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Macroeconomic Factors and Stock Returns:

Evidence from the Swedish Stock Market

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Abstract

This study investigates the relationship between stock returns and macroeconomic factors in a small, open economy by utilizing a vector autoregression (VAR) approach on Swedish large-cap, mid-cap, and small-cap data from 2003 to 2019. To determine the relationship between the macroeconomic factors and stock market return, Granger causality tests are run on each of the markets. Consistent with previous studies, the empirical evidence suggests that the Swedish repo rate, inflation rate, and slope of the yield curve significantly impact the stock returns of the OMX 30, OMX mid-cap, and OMX small-cap Swedish stock markets.

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Contents

1 Introduction

There has long been an interest in examining the construction of efficient and reliable predictions of stock market returns. Generally, there is no consensus on which specific factors, if any, could be used to predict stock market returns. As the stock markets tend to reflect the state of the aggregate economy relatively well, some macroeconomic factors are presumably inclined to affect firms' future outcomes. According to Breeden (2005) macroeconomic variables have a particular impact on consummation and investment opportunities, and thus firms output and return. The transmission from which macroeconomic variables may affect stock market returns depends on their respective effects on the economy as a whole; future consumption rates are often tied to unemployment levels, inflation, and GDP (Balvers et al., 1990; Fama, 1981) and monetary changes in money supply and interest rates (Hamburger and Kochin, 1972).

However, as discussed by Fama (1970), an efficient market should already have integrated all publicly available information into the stock prices on the market. Thus, there should be no possibility of finding any causal relationships between the macroeconomic variables and stock market returns. Albeit, this hypothesis does not always hold; for instance, Keim and Stambaugh (1986) shows that there exists several predetermined variables that have predictive power over bond and stock prices in the U.S. Furthermore, Hong et al. (2007) also indicates that there exist significant semi-strong market inefficiencies while investigating the stock market predictability using several industry market portfolios in the U.S.

The literature displays a vast number of studies examining the relationship between macroeconomic variables and stock returns. In combination with the lack of specific macroeconomic variables, variations in data frequency, time horizon, and econometric models are also significant differences between previous studies. Studies on this topic has been examined at both large economies and heavily traded stock exchanges (for instance: Campbell (1987); Ferreira and Santa-Clara (2011); Geske and Roll (1983)), and small markets (for instance: Tsoukalas (2003); Gan et al. (2006); Gjerde and Saettem (1999)) with varying results.

1.1 Purpose

In this paper, we examine the macroeconomic effect on stock market returns in Sweden, as suggested by Gjerde and Saettem (1999), where they discusses potential differences in outcomes between the Norwegian and Swedish markets. An autoregressive vector framework is used to simultaneously determine the relationship between the macroeconomic variables and stock market returns. As for disparities in conclusions around the market size link to market efficiency, we also examine if there is any variation between large-cap, mid-cap and small-cap Swedish stock market returns and the macroeconomic factors: The Swedish *repo rate, inflation rate, exchange rate, the slope of the yield curve* and *unemployment*.

Thus, the purpose of this paper is to examine the following research question:

i *Is there a causal relationship between Swedish stock market returns and macroeconomic variables?*

In examining the causality between the macroeconomic factors and stock market returns, this study tries to provide information for stakeholders in the Swedish stock market. Furthermore, we want to expand the results of previous research and how similar methods, used on the Swedish stock market, may differ from the macroeconomic effect on stock market returns compared to different countries. In addition, we want to fill this information gap since previous studies regarding the Swedish stock market are few, and thus we hope to provide new information about the relationship between macroeconomic variables and stock returns on the Swedish stock market.

1.2 Brief Findings

Our findings suggest slight differences in predictive power depending on each market. Consistent in all markets, the Swedish repo rate is shown to have some predictive power over stock market returns. Furthermore, the inflation rate is shown to affect stock returns, both in the large-cap and mid-cap markets. The slope of the yield curve is also shown to affect the mid- and small-cap markets significantly. When combining all macroeconomic factors, the predictive power is increased substantially, except on the OMX30 at a 1-month lag.

2 Literature Review

In this chapter, relevant literature regarding this study is presented. We start by introducing the efficient market hypothesis to gain a better understanding of how market efficiency could impact the relationship between macroeconomic factors and stock market returns. Secondly, we present previous research concerning each macroeconomic variable and its effect on stock market returns.

2.1 Efficient Market Hypothesis

A market is said to be efficient if the market is following a random walk. In particular, all asset prices on the market should have incorporated all available information that can be profitably exploited. This implies that it should be impossible to out-preform the market on a consistent risk-adjusted basis since all new information on intrinsic values should already be reflected in the asset prices (Fama, 1970).

Fama (1970) categorized market efficiency into three parts: Weak-form efficiency, semi-strong efficiency, and strong efficiency. Consequently, this means that if the market is efficient, it should not be possible to find a causal relationship between stock returns and macroeconomic factors, since this information should already be incorporated in the actual price.

Interestingly, the empirical evidence is not consistent and highly market dependent. Generally, inefficient markets tend to be small, emerging markets, as shown in Worthington and Higgs (2005) when investigating weak-form efficiency in Asian emerging and developed equity markets. Worthington et al. (2003) also provides similar results when investigating weak-form efficiency in four European emerging markets (Czech Republic, Hungary, Poland, and Russia), where only Hungary showed weak-form efficiency. However, market inefficiencies are not only eminent in emerging markets; Hakkio and Rush (1989) suggests significant evidence of inconsistent market efficiency when examining the sterling exchange rate.

Concerning this study, Shaker (2013) suggests that the Swedish stock market exhibits weak-form inefficiencies. Similarly, Östermark (1989) shows using a univariate time series methodology that the majority of the stocks on the Stockholm Stock Exchange are predictable. Furthermore, Frennberg and Hansson (1993) investigates the possibility of a random walk in Swedish stock prices between 1919-1990. They find no evidence of the Swedish stock market following a random walk, and thus no evidence of market efficiency. In contrast, Worthington et al. (2003) shows that the Swedish market exhibits weak-form efficiency.

As new information gets available to the public, the degree of market efficiency determines how fast the information is reflected in the price. Forecasts using lagged values constitute one type of market efficiency; the markets ability to react to shocks constitutes another. The distinction is crucial to distinguish the long-term and short-term effects of macroeconomic factors on stock market returns when discussing new information's impact on stock prices. Bredin et al. (2007) investigates the short-term impact of monetary shocks effect on stock market returns in the UK. They show, using a variance decomposition method, that interest rates shocks yields persistent negative returns in the U.K. stock market. This conclusion is also consistent with the findings from Gregoriou et al. (2009) when investigating the U.K. stock market response to unexpected interest rates changes. A similar effect is also shown by Laeven and Tong (2012) when investigating U.S. monetary shocks' effect on the global stock market. Furthermore, these effects are also prevalent when investigating fiscal shocks effect on stock market returns, as shown by Chatziantoniou et al. (2013) and Afonso and Sousa (2011). Thus, market efficiency gives rise to similar effects of expected changes as unexpected when examining monetary and fiscal effects, as soon as the market absorbs the new information.

The inconsistency in the empirical evidence suggests there might be possibilities of exploiting market inefficiencies, giving notice that the macroeconomic factors may have some predictable relationship with the Swedish stock market returns. Moreover, the inconsistency in the literature regarding small market efficiencies also proposes that there might be coherent differences in the analysis of macroeconomic factors affect on different sized Swedish stock markets.

2.2 Macroeconomic Factors Effect on Stock Returns

Early research often utilized factor models to determine macroeconomic effects on expected stock market returns. For instance, Chen et al. (1986) used a five-factor model, consisting of an industrial production index, default risk premiums, yield curve, and inflation and found evidence that these sources of risk significant affect stock prices.

More recent studies, however, have developed some alternative methods for investigating the relationship; Rapach et al. (2005) uses a predictive regression framework to analyze both in-sample and out-of-sample tests, based on Granger causality, for predictive power. They use data for 12 industrialized countries and finds the interest rate to be the most significant variable when it comes to predictive power in both the in-sample and out-of-sample analysis. They also show that the inflation rate has some predictability power in some of the countries.

Furthermore, autoregressive models have been used to determine the interdependence between various macroeconomic variables and stock returns; Tripathy (2011) uses an autoregressive integrated moving average model (ARIMA) and a Granger causality test to estimate the causal relationship between various macroeconomic variables and stock market returns in India. He concludes that interest rates and exchange rates significantly influence the stock market. Likewise, Gjerde and Saettem (1999) utilizes a multivariate vector autoregressive model approach to investigate Norwegian data. They find evidence that the real interest rate and changes in oil prices affect the stock market.

Most studies discussed above find relatively strong evidence on macroeconomic predictability on stock market returns. However, the empirical evidence is far from unambiguous in the predictability of stock market returns. For example, Durham (2001) shows irregularities in stock market predictability over time when looking at monetary effects, whereas some do not find any predictability at all (Chan et al., 1998). Some studies even suggest that one factor has significant predictability while others find no significance in the same variable; for example, Balvers et al. (1990) and Flannery and Protopapadakis (2002).

2.2.1 Interest Rate

Generally, the empirical evidence suggests that the interest rate is the factor that manifests the most significant effect on stock market returns. Interest rates tend to have a negative relationship with the stock markets returns as increases in the interest rates affect the investment opportunities for firms negatively, as well as eliciting more saving in the economy as a whole, which affect the firms' revenues as discussed by Campbell (1987). In agreement, Ang and Bekaert (2006) also indicated that there exists a negative short term relationship between interest rates and predicted returns. Alam et al. (2009) shows that the interest rate-stock market relationship is consistent in both developed and emerging markets.

2.2.2 Inflation

As discussed by Fama (1981), inflation tends to be negatively correlated with future stock returns. Gupta and Modise (2013) utilizes a predictive regression on the South African stock market and find evidence of the inflation rate showing some out-of-sample predictability. Besides, Chen (2009) also employs a predictive regression framework to establish which macroeconomic factors can be used to predict a recession in the stock market. He concludes that inflation was a good indicator of predicting the stock market. The consistent empirical evidence of a negative relationship between inflation and stock returns is mainly driven from the decrease in purchasing power when the inflation increase; higher prices tend to make profits decline, which affects the firm negatively.

2.2.3 Exchange Rate

From a theoretical point of view, a small exporting country is strongly affected by exchange rate fluctuations, since it has a direct effect on export opportunities. Tsoukalas (2003) investigates the relationship between macroeconomic factors and stock prices in the Cypriot stock market using an autoregressive model and Granger Causality tests to establish the interdependence between stock prices and macroeconomic variables. Based on Cyprus being an export sensitivities country, the study suggests that the exchange rate has a significant impact on stock market prices; since fluctuations in exchange rates affect the composition of firms export opportunities. Likewise, Tripathy (2011) shows similar results when investigating the Indian stock market using Granger Causality tests.

2.2.4 Yield Curve

The yield curve is broadly regarded as one of the leading indicators of predicting future economic activity (e.g. Estrella and Hardouvelis, 1991; Estrella and Mishkin, 1995; Berk, 1998). To that extent, the empirical evidence suggests that the yield curve also tend to have predictive power in the prediction of recessions and recoveries of the economy. Chen (2009) uses a Markov-switching model to identify bull and bear markets in the S&P 500 stock market. From this, he shows, using a predictive regression framework, that yield curve spread shows significant predictive power in determining recessions in the U.S. stock market.

Similar results are also demonstrated by Dueker (1997) when investigating the yield curve's predictive power of recessions in the U.S.

2.2.5 Unemployment

Studies regarding unemployment and stock market returns are not as prevalent as the variables above. However, Boyd et al. (2005) examines the stock market response to news about unemployment. They find that the effect of unemployment news is dependant on the state of the economy; in an expansion, news about increasing unemployment tends to affect stock returns positively. They argue that news about unemployment bears information about expected interest rates, risk premiums on equity, and firm-specific factors, which might affect the casual effect. Although, they do not preclude their findings to being merely an effect of unemployment news.

3 Data and Methodology

We start of this chapter with defining our data set and how the variables are formatted. We also elaborate on our method by presenting Granger causality and vector autoregression and how they are used in this study.

3.1 Data Selection and Variable Formatting

This paper focuses on the Swedish large, mid and small-cap stock markets and investigates its return using the monthly return of each index from 2003 to 2019. The large-cap data is collected through the OMX30 Stockholm index, which consists of the 30 most traded firms on the Stockholm Stock Exchange. The mid-cap data is collected through the OMX Stockholm mid-cap index. Likewise, the small-cap return is collected through the OMX Stockholm small-cap index. The monthly return is defined as the logarithmetic percent change in the closing prices of the respective stock markets:

$$\text{Return}_t = \log\left(\frac{P_t}{P_{t-1}}\right) \cdot 100, \tag{1}$$

where P_t and P_{t-1} are the monthly closing prices at time t and $t-1$ respectively. The times 100, realize the data in percent, rather than decimal values.

The interest rate used in this paper is the Swedish repurchase agreement (repo) rate and is defined as the monthly percent change in the repo rate

$$\text{Repo}_t = (i_t - i_{t-1}) \cdot 100, \tag{2}$$

where i represent the repo rate at time t and $t-1$ respectively. Since the repo rate is already expressed in percent, it is not necessary to consider the relative change.

Moreover, inflation is defined as the logarithmic difference between the price level at time

t and $t-1$:

$$\text{Inf}_t = \log\left(\frac{\pi_t}{\pi_{t-1}}\right) \cdot 100. \tag{3}$$

The price level constitutes the value of the Swedish consumer price index, with the base year 2015.

The exchange rate is proxied by the Riksbank's total competitiveness weight index, which is an effective exchange rate of the Swedish krona, where the weights are based on average aggregated trade flows from 21 countries. The relative exchange rate change could then be written as

$$\text{Xchange}_t = \log\left(\frac{E_t}{E_{t-1}}\right) \cdot 100, \tag{4}$$

where E is the exchange rate value at time t and $t-1$.

The slope of the yield curve is defined as the difference between Swedish government bonds with long, respectively short maturity dates. In this paper, we regard the difference between the ten-year Swedish government bond, B^{10}, and the two-year Swedish government bond, B^2. Hence, the change in the slope of the yield curve is:

$$dY_t = \left((B_t^{10} - B_t^2) - (B_{t-1}^{10} - B_{t-1}^2)\right) \cdot 100. \tag{5}$$

The unemployment is constructed as the first difference between the unemployment at time t and $t-1$:

$$\text{Unemp}_t = (U_t - U_{t-1}) \cdot 100. \tag{6}$$

Table 1 provides descriptive statistics for the return on each of the markets, as well as the macroeconomic variables[1].

[1] Table A.1 in appendix shows the variable description and where all the data is collected from.

Table 1: Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min	Max
OMX30	199	0.600	4.607	-18.466	15.678
OMXMid	199	1.124	5.005	-16.168	21.119
OMXSmall	199	1.064	5.149	-20.608	12.371
Repo	199	-2.010	15.386	-110.53	25
Inf	199	0.096	0.415	-1.352	1.021
Xchange	199	0.0547	1.362	-5.796	4.543
dY	199	-0.317	14.212	-63.43	53.1
Unemp	199	0.502	33.766	-80	110

Note: All values are expressed in percent.

3.2 Granger Causality

Granger causality tests are run to determine if one time series significantly affects the forecast of another time series. As suggested in Granger (1969), for a time series to Granger cause another, the following underlying principles have to hold:

1. The past and present can cause the future, but the future cannot cause the past.
2. The information from the cause is unique and is not observable elsewhere.

Thus, if the prediction of Y is significantly improved using the random variable X and it's lagged values, as compared to only using lagged variables of Y, X is said to be Granger causing Y (Granger, 1969, 1980). To test for Granger causality, Granger (1980) suggests testing the hypothesis.

$$\mathbb{P}(Y_{t+1} \in \mathbb{A} \mid \ell_t) \neq \mathbb{P}(Y_{t+1} \in \mathbb{A} \mid \ell_t - X_t), \tag{7}$$

where $\mathbb{A}$ is a arbitrary non-empty set, ℓ_t is all the available information at time t, and $\ell_t - X_t$ is all the available information excluding the random variable X. If the hypothesis hold, X is said to Granger cause Y.

By using Granger causality, the causal effect of the macroeconomic variables on stock market returns can be determined.

3.3 Vector Autoregressive Model

An autoregressive vector process is a stochastic process that investigates the joint dynamics among multiple time series. Vector autoregressive (VAR) models treat each endogenous variable in the system as a function of lagged values of all endogenous variables (Sims, 1980). That is, each time series has a linear function describing the evolution of its own lagged values, the lagged values of the other endogenous time series, and an error term.

Let $\mathbf{y_t}$ denote a vector with the value of k variables at time t:

$$\mathbf{y_t} = [y_{1,t}\ y_{2,t} \cdots y_{k,t}]' .$$

A p-order vector autoregressive progress could then be expressed as k linear functions with p orders of lagged values:

$$y_{1,t} = \delta_1 + \pi_{1,1} y_{1,t-1} + \pi_{1,2} y_{1,t-2} + \cdots \pi_{1,p} y_{p,t-p} + U_{1,t}$$

$$y_{2,t} = \delta_2 + \pi_{2,1} y_{2,t-1} + \pi_{2,2} y_{2,t-2} + \cdots \pi_{2,p} y_{2,t-p} + U_{2,t}$$

$$\vdots$$

$$y_{k,t} = \delta_k + \pi_{k,1} y_{k,t-1} + \pi_{k,2} y_{k,t-2} + \cdots \pi_{k,p} y_{k,t-p} + U_{k,t},$$

or in a more concise way:

$$\mathbf{y_t} = \boldsymbol{\delta} + \boldsymbol{\pi_1} \mathbf{y}_{t-1} + \boldsymbol{\pi_2} \mathbf{y}_{t-2} + \cdots + \boldsymbol{\pi_p} \mathbf{y}_{t-p} + \mathbf{U_t} = \boldsymbol{\delta} + \sum_{i=1}^{p} \boldsymbol{\pi_i} \mathbf{y}_{t-i} + \mathbf{U_t}. \tag{8}$$

The term $\boldsymbol{\delta}$ is an $(k \times 1)$ vector of constants - or intercepts - $\boldsymbol{\pi}$ is a time invariant $(k \times k)$-matrix of unknown coefficients and $\boldsymbol{U_t}$ is an $(k \times 1)$ vector of error terms, with white noise properties (zero mean and no serial correlation in error terms).

The estimation of the VAR model is performed by ordinary least squares (OLS) on each equation simultaneously. Since only lagged values of the endogenous variables appear as regressors, the estimates are consistent. Moreover, the estimates are also efficient since all regressors have identical equations (Hamilton, 1994).

By utilizing a VAR framework in combination with Granger causality it lets us investigate, not only the casual relationship, but also if the macroeconomic factors has a positive or a negative effect on stock returns.

3.4 Model Diagnostics

3.4.1 Stationrity

Wooldridge (2016) describes a stationary process as a process whose unconditional joint probability does not change over time; more specific, the mean and variance are constant across time, and the covariance only depends on the distance across time, not the time itself. Thus, the VAR is said to be covariance stationary if it has finite and time-invariant first and second-order moments. The variables are formatted as first-differences as well as logarithmic transformations to preclude stationarity in the time series. An augmented Dickey-Fuller test is used to evaluate if the time series displays stationary properties. The Dickey-Fuller test examines the null hypothesis of the time series having a unit root; if rejected, the test suggests that the series is stationary. Table A.1, in the appendix, shows the results from the Dickey-Fuller test, in which all variables are considered stationary.

3.4.2 Lag Specification

The lag selection criteria is fundamental for the specification of the VAR model. An insufficient number of lags will lead to misspecification of the model; in particular, problems with multicollinearity and autocorrelation in residuals. In this paper, we use both the Akaike Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (SBIC) to determine the lag length selection.

As discussed by Shibata (1976), the Akaike Information Criterion compensates relatively well for the problems with bias in the estimators, and overfitting of the model. However, as the AIC tends to choose higher lags, the SBIC is used to reduce the chance of overfitting, as it penalizes higher lags, favoring parsimony, as suggested by Kuha (2004).

Table A.3, A.4, and A.5 show the lag selection order criteria for each of the models. In all the models, the AIC suggests using lag 4, whereas the SBIC suggests a more parsimonious model of 1 lag.

3.4.3 Autocorrelation in residuals

For testing autocorrelation in the residuals, we use the Lagrange Multiplier test, presented in table A.6. The Lagrange Multiplier test examines the null hypothesis of no autocorrelation in residuals at a specific lag p. As shown in table A.6, the test can not be rejected at lag levels 1 and 4 for each of the models, implying no autocorrelation in the residuals.

3.4.4 Normally distributed residuals and Model Stability

As shown in figures 1, 2, and 3, we observe the residuals to be closely normally distributed. However, the Jarque-Bera test for normality rejects the null hypothesis for normally distributed residuals. Although the residuals are not normally distributed, Lumley et al. (2002) and Schmidt and Finan (2018) suggests that, for large samples, the impact of non-normality (e.g., where the number of observations per variable is > 10) often has a minuscule effect on results. For our sample of 199 observations per variable, we thus assume that the normality assumption holds relatively well.

To ensure model stability, we check the eigenvalue stability condition. As shown in figures 4, 5, and 6, all the eigenvalues lie inside the unit circle; thus, the VAR models satisfies the stability condition.

4 Result

In this section, we will present the main result of this study. In addition, the result will be put in proportion to previous research and analyzed to provide plausible explanations for the outcome. First, the result of each variable is presented and discussed. Second, we provide some reflection on our result, in particular, what implications can be drawn from the study and what our result tells us about market efficiency.

4.1 Granger Causality Tests

To determine the macroeconomic effects on the stock market returns, Granger causality tests are run on each market. Table 2, below, shows the Granger causality test. The first panel displays the result for the OMX30 when excluding each of the macroeconomic variables; the second panel shows the Granger causality from the OMX mid-cap; the third panel shows the Granger causality from the OMX small-cap.

The excluded variable is said to Granger cause the stock return if the p-value is less than five percent. Each significant value in the table is highlighted and expressed at its respective significance level.

Table 2: Granger Causality Wald Tests for Macroeconomic Variables

		H_0 : The variables does not Granger cause the stock returns at 1 month lag			H_0 : The variables does not Granger cause the stock returns at 4 month lags		
Equation	Excluded	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2
OMX30	Repo	2.1623	1	0.141	9.8966	4	**0.042***
OMX30	Inf	0.52779	1	0.468	10.024	4	**0.040***
OMX30	Xchange	0.33245	1	0.564	1.8971	4	0.755
OMX30	dY	1.1711	1	0.279	4.6162	4	0.329
OMX30	Unemp	0.1894	1	0.663	6.7823	4	0.148
OMX30	All	4.6933	5	0.454	45.339	20	**0.001*****
OMXMid	Repo	5.8606	1	**0.015***	13.338	4	**0.010****
OMXMid	Inf	2.3098	1	0.129	11.199	4	**0.024***
OMXMid	Xchange	0.83864	1	0.360	1.2471	4	0.870
OMXMid	dY	4.5875	1	**0.032***	11.16	4	**0.025***
OMXMid	Unemp	2.9707	1	0.085	6.1076	4	0.191
OMXMid	All	17.699	5	**0.003****	60.621	20	**0.000*****
OMXSmall	Repo	7.367	1	**0.007****	5.2553	4	0.262
OMXSmall	Inf	1.2132	1	0.271	5.2384	4	0.264
OMXSmall	Xchange	0.43785	1	0.508	2.3232	4	0.677
OMXSmall	dY	7.8459	1	**0.005****	14.431	4	**0.006****
OMXSmall	Unemp	2.619	1	0.106	4.6651	4	0.323
OMXSmall	All	19.062	5	**0.002****	42.719	20	**0.002****

$*p$-value $< 5\%$ $**p$-value $< 1\%$ $***p$-value $< 0.1\%$

Note: All highlighted values is said to Granger cause the stock return at their respective lag

4.2 Repo Rate

Table 2 shows the interest rate to be significant independently of market size since all markets are affected by the interest rate. Although, at lag 1, there is no evidence of Granger causality between the repo rate and the OMX 30 large-cap market. This evidence is also valid for the OMX small-cap market at lag 4.

Consistent with Campbell (1987) and Ang and Bekaert (2006), the evidence, displayed in table A.10, also suggests that there exists a negative relationship between the interest rate and stock market returns; implying that decreases in the market return tend to follow from increases in the interest rate. As shown, in table A.10, the interest rates effect on stock market returns is more significant at higher lags, suggesting some durability in the interest rate effect on stock market returns.

Despite our model not giving any direct implications of the mechanisms behind this relationship, consistent with previous research, changes in the interest rate are strongly linked with consumption and investment (Campbell, 1987; Breeden, 2005; Ang and Bekaert, 2006). Hence, it is reasonable for this relationship to be prevalent and, thus, to be a plausible explanation for this evident relationship.

4.3 Inflation

From table 2, it follows that the inflation is only significant in the OMX large and mid-cap markets at 4 lags, following Gupta and Modise (2013) and Chen (2009). Interestingly, the inflation rate's specific significance in two markets at 4 lags suggests a relatively small overall effect on the markets.

As suggested by Fama (1981) and Gupta and Modise (2013) the inflation rate tends to be negatively correlated with future stock returns. For the mid-cap market, this is true, as indicated by the negative coefficient in table A.10. However, from table A.10, we can also observe that at the large-cap market, the inflation rate has a positive effect on stock market returns.

Contrary to previous research, our results imply compelling differences in the effect of the inflation rate on stock market returns. Our results give no peculiar explanations on the reasons for the inverse inflation relationship between the large and mid-cap markets. However, it could provide some indication that the effect of inflation in a low inflation environment may not have a uniform impact on the stock markets as a whole.

4.4 Exchange Rate

We find no evidence of the exchange rate to have any significant effect on the Swedish stock market, at any lag. Considering Sweden as a small open economy, relevant theories suggest that a weakened currency leads to increases in exports and, thus, a positive effect on the stock market, e.g., as documented by Tsoukalas (2003). However, our empirical evidence gives no support to such a relationship in any of the markets, implying that the market as a whole might not be susceptible to changes in the exchange rate.

Our model does not give the reasons behind this; however, for relevancy, the overall effect of the Riksbank's total competitive exchange rate index might not be as actuatable as some specific exchange rates (e.g., SEK/Dollar, SEK/Euro, etc.). This could explain why our results suggest that the exchange rate does not significantly affect the stock market returns.

4.5 Yield Curve

From table 2 changes in the slope of the yield curve is shown to be significant at both the mid and small-cap market at both 1 and 4 lags. We show that changes in the yield curve will have an overall negative effect on the stock markets, in line with Chen (2009), and Balvers et al. (1990).

From table A.10, it is also clear that the short-run effect is significantly stronger at 1 lag, compared to 4 lags, although the overall effect on changes in the slope of the yield curve is not particularly strong.

Interestingly, there exists a discrepancy between which markets are affected by the slope of the yield curve, as the OMX30 is not affected but both mid-cap and small-cap is affected. As for this result, our model does not indicate why this may be; however, one plausible explanation for this result could be that the term-structure of interest rates - specifically those on bonds - affect the smaller markets more since smaller markets tend to be more sensitive to interest rate risks.

4.6 Unemployment

In contrast to Boyd et al. (2005) we find no evidence on the unemployment rate to Granger cause any of the stock markets at any lags. This result provides interesting information since information about unemployment provides significant indications about the health of the economy. However, no such information is sufficient enough to give any information about futre stock market returns.

4.7 Reflection

4.7.1 Implications

From our result, we observe the Swedish repo rate, inflation rate, and the slope of the yield curve to be the macroeconomic factors affecting stock market returns. In table A.10, we see that both the repo rate and slope of the yield curve is negatively correlated with the stock returns, implying that increases in the repo rate and slope of the yield curve is to be followed by decreases in stock market returns, in all three markets. The inflation effect is not as distinguishable, as it is shown to be negatively affecting the OMX mid-cap and positively affecting the OMX30.

The implications from our study are mainly relevant for either investors or policymakers: Our study provides percipient information to investors trying to procure adequate investment information about future market fluctuations; nonetheless, our result does not affirm any relevant implications about investment strategies. However, each of the significant macroeconomic factors can provide information about market timing positions, as documented by Shen (2003).

Furthermore, the study shows an interesting result since the three significant factors are closely influenced by each other: The repo rate is used to affect the inflation rate, while simultaneously decaying the term structure of interests and thus the yield curve. This provides valuable insights for policymakers about the possible effects of monetary policy on stock markets.

4.7.2 Market Efficiency

Although analyzing market efficiency was not this thesis principal objective, our results may give notice to the analysis of efficiency in the Swedish stock market. Our study proposes that there is some evidence of inefficiency in the Swedish markets. Although not unambiguous, our results are sufficiently in line with previous research about efficiency in the Swedish stock market (Shaker, 2013; Frennberg and Hansson, 1993; Östermark, 1989).

Somewhat consistent with the efficient market hypothesis, our findings suggest that market size does entail differences in predictive power from the macroeconomic factors. As seen in table 2, at 1 month lag in the large-cap market, no variables provide any significant information about the market, as opposed to the significance in the other markets. This insight realizes at least some market efficiency in the short run.

To the extent that our results suggest market inefficiency, the results do not confer any suggestions as to which degree the markets are efficient, implying that changes in the significant variables over time might have less effect on the markets as the information is absorbed.

However, as discussed by Tsoukalas (2003), using a similar approach to determine the macroeconomic effect on stock market returns, our analysis does give some suggestions about market inefficiencies but can not be used as clear evidence for concluding market inefficiency - this in itself has to be examined with a more precise method for that sole purpose.

5 Discussion

5.1 Conclusion

This thesis investigates the relationship between macroeconomic variables and stock market returns using a vector autoregressive model and Granger causality test to determine the causal relationship between the macroeconomic variables. Moreover, we examine if there is any variation in the macroeconomic effect depending on market size.

The empirical findings suggest that the Swedish repo rate, the slope of the yield curve, and the inflation rate have the most overall significant effect on each market. The repo rate is shown to be significant at all markets, except at lag 1 and 4 in the large and small-cap markets, respectively. The inflation rate has the most effect in the large and mid-cap markets at lag 4. The slope of the yield curve is shown not to affect the large-cap market but has a significant impact at lag 1 and 4 in both the mid and small-cap markets. Combined, all variables are shown to significantly Granger cause each market at all lags except in the large-cap at lag 1, where we find no evidence of any of the variables affecting the stock market returns.

5.2 Limitations and Further Research

In this paper, the main focus was on five specific macroeconomic variables, whereas the economy and stock markets face a vast of other effects from different factors - both macroeconomic and firms specific. This gives opportunities to expand our research to the inclusion of other relevant, not only macroeconomic factors to examine if any other significant factors affect stock market returns. Moreover, our analysis was restricted to only using monthly data, which limited the number of factors that could be used. To further expand on our research, one could extend the analysis to a mixed frequency data to obtain more relevant variables. Another limitation was the examined time period, where the data for the small-cap and mid-cap returns hindered us from going even further back in time to see if there were any significant differences in variables affecting the stock market returns - especially before and after the introduction of a floating exchange rate.

There were also a few limitations in our model choice. By using first differences to ensure stationarity, we do that with a trade-off of losing valuable information about the series and hence ignoring possible long-run relationships between the variables. As our result give notice of short-run relationship one could use a vector error correction model (if the variables are cointegrated), not only to account for the information loss but also to examine any long-run casual relationships between the macroeconomic variables and stock market returns.

Furthermore, a similar VAR model could be used to examine the dynamics of other countries in order to gain a more fundamental understanding of the macroeconomic forces. With Gjerde and Saettem (1999) analysis of Norway, similar studies from other small open economies with similar economic potential and social dynamics would be of interest: Denmark, Finland, or Iceland, for example.

Given our result, future research could try to utilize our findings by examining the possibility of beating the OMX market index, by constructing a market timing model concerning the macroeconomic variables.

The result regarding differences in effect on the stock markets from inflation could also provide an exciting future research topic. In particular, the reasons behind these differences.

Another interesting point of view would have been to examine the reverse conditions; if any of the stock markets can causally explain any of the macroeconomic variables. Specifically, this would be of interest considering the persistent negative interest rate, and what this has for implications on structural brakes and the study of a lower bound on the interest rate.

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6 Appendix

Table A.1: Variable Description

Variable	Description	Source
$OMX30_t$	The monthly return on the OMX 30 stock index	Investing.com
$OMXMid_t$	The monthly return on the OMX mid cap stock index	Investing.com
$OMXSmall_t$	The monthly return on the OMX small cap stock index	Investing.com
$Repo_t$	The monthly percentage change in the repo rate	Riksbank
Inf_t	The monthly percentage change in the inflation rate	Statistics Sweden (SCB)
$Xchange_t$	The monthly percentage change in the exchange (TWC) rate	Riksbank
dY_t	The monthly percentage change in the slope of the yield curve	Riksbank
$Unemp_t$	The monthly percentage change in the unemployment rate	Statistics Sweden (SCB)

Table A.2: Dickey-Fuller Test For Unit Root

		Interpolated Dickey-Fuller		
	Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
OMX30	-13.727	-3.477	-2.883	-2.573
OMXMid	-11.991	-3.477	-2.883	-2.573
OMXSmall	-10.291	-3.477	-2.883	-2.573
Repo	-6.578	-3.477	-2.883	-2.573
Inf	-15.173	-3.477	-2.883	-2.573
Xchange	-10.775	-3.477	-2.883	-2.573
dY	-10.135	-3.477	-2.883	-2.573
Unemp	-21.804	-3.477	-2.883	-2.573

MacKinnon approximate p-value for $Z(t) = 0.0000$

Note: All variables are stationary since all reject the null hypothesis of having a unit root.

Table A.3: Selection Order Criteria for VAR on OMX 30

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-3434.85				2.6e+08	36.4111	36.4528	36.514
1	-3319.44	230.81	36	0.000	1.1e+08	35.5708	35.8626*	**36.2912***
2	-3269.13	100.62	36	0.000	9.7e+07	35.4193	35.9613	36.7572
3	-3231.39	75.48	36	0.000	9.6e+07	35.4009	36.1931	37.3563
4	-3181.76	99.25	36	0.000	8.3e+07*	**35.2567***	36.2991	37.8296
5	-3153.61	56.299	36	0.017	9.1e+07	35.3398	36.6323	38.5301
6	-3120.59	66.053	36	0.002	9.6e+07	35.3713	36.9139	39.1791
7	-3085.34	70.487	36	0.001	9.8e+07	35.3793	37.1721	39.8045
8	-3037.91	94.876*	36	0.000	8.9e+07	35.2583	37.3012	40.301
9	-3023.01	29.783	36	0.758	1.1e+08	35.4816	37.7747	41.1418
10	-3007.42	31.19	36	0.697	1.5e+08	35.6976	38.2408	41.9752

Endogenous: OMS30 Repo Inf Xchange dY Unemp

Exogenous: _cons

Note: The highlighted values are the ones used in the VAR model

Table A.4: Selection Order Criteria for VAR on OMXMid

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-3448.49				3.0e+08	36.5554	36.5971	36.6583
1	-3327.28	242.41	36	0.000	1.2e+08	35.6538	35.9456*	**36.3742***
2	-3279.59	95.386	36	0.000	1.1e+08	35.53	36.072	36.8679
3	-3246.97	65.24	36	0.002	1.1e+08	35.5658	36.358	37.5212
4	-3196.18	101.58	36	0.000	9.7e+07*	**35.4093***	36.4516	37.9821
5	-3172	48.357	36	0.082	1.1e+08	35.5344	36.8268	38.7247
6	-3138.5	66.993	36	0.001	1.2e+08	35.5609	37.1035	39.3686
7	-3104.45	68.107	36	0.001	1.2e+08	35.5815	37.3742	40.0067
8	-3058.29	92.324*	36	0.000	1.1e+08	35.4739	37.5169	40.5167
9	-3044.02	28.529	36	0.808	1.4e+08	35.7039	37.997	41.3641
10	-3023.44	41.166	36	0.255	1.8e+08	35.8671	38.4103	42.1448

Endogenous: OMSMid Repo Inf Xchange dY Unemp

Exogenous: _cons

Note: The highlighted values are the ones used in the VAR model

Table A.5: Selection Order Criteria for VAR on OMXSmall

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-3451.2				3.0e+08	36.5842	36.6258	36.6871
1	-3324.91	252.58	36	0.000	1.2e+08	35.6287	35.9206*	**36.3491***
2	-3278.72	92.392	36	0.000	1.1e+08	35.5208	36.0628	36.8587
3	-3246.72	64.002	36	0.003	1.1e+08	35.5631	36.3553	37.5185
4	-3203.28	86.875	36	0.000	9.7e+07*	**35.4844***	36.5267	38.0572
5	-3180.3	45.953	36	0.124	1.1e+08	35.6222	36.9147	38.8125
6	-3147.93	64.749	36	0.002	1.2e+08	35.6606	37.2032	39.4684
7	-3112.27	71.318	36	0.000	1.2e+08	35.6642	37.457	40.0895
8	-3068.64	87.25*	36	0.000	1.1e+08	35.5835	37.6265	40.6263
9	-3049.11	39.06	36	0.334	1.4e+08	35.7578	38.0509	41.418
10	-3032.07	34.097	36	0.559	1.8e+08	35.9584	38.5016	42.236

Endogenous: OMXSmall Repo Inf Xchange dY Unemp

Exogenous: _cons

Note: The highlighted values are the ones used in the VAR model

Table A.6: Lagrange Multiplier test

H_0 : No Residual Autocorrelation at Lag Order p

	OMX30			OMXMid			OMXSmall		
Lag	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2
1	61.7479	36	0.58010	53.2631	36	0.07188	52.1460	36	0.39937
2	48.3776	36	0.08146	52.2989	36	0.09873	37.8555	36	0.38462
3	47.1041	36	0.10188	59.0547	36	0.00905	51.1312	36	0.04873
4	56.8862	36	0.10475	63.9967	36	0.06747	60.6445	36	0.62594

Note: The tests are conducted on each of the VAR regressions at lag 1 and 4.

Table A.7: Jarque-Bera test for OMX30

H_0 : Residuals are Normally Distributed

	At lag order 1			At lag order 4		
Equation	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2
OMX30	44.839	2	0.00000	24.165	2	0.00001
Repo	119.076	2	0.00000	91.227	2	0.00000
Inf	10.606	2	0.00498	13.526	2	0.00116
Xchange	8.860	2	0.01191	0.747	2	0.68822
dY	106.059	2	0.00000	21.618	2	0.00002
Unemp	0.617	2	0.73470	2.055	2	0.35795
All	290.057	12	0.00000	153.338	12	0.00000

Note: The tests are conducted on each of the OMX30 VAR regressions at lag 1 and 4

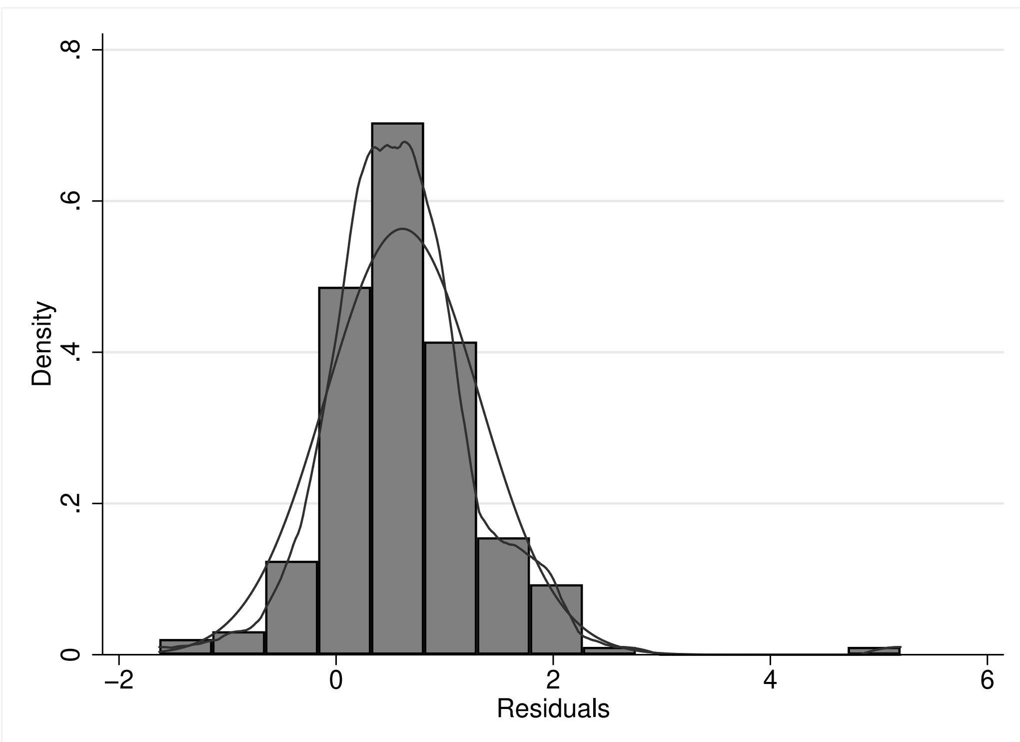

Figure 1: Residual Normality from OMX30 VAR

Table A.8: Jarque-Bera test for OMXMid

H_0 : Residuals are Normally Distributed

	At lag order 1			At lag order 4		
Equation	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2
OMXMId	5.184	2	0.07489	0.866	2	0.64847
Repo	102.765	2	0.00000	92.820	2	0.00000
Inf	11.613	2	0.00301	19.759	2	0.00005
Xchange	11.470	2	0.00323	1.674	2	0.43309
dY	112.884	2	0.00000	19.737	2	0.00005
Unemp	0.376	2	0.82857	1.108	2	0.57473
All	244.292	12	0.00000	135.963	12	0.00000

Note: The tests are conducted on each of the OMXMid VAR regressions at lag 1 and 4

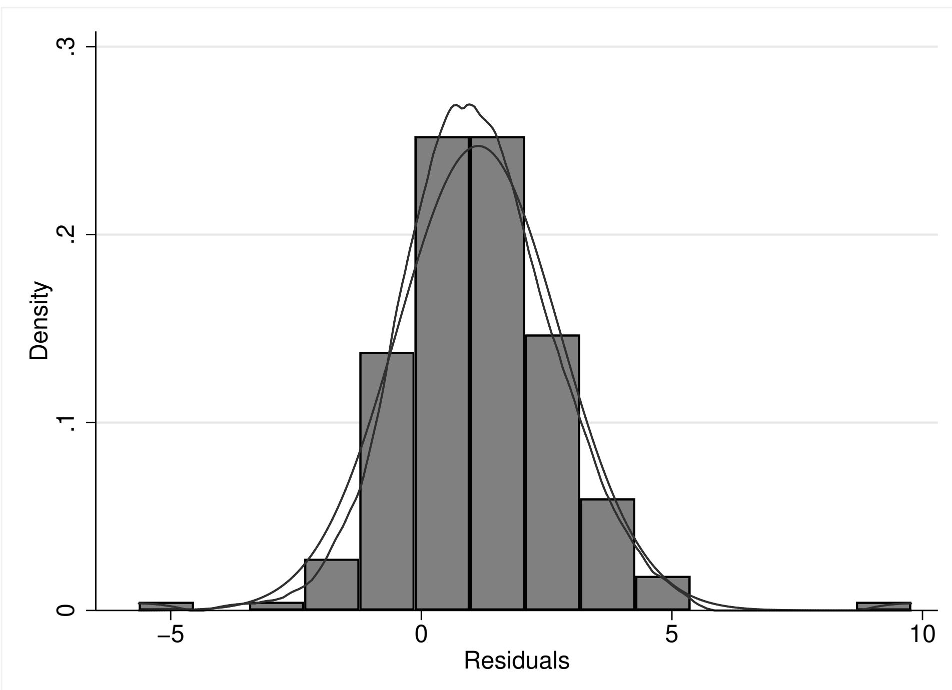

Figure 2: Residual Normality from OMXMid VAR

Table A.9: Jarque-Bera test for OMXSmall

H_0 : Residuals are Normally Distributed						
	At lag order 1			At lag order 4		
Equation	Chi2	df	Prob > Chi2	Chi2	df	Prob > Chi2
OMXSmall	0.674	2	0.71392	1.312	2	0.51892
Repo	104.256	2	0.00000	73.949	2	0.00000
Inf	9.889	2	0.00712	15.981	2	0.00034
Xchange	17.462	2	0.00016	0.720	2	0.69773
dY	117.819	2	0.00000	31.126	2	0.00000
Unemp	0.422	2	0.80982	2.814	2	0.24486
All	250.521	12	0.00000	125.902	12	0.00000

Note: The tests are conducted on each of the OMXSmall VAR regressions at lag 1 and 4

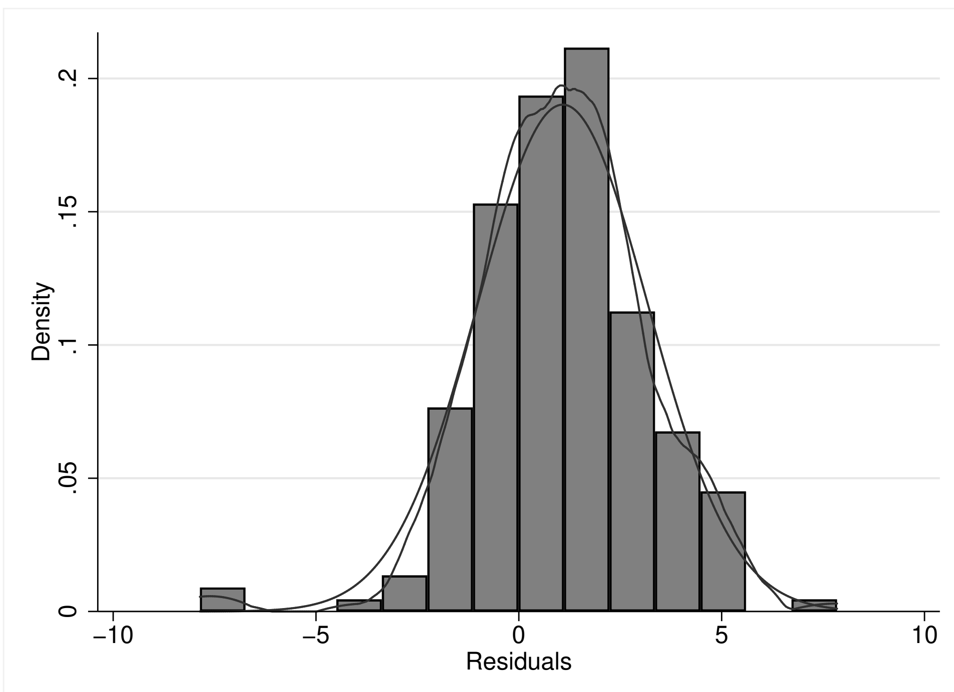

Figure 3: Residual Normality from OMXSmall VAR

Model Stability

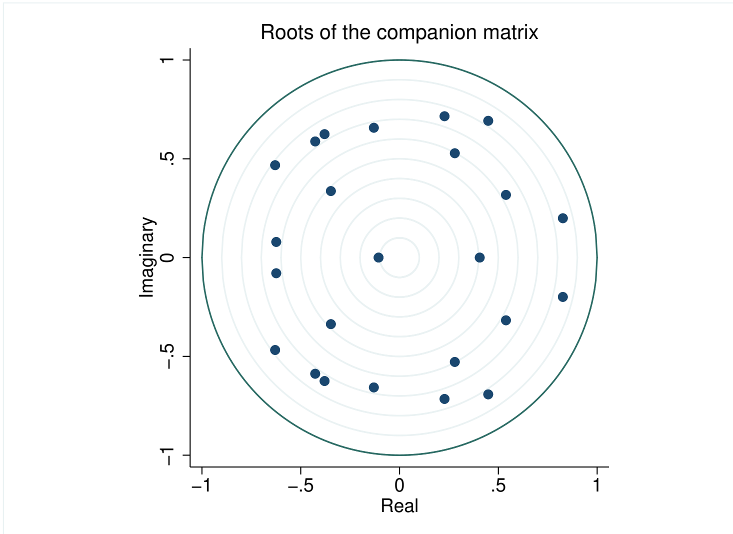

Figure 4: Model Stability of the OMX30 VAR

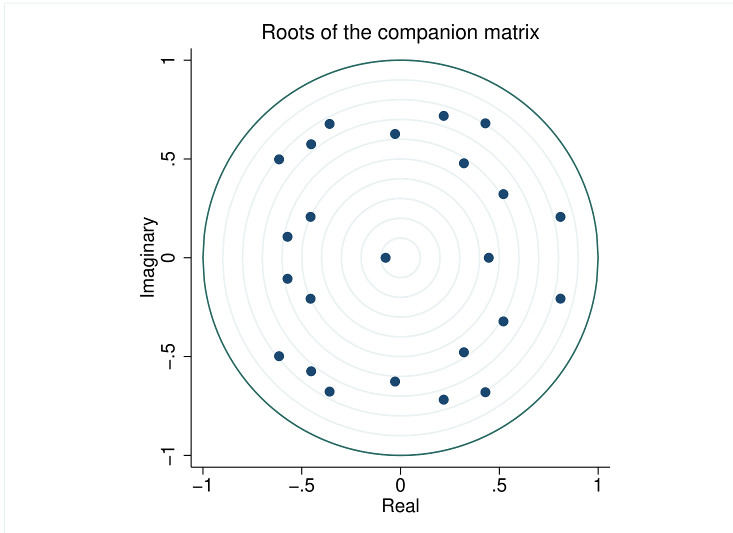

Figure 5: Model Stability of the OMXMid VAR

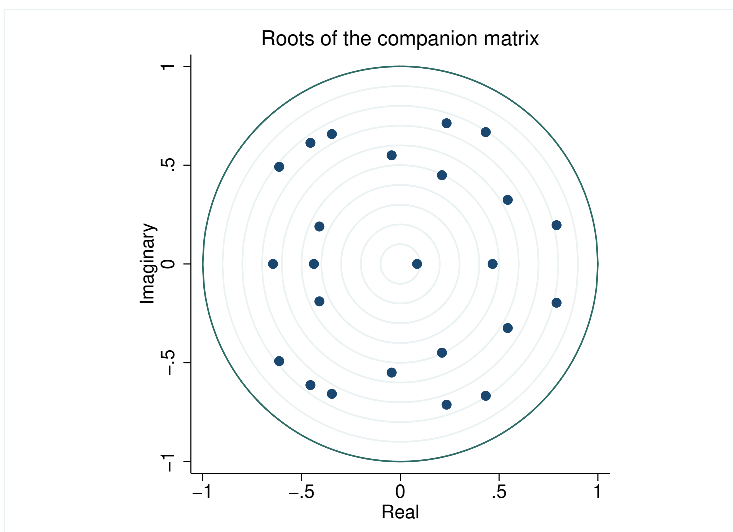

Figure 6: Model Stability of the OMXSmall VAR

Table A.10: VAR Output for Each Equation

Equation	(1) OMX30	(2) OMXMid	(3) OMXSmall
Repo			
L1	-0.0369 (-1.47)	-0.0633* (-2.42)	-0.0701** (-2.71)
L4	-0.104*** (-4.45)	-0.101*** (-3.89)	-0.0799** (-2.93)
Inf			
L1	-0.619 (-0.73)	-1.346 (-1.52)	-0.968 (-1.10)
L4	0.537 (0.67)	-0.894 (-1.01)	0.0850 (0.09)
Xchange			
L1	-0.145 (-0.58)	-0.248 (-0.92)	-0.179 (-0.66)
L4	0.168 (0.71)	0.0177 (0.07)	-0.0116 (-0.04)
dY			
L1	-0.0266 (-1.08)	-0.0547* (-2.14)	-0.0709** (-2.80)
L4	-0.0266 (-1.16)	-0.00388 (-0.15)	-0.0215 (0.81)
Unemp			
L1	-0.00421 (-0.44)	-0.0173 (-1.72)	-0.0162 (-1.62)
L4	-0.0202* (-2.21)	-0.0169 (-1.67)	-0.0139 (-1.31)
_cons			
L1	0.605 (1.75)	1.011** (2.77)	0.744*(2.05)
L4	0.273 (0.84)	0.985**(2.70)	0.873* (2.27)

t statistics in parentheses

$*p$-value $< 5\%$ $**\,p$-value $< 1\%$ $***p$-value $< 0.1\%$