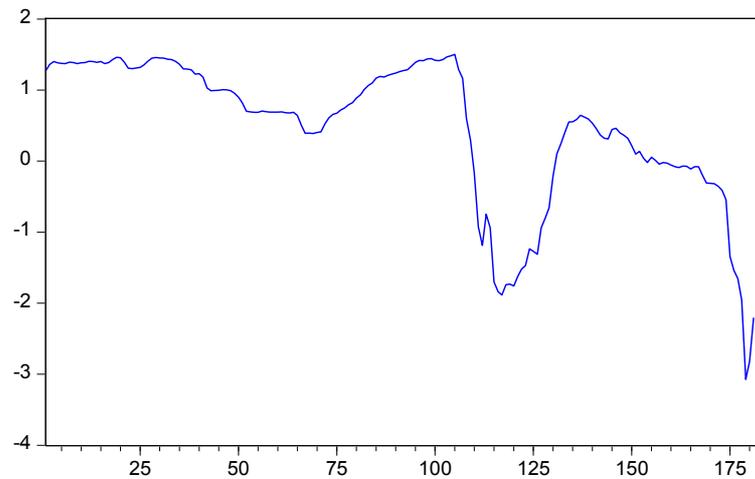
Appendix

Graphs

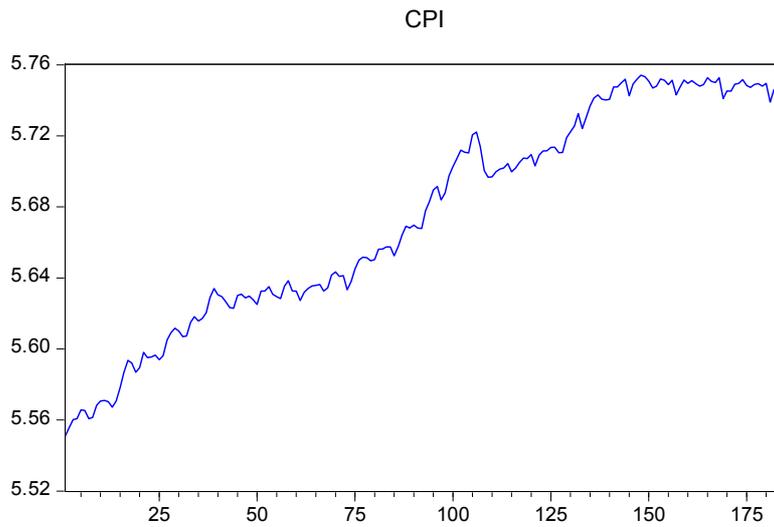
Graph 3: *Swedish 10-Year Government Bond yield, Logarithmic Scale, 2000-2015.*
BOND



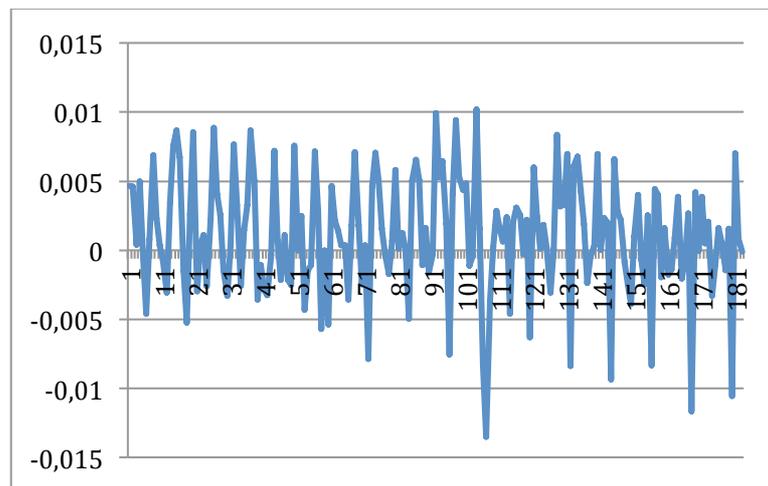
Graph 4: *Swedish 3-Month Treasury bill yield, Logarithmic Scale, 2000-2015.*
TB



Graph 5: Swedish CPI, Logarithmic Scale, 2000-2015.



Graph 6: Swedish CPI, First difference, 2000-2015.



Tables

Table 6: Vector Auto Regression, Lag Order Selection Criteria, 2000-2015, Lags intervals: 12.

VAR Lag Order Selection Criteria
 Endogenous variables: OMXS30 BOND CPI IP DAX30 DJI SEKEUR
 SEKUSD TB
 Exogenous variables: C
 Date: 05/27/15 Time: 08:37
 Sample: 1 184
 Included observations: 169

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1366.414	NA	8.53e-19	-16.06407	-15.89738	-15.99642
1	3290.996	3621.404	2.86e-28	-37.88161	-36.21480*	-37.20519*
2	3374.974	149.0737	2.78e-28	-37.91686	-34.74992	-36.63165
3	3467.788	154.8719	2.47e-28*	-38.05666	-33.38959	-36.16267
4	3528.807	95.31949	3.24e-28	-37.82020	-31.65300	-35.31743
5	3599.838	103.3952	3.88e-28	-37.70223	-30.03490	-34.59068

6	3684.090	113.6653*	4.10e-28	-37.74071	-28.57326	-34.02039
7	3756.204	89.60882	5.22e-28	-37.63555	-26.96797	-33.30644
8	3846.043	102.0655	5.68e-28	-37.74015	-25.57244	-32.80226
9	3934.973	91.56163	6.68e-28	-37.83400	-24.16616	-32.28734
10	4030.063	87.77542	7.96e-28	-38.00075	-22.83278	-31.84530
11	4136.608	87.00123	9.23e-28	-38.30306	-21.63496	-31.53883
12	4258.726	86.71101	1.03e-27	-38.78966*	-20.62143	-31.41665

* indicates lag order selected by the criterion
 LR: sequential modified LR test statistic (each test at 5% level)
 FPE: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

Table 7: Correlogram of Residuals from VAR, 2000-2015, Lags interval; 12.

Date: 05/27/15 Time: 08:51
 Sample: 1 184
 Included observations: 169

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. .	. .	1	-0.035	-0.035	0.2120	0.645
. .	. .	2	0.004	0.003	0.2149	0.898
* .	* .	3	-0.070	-0.070	1.0746	0.783
* .	* .	4	-0.071	-0.076	1.9529	0.744
* .	* .	5	-0.117	-0.124	4.3661	0.498
. .	. .	6	-0.018	-0.034	4.4221	0.620
. .	. .	7	0.065	0.052	5.1695	0.639
. .	. .	8	-0.014	-0.032	5.2025	0.736
. .	. .	9	0.047	0.024	5.6016	0.779
. .	. .	10	-0.034	-0.042	5.8155	0.831
* .	* .	11	-0.159	-0.169	10.455	0.490
* .	* .	12	-0.164	-0.177	15.423	0.219

Table 8: Johansen Co-integration Test, Rank test, Lags interval; 1.

Included observations: 179 after adjustments
 Trend assumption: Linear deterministic trend
 Series: OMXS30 BOND CPI DAX30 DJI IP SEKEUR SEKUSD TB
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.318499	247.6225	197.3709	0.0000
At most 1 *	0.282270	178.9836	159.5297	0.0028
At most 2	0.232996	119.6161	125.6154	0.1096
At most 3	0.143506	72.13405	95.75366	0.6486
At most 4	0.086337	44.40555	69.81889	0.8493
At most 5	0.072213	28.24301	47.85613	0.8031
At most 6	0.047767	14.82647	29.79707	0.7912
At most 7	0.028028	6.065264	15.49471	0.6878
At most 8	0.005441	0.976513	3.841466	0.3231

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.318499	68.63885	58.43354	0.0037
At most 1 *	0.282270	59.36752	52.36261	0.0083
At most 2 *	0.232996	47.48205	46.23142	0.0365
At most 3	0.143506	27.72849	40.07757	0.5812
At most 4	0.086337	16.16254	33.87687	0.9497
At most 5	0.072213	13.41654	27.58434	0.8607
At most 6	0.047767	8.761204	21.13162	0.8512
At most 7	0.028028	5.088751	14.26460	0.7306
At most 8	0.005441	0.976513	3.841466	0.3231

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 9: *Phillip-Perron test on CPI, First difference, 2000-2015.*

Null Hypothesis: D(CPI) has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 95 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-16.95061	0.0000