The Yield Spread and Inflation as Leading Indicators of Future Economic Activity

The case of Sweden

Author: Delaram Hormozastarabady

Thesis: Bachelor Thesis in Financial Economics

Department of Economics

Code: NEKK01

Supervisor: Hossein Asgharian

Date: 2011-01-14

ABSTRACT

Title:	The Yield Spread and Inflation as Leading Indicators of Future Economic Activity
Seminar Date:	January 21, 2011
Course:	NEKK01, Bachelor thesis in financial economics, 15 ECTS
Author:	Delaram Hormozastarabady
Supervisor:	Hossein Asgharian
Keywords:	Yield Curve, Yield Spread, Inflation, Leading Indicators, Multiple Regression Model
Aim:	The aim of this paper is to examine the abilities of the yield curve and inflation in terms of predicting future real growth in the case of Sweden.
Methodology:	The methodology is a quantitative study using the single and multiple regression model based on econometric theory.
Theory:	The theoretical framework is built on the slope of the yield curve and its significance in predicting future economic activity.
Conclusion:	The thesis concludes that although the yield spread has shown to be a strong predictor of economic activity in previous research, it does not perform as well predicting future GDP growth in Sweden, with or without inflation as an additional explanatory variable.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. INTRODUCTION

In this chapter the topic is introduced and the aim, problem discussion together with the delimitations of the paper are specified. The chapter is finalized by a compilation of previous research.

1.1 Background

Identifying leading indicators that could help to predict economic activity is of great importance for many participants on the financial markets. Investors may take advantage of the information given by such indicators to determine future investments. Corporations have the need to estimate future demand to be able to decide for the capacity today. Information about future development of the economy can therefore be of great assistance for them. The main advantage however would lie with the central banks who could with more precision decide on future monetary policies.[1] There are different macroeconomic and financial variables that have been used in the past for purpose of prediction, but specific attention has been given to the financial variables. The main reason for this is that participants on financial markets are forward-looking, making prices on securities incorporate and reflect the future expectations of economic activity.[2] This behavior makes it reasonable to assume that data from financial markets can be of great help when investigating and forecasting future growth. The yield curve, defined as the spread between two interest rates namely between the 10-year Treasury bond and the 3-month Treasury bill, has shown to be a highly valued forecasting tool, as it contains information about future expectations and has been proven to outperform other financial indicators in predicting recessions.[3] Extensive research in this area has been done since the early 1980s, mainly by Stock and Watson (1989), Estrella and Hardouvelis (1991) as well as Estrella and Mishkin (1997).

[1] Dotsey Michael (1998), p. 31
[2] Estrella Arturo, Trubin Mary (2006), p. 2
[3] Estrella Arturo, Mishkin Fredric S. (1996), p. 1

1.2 Problem Discussion

The majority of all studies regarding the yield curve have been performed on the United States. The availability and constancy of financial data is a central underlying reason for this. The United States is one of the largest and leading economies in the world, having a well developed and highly influential financial market. There are however some studies made on European countries regarding the yield curve and its ability as a leading indicator of economic activity. The results of the yield spread's ability to predict economic activity across different countries vary. Estrella and Mishkin (1997) examined the predictive power of the term structure of interest rates subsequent to real economic activity and inflation in several European countries. They concluded that as the predictive power of the yield spread varies from country to country, it contains significant independent information about future growth in the majority of cases examined, and can be of great assistance to the European Central Bank.[4] Other studies in this area suggest that the yield spread in some cases explain roughly 30 to 50 percent of the variation in economic activity, such as in the United States and Canada, whereas it explains almost no part of the variation in countries such as Japan and Switzerland.[5] This is confirmed by Kozichi (1997) who also examined the predictive power of the yield spread in other countries than the United States.[6] It has been observed that the type of forecast and the measure of real economic activity are two important aspects of how well the yield spread performs in different countries. A study done by Bonser-Neal and Morley suggests that the yield spread explains the variation of real economic activity in Sweden most accurately when change in rate of unemployment is used as the measure of economic activity.[7] However, there is a lack of studies made on small economies such as Sweden and it is therefore of interest to examine if the predictive abilities of the yield spread in combination with inflation as an explanatory variable hold for Sweden.

[4] Estrella Arturo, Mishkin S. Frederic (1997), p. 1399
[5] Bonser-Neal Catherine, Morley R. Timothy (1997), p. 49
[6] Kozicki Sharon (1997), p. 44
[7]Bonser-Neal Catherine, Morley R. Timothy (1997), p. 45

1.3 Question at Issue

Does the yield spread have a significant relationship with GDP growth and can it, alone or with inflation as an additional explanatory variable, predict future economic activity of Sweden?

1.4 Aim

The aim of this paper is to examine the abilities of the yield curve and inflation in terms of predicting future real growth in the case of Sweden. Further, this paper aims to examine if the spread by itself is a better model for forecasting.

1.5 Delimitations

The Swedish exchange rate was fixed until November 1992, at which point the floating exchange rate was adopted. During the period prior to this point Sweden had had violent and unstable interest hikes. To prevent an excessive outflow of currency, the Swedish central bank, Riksbanken, was forced to raise the interest rates dramatically. The central bank raised its key rate to 500 percent as a last attempt to protect the Swedish krona, but was unable to do so. Sweden was thereby forced to give up the fixed exchange rate. [8] The unstable state of the financial market in Sweden during this period is why the sample size used in this study is chosen from quarter 2 1993 and forward.

There are several financial variables that can be included in an OLS regression for forecasting purposes. However this study focuses on the Spread and the percentage change in inflation as the independent variables in the performed regression analysis. Not having a large number of independent variables have the advantage that the results are easier to interpret and compare, however the disadvantage is that not all information is included. The GDP growth is used as the measure of real economic activity, as done in previous research, enabling the results reflecting the traditional model used for forecasting in other studies as well as a comparison

[8] http://www.riksbank.se/templates/speech.aspx?id=6211

between these. However, as this is only available on a quarterly basis, all other variables are also given on quarterly basis.

Regarding the forecasting technique and forecasting horizons, this study focuses on an out-of-sample forecast, which uses information available at the time of the forecast, whereas an in-sample forecast estimates an average relationship between the independent variables and the dependent variable for the whole period for which data exists.[9] The out-of sample performance examines predictions for quarters beyond the period of model estimation, which provides a more real-world forecasting ability.[10] The forecast horizon is limited to one to eight quarters ahead. This decision is made upon earlier research and results concerning how well the yield curve has performed for different forecast horizons.

1.6 Outline

This paper is outlined as follows:

In Chapter 1 the topic is introduced and the aim, problem discussion together with the delimitations of the paper are specified. The chapter is finalized by a compilation of previous research.

In Chapter 2 the theoretical considerations regarding the topic are depicted. The theories behind the yield curve and its properties as well as abilities of predicting economic activity are portrayed. The chapter continues with an outline of the relationship between the yield spread and inflation. Also, an introduction is given for the multiple regression model and the econometric issues that may emerge when dealing with time series.

Chapter 3 consists of the methodology where details about the data used in this study as well as the approach are described.

In Chapter 4 the regression results are presented and discussed. The first part of the chapter deals with an overall view of the data and in the second part the actual results are presented. The third part deals with hypothesis testing whereas the fourth and final part investigates the forecasting model and its fit.

Chapter 5 concludes the study and topics for further research are suggested.

[9] Bonser-Neal Catherine, Morley R. Timothy (1997), p.47
[10] Estrella Arturo, Mishkin Fredric S. (1996), p.1

1.7 Earlier Research

Since the 1980's, an extensive literature has been developed on the yield curve and its ability to predict future economic activity and most importantly to foresee recessionary periods. Stock and Watson (1989) provided an extended ground for further research by showing that the spread was a central component of leading economic indicators.[11] Estrella and Hardouvelis (1991) uncovered that the spread between the 10-year Treasury bond and the 3-month Treasury bill was an effective indicator of future economic activity up to seven quarters in the future. Further, they found that the yield curve was a useful tool when calculating the likelihood of recessions. By concentrating on the spread's predictive content, the authors made the forecasting easy to apply in a way that complex econometric tools or large economic data sets were not required. Estrella and Hardouvelis did also examine other explanatory variables that may be suitable for predicting future economic activity and made a comparison between these and the term spread. They found that the term spread contained more information than the other variables examined.[12] This was a conclusion that was confirmed by Dotsey (1998).[13] Estrella and Mishkin (1997) further examined the relationship of the term structure of interest rates to monetary policy instruments as well as to real activity and inflation in both Europe and the United States. They outlined the importance of monetary policy as a determinant of the term structure. In addition, they acknowledged the significance of the yield curve and its predictive power for both inflation and real economic activity.[14] Haubrich and Dombroskey (1996) also found that the yield curve could predict recessionary periods relatively accurate, but that its predictive ability has changed over time. In their research they found that the yield curve did not perform accurately over the period 1985 to 1995, at which point the yield curve failed to predict the 1990-91 recession.[15]

Estrella and Mishkin (1998) performed a research on the out-of-sample performances of various financial variables to examine if these could be used as valid predictors of U.S. recessions. Interest rates and spreads, monetary aggregates, stock prices are some examples of the financial variables that were evaluated in their research. With regard to the results

[11] Stock James H., Watson Mark W. (1989), pp. 352-94
[12] Estrella Arturo, Hardouvelis Gikas (1991), p. 575
[13] Dotsey Michael (1998)
[14] Estrella Arturo, Mishkin S. Frederic (1997), p. 1399
[15] Dotsey Michael (1998), p. 33

obtained, it was concluded that the yield curve spread showed the best predictive performance across the range of horizons examined.[16]

[16] Estrella Arturo, Mishkin S. Fredric (1998), p. 55

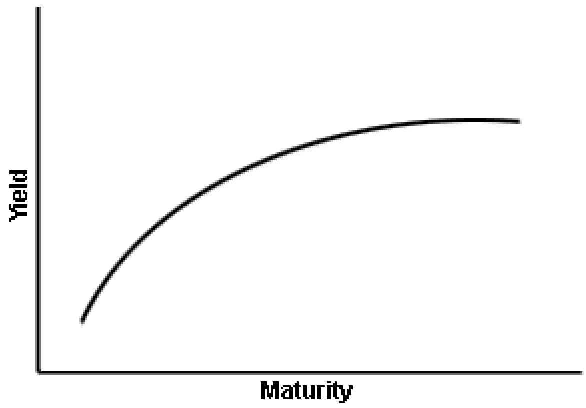
2. THEORETICAL CONSIDERATIONS

In this chapter the theoretical considerations regarding the topic are depicted. The theories behind the yield curve and its properties as well as abilities of predicting economic activity are portrayed. The chapter continues with an outline of the relationship between the yield spread and inflation. Also, an introduction is given for the multiple regression model and the econometric issues that may emerge when dealing with time series.

2.1 The Yield Curve

It is well known that the term structure of interest rates and economic activity have a systematic relation to one another. The slope of the yield curve, known as the spread between the long- and short term interest rate, is argued to be a good predictor of future economic activity.[17] The curve plots the interest rates of bonds with similar risk and liquidity considerations but differing maturity dates.[18] The Spread measures the steepness of the curve so that the larger the spread, the steeper is the yield curve. The yield curve is flattened due to impending recessions as the long term rate declines relative to the short term rate. Correspondingly, the yield curve steepens as the long term rate exceeds the short term rate, and thereby predicting a period of economic expansion. There are mainly three types of shapes that the yield curve takes form in; these are portrayed below.

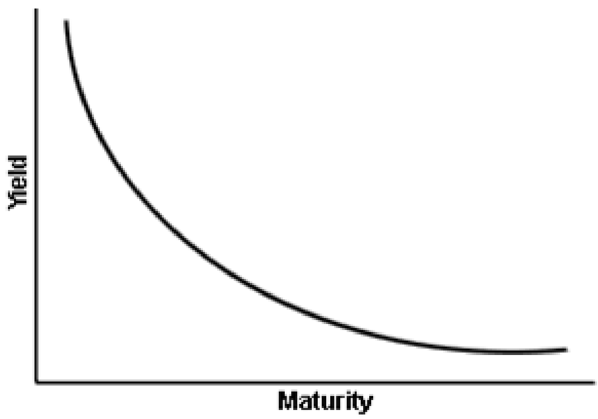
Figure 1*:* ***Positive Yield Curve***



[17] Estrella Arturo, Trubin Mary (2006), p. 1
[18] Bonser-Neal Catherine, Morley R. Timothy (1997), p. 38

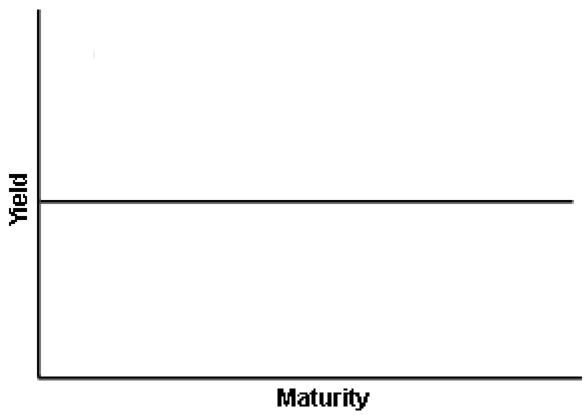
Here, longer maturity bonds have a higher yield compared to short term bonds. This is also known as the "normal" shape in which the yield curve depicts itself. [19]

Figure 2: ***Inverted Yield Curve***



Above, short term bonds have a higher yield compared to the long term yield. This is also known as an "inverted" yield curve. Inversion of the yield curve predicts lower interest rates in the future and has been used as an indicator of recessionary times.

Figure 3: ***Flat Yield Curve***



When the difference between the short-term and the long term rates is too small, the yield curve tends to flatten.

In order to understand this empirical relationship between interest rates and future economic activity one must explore the economic theory that the relationship is based upon.[20] One

[19] http://www.investopedia.com/terms/y/yieldcurve.asp
[20] Lakshman Alles (1995), p. 71

model that has been used in attempt to give ground for this relationship is how changes in monetary policy influence the yield curve.

A predominant effect of the monetary policy being tightened is a tightening of supply of credit resulting in the short term interest rates being raised. Rates reflecting expectations of longer term will also be affected due to the changes in expected inflation. [21] A monetary tightening will conduct in a rise in long term rates as well, though less relative to the short term rates. This will tend to flatten the yield curve. [22] Monetary expansions on the other hand will lead to a greater decline in the short term rate relative to the long term rate and will thereby result in a steeper yield curve. [23] Estrella and Mishkin (1997) conclude in their analysis that monetary policy is an important determinant of the term structure spread, but that it is not the only determinant. With the evidence provided they argue that as an indicating factor for monetary policy, the term structure of interest rates has a useful role. Furthermore, the same is true for the other way around, meaning that the term structure spread can be affected via monetary policy actions on a central bank interest rate. [24]

Another explanation for the link between the yield spread and future growth is changes in investor expectations and their effect on the yield curve. In further elaboration, considering that the expectations of future short term interests are related to future real demand for credit as well as future inflation, it can be concluded that if short term interest rates are risen as a result of monetary policy, it can lead to a slowdown of future economic activity and demand for credit. The expectations of future inflation may lower as a result of slowing activity and thereby increasing the expectations of an easing in future monetary policy. The future short term interest rates would be expected to decline, which would have a reduction effect on the current long term interest rates.[25]

Harvey (1988) outlays how real growth in aggregate consumption is linearly related to the yield spread of term structure. This relation has its foundation in consumption based on the capital asset pricing model. Considering that consumers find themselves in a rather good economic state with expectations of less favourable conditions in the future, such as a drop in future incomes, consumers would attempt to hedge by chasing long term bonds and selling

[21] Estrella Arturo, Mishkin S. Frederic (1997), p. 1378
[22] Estrella Arturo, Trubin Mary (2006), p. 2
[23] Lakshman Alles (1995), p. 72
[24] Estrella Arturo, Mishkin S. Frederic (1997), p. 1399
[25] Lakshman Alles (1995), p. 71

short term instruments. This would allow the yield curve to flatten, indicating recessionary conditions. [26]

There are, however, other theories concerning the spread and how it may communicate future economic behaviour. It was shown by Plosser and Rouwenhorst (1994) that the spread's behaviour is consistent with real business cycle theory. The assumption behind this theory is that business cycles arise from real shocks to the economy such as technology advances rather than shocks induced by monetary policy.[27] In a real business cycle model, high expected future growth would imply a rise in real interest rates and thereby a steepening of the yield curve. The reverse would occur if a slowdown in growth was expected. This implies that the yield curve could signal changes in future economic activity that is due to nonmonetary shocks.[28]

The involvement of the yield spread in prediction of whether or not a country will find itself in a recession in the near future must not be disregarded.[29] Economists and researchers have applied this approach with the yield spread as the only explanatory variable in probit[30] models to find out if a specific country will be in recession k quarters in the future.[31] Estrella and Mishkin (1996) used this approach to examine the probability of the United States being in recession two, four and six quarters in the future and compared the performance of the yield curve as an indicator of recession, with that of other financial and macroeconomic variables such as the New York Stock exchange (NYSE) stock price index, the Commerce Department's index of leading economic indicators, and the Stock-Watson index. They found that although all variables had some forecasting abilities, the yield curve outperformed the other variables when predicting recessions two or more quarters in the future.[32]

2.2 Structural stability

As outlined earlier, the predictive power of the yield curve is manifested through different channels, which is a trait that is often being criticized. Estrella, however, claims that the

[26] Lakshman Alles (1995), p. 72
[27] Plosser Charles I., Rouwenhorst Geert K. (1994), pp. 133 - 56
[28] Dotsey Michael (1998), p.38
[29] Estrella Arturo, Mishkin Fredric S. (1996),
[30] Models where the dependent variable of the equation only takes two values, namely 1 when the economy is in recession, and 0 if not.
[31] Estrella Arturo, Mishkin S. Frederic (1997), p. 1388
[32] Estrella Arturo, Mishkin Fredric S. (1996), p. 4

multiplicity of the channels is what makes the relationship robust; meaning that if one channel is out, other channels will come forward and make up for the one that is out.[33] Another appreciated trait of the yield curve is its ability to be more forward-looking than other leading indicators due to the fact that financial markets are forward looking and prices of securities reflect expectations of future economic activity**.**[34] There are however some basic criteria that need to be seen to when considering the yield curve as a leading indicator; these are given below.

2.2.1 Choice of country

A crucial factor for proper evaluation of the yield curve is a lengthily time series of market-determined interest rates and correct measurements of real economic activity. This implies that only industrial countries with well developed financial markets may be included. Hence that it is of importance that the market is transparent and that the interest rates genuinely reflect market expectations as well as can be expected. Another criterion that has to be satisfied is the existence of good amount of historical data on interest rates and real economic activity. A large sample size ensures the forecast power of the yield curve. [35]

2.2.2 Choice of Spread

Previous research done on the yield curve as a leading indicator of real economic activity has focused on the spread between the 10-year Treasury bond and the 3-month Treasury bill rate. However, some academic researchers have preferred to use the spread between the 10-year Treasury rate and the federal funds rate. Although these have shown to accurately predict recessions during some periods of time, they have failed to do so during other periods.[36] When choosing the most appropriate rates to include, it is important to consider the availability of historical data as well as the consistency in how the rates are computed over time. [37] It is also of central value to take the difference between two Treasury yields that are

[33] Estrella Arturo, Trubin Mary (2006), p. 2
[34] Dotsey Michael (1998), p. 31
[35] Bonser-Neal Catherine, Morley R. Timothy (1997), p. 40
[36] Estrella Arturo, Trubin Mary (2006), p. 3
[37] Bordo D. Michael, Haubrich G. Joseph (2004), p. 2

far apart in terms of maturities, as this has been shown to produce the most effective and accurate results. [38]

The relationship between the term structure and future economic activity tends to raise the question of weather the term structure carries the ability to give us valid information about future economic activity.

2.3 The Relationship between the Yield Spread and Inflation

The yield curve contains substantial information about different financial variables. As outlined before, a large number of empirical literatures has attested the predictive power of the yield curve and has confirmed its positive relation to future real economic activity. As the yield spread is the difference in nominal interest rates on bonds with different maturities, it holds information about expectations of future inflation.[39] When inflationary expectations are increased the yield curve is steepened, resulting in an increase in short term interest rates through monetary policy.[40] In a study done by Hardouvelis and Malliaropulos (2005), it is concluded that there exists a symmetric relationship between the yield spread and future real output growth as well as inflation. They found that an increase in the yield spread reflects an increase in future real output as well as an inflationary decline by approximately the same magnitude.[41] This hypothesis stresses that changes in expectations of future inflation are related to changes in long term interest rates.[42] This is confirmed in a study by Kozicki (1997) where evidence suggests that inflationary changes are part of the information contained by the yield spread.[43] This indicates that inflation is a component part of the yield spread and by including it in the forecasting model for prediction of future economic activity, one can observe if the yield spread contains information in excess of inflationary expectations.

2.4 The Multiple Regression Model

The single linear regression model is carried out to estimate the relationship between the dependent variable Y and the single explanatory variable X.[44] In contrast to the single linear regression model, the multiple regression model is extended to the case where more than one

[38] Estrella Arturo, Trubin Mary (2006), p.3
[39] Hardouvelis Gikas A., Malliaropulos Dimitrios (2005), p. 2
[40] Dotsey Michael (1998), p.37
[41] Hardouvelis Gikas A., Malliaropulos Dimitrios (2005), p. 23
[42] Kozicki Sharon (1997), p.44
[43] ibid. p.48
[44] Westerlund Joakim (2005), p. 67

explanatory variable is used to explain the dependent variable.[45] The Ordinary Least Square (OLS) criterion is used to estimate the equation. The OLS states that b_1 and b_2 should be chosen so that the differences between the actual and predicted values for each observation in the sample are squared and minimized.[46]

2.4.1 Assumptions

1. The dependent variable can be expressed as a linear function of K-1 number of independent variables $x_{1i}, x_{2i}, \dots, x_{Ki}$, an intercept β_0 as well as the error term ε_t. The econometric model is expressed as below.

$$Y_i = \beta_0 + \beta_2 x_{2i} + \beta_3 x_{3i} + \dots + \beta_K x_{Ki} + \varepsilon_t$$

2. The disturbance has no systematic components and therefore has an expected value equal to zero.

$$E(\varepsilon_i) = 0$$

3. The third assumption suggests the constant variance-homoscedasticity, meaning that the error term ε_i has the same variance for all i.

$$Var(\varepsilon_i) = \sigma^2$$

   If $Var(\varepsilon_i) \neq \sigma^2$ for some i, the condition given above is not satisfied and ε_i is heteroscedastic.

4. The variance of ε_i and ε_j are equal to zero whenever $i \neq j$. This assumption implies that the sample is randomly generated, meaning that each observation in the sample can be regarded as independent of each other observation. If the condition below is not satisfied, ε_i is auto correlated.

$$Cov\left(\varepsilon_i, \varepsilon_j\right) = 0 \quad if \quad i \neq j$$

5. The independent variables x_{Ki}, k = 2, 3,...,K, are not random and no variable can be expressed as a precise linear combination of the other independent variables.

[45] Gujarati D.N. (2006), p. 145
[46]ibid. p. 214

6. The error term is normally distributed with an expected value equal to zero and a variance of σ^2.[47]

$$\varepsilon_i \sim N(0, \sigma^2)$$

2.5 Econometric Issues

When dealing with time series data there are several problems that may occur which can influence hypothesis testing in a negative manner. These problems are presented below.

2.5.1 Auto Correlation

In regression analysis, when using time series, autocorrelation is a central problem, as the errors are correlated with the errors immediately before them. When the errors have positive correlation the confidence interval tends to narrow, which leads to rejection of the true null hypothesis with a higher probability. On the contrary, when dealing with negative autocorrelation, the confidence interval tends to widen and the power of significance test is reduced. [48] In case of positive or negative correlation the ordinary least square method has no longer the least variance among existing linear and unbiased estimators, which would mean that it is no longer the best estimator.[49]

2.5.2 Heteroskedasticity

The volatility of financial time series changes over time. This is a characteristic that is referred to as heteroskedasticity and occurs as the variance of the error terms differ throughout the observations.[50] Heteroskedasticity occurs often with cross-sectional data and has similar effects and consequences on the ordinary least square estimate as autocorrelation. With existence of heteroskedasticity the third assumption of the multiple linear regression model would not hold, making the standard errors biased. Biased standard errors will make

[47] Westerlund Joakim (2005), p. 139
[48]Gujarati D.N. (2006), p. 432
[49]Westerlund Joakim (2005), p. 185
[50]ibid. p. 391

the *t* statistics and F-statistics useless for drawing inferences.[51] It is thereby of importance to test for heteroskedasticity so that the error terms can be adjusted for a correct hypothesis test.

There are two approaches that can be used when dealing with autocorrelation and/or heteroskedasticity. Either the entire model is transformed and generalized least squares (GLS) is applied, or an attempted is made to adjust the estimated standard errors for autocorrelation and heteroskedacticity. Both approaches have their advantages and are appropriate in different circumstances. The main advantage of the latter approach is that it is not necessary to have information about the form of heteroskedasticity or correlation. Newey-West standard errors are used for this aim as they correct the standard errors of the estimated regression for correlation and heteroskedasticity.[52]

[51]Gujarati D.N. (2006), p. 397
[52] Newey and West (1987)

3. METHODOLOGY

This following chapter consists of methodology where details about the data used in this study as well as the approach are described.

3.1 Data Description

The data used in this study is seasonally adjusted GDP, the difference between the 10-year Treasury bond and the 3-months Treasury bill, as well as Consumer Price Index as a measure of Inflation. The seasonally adjusted GDP data and Consumer Price Index are obtained from Datastream. The yields are compiled by the Swedish central bank, Riksbanken.[53] The Spread is chosen as the difference between the 10-year Treasury bond and the 3-month Treasury bill because this specific spread has shown the strongest performance when forecasting economic activity. Earlier research has concluded that the further apart the rates are in maturity, the more information does the spread hold.[54] In computing the two rates, average quarterly data is used rather than point-in-time data. Economists and researchers in the past have chosen differently, some have used beginning-of-period and others the average data. However, in predicting growth of GDP point-in-time data is not essential.[55] All data is given quarterly as it must match the frequency of the GDP data which are only available at quarterly intervals. The Consumer Price Index is seasonally adjusted by following calculation: $\pi_t = (CPI_t - CPI_{t-4})/CPI_{t-4}$. The in-sample period is from Q2 1993 to Q4 2009.

3.2 Approach

The dependent variable in the regression is the annualized cumulative growth rate of seasonally adjusted real GDP from quarter k to quarter $k+t$. The following definition is used in research done by Estrella and Hardouvelis (1991).[56]

[53] www.riksbanken.se
[54] Estrella Arturo, Trubin Mary (2006), p.3
[55] Estrella Arturo, Hardouvelis Gikas (1991), p. 558
[56] ibid.

$$Y_{t,t+k} \equiv \left(\frac{400}{k}\right) [\log(y_{t+k}/y_t)]$$

Where k denotes the forecasting horizon in quarters, y_{t+k} denotes the level of real GNP during quarter $t+k$ and $Y_{t,t+k}$ denotes the cumulative growth in GDP from current quarter *t* to further quarter $t+k$.

The yield curve will be constructed by use of two interest rates, namely the 10-year government bond and the 3-month Treasury bill, denoted as R_t^L and R_t^S. The slope of the yield curve is given by the difference between the two rates:

$$SPREAD_t = R_t^L - R_t^S$$

The econometric model used will have the following form:

$$Y_{t,t+k} = \beta_0 + \beta_1 SPREAD_t + \beta_2 CPI_t + \varepsilon_t$$

Where

$Y_{t,t+k}$: Cumulative GDP growth, defined in equation 1

$SPREAD_t$: The difference between the long and short market interest rates in period t

CPI_t : Consumer Price Index, as a measure of inflation

ε_t : The error term

Before exploring the forecast model and its ability to predict future economic activity, the relationship between the yield spread, inflation and the cumulative GDP growth is examined. This is done both visually with help of the plotted data, and through hypothesis testing. The plot will provide an instructive and casual view of the behaviour of the yield curve and inflation in comparison to the behaviour of real GDP growth. The hypothesis testing will show if the yield spread and inflation, both jointly and individually, have a positive and statistically significant relationship with the cumulative GDP growth. This will provide useful information about the spread's properties for predicting cumulative GDP growth in the case of Sweden.

Further, a regression is run for the purpose of predicting cumulative GDP growth in period Q2 2005 to Q4 2009 using parameters from regressions from the period Q2 1993 to Q1 2005. The coefficients of this regression, denoted as α and β, are examined to see if the model performance is significant. The analysis is finalized by a comparison of the Root Mean Square Errors (RMSE) of the main model used in this study, which includes both the yield spread and inflation as its explanatory variables, with a model that includes the yield spread as its only explanatory variable, to find if any of the models dominate the other.

4. REGRESSION EVIDENCE AND ANALYSIS

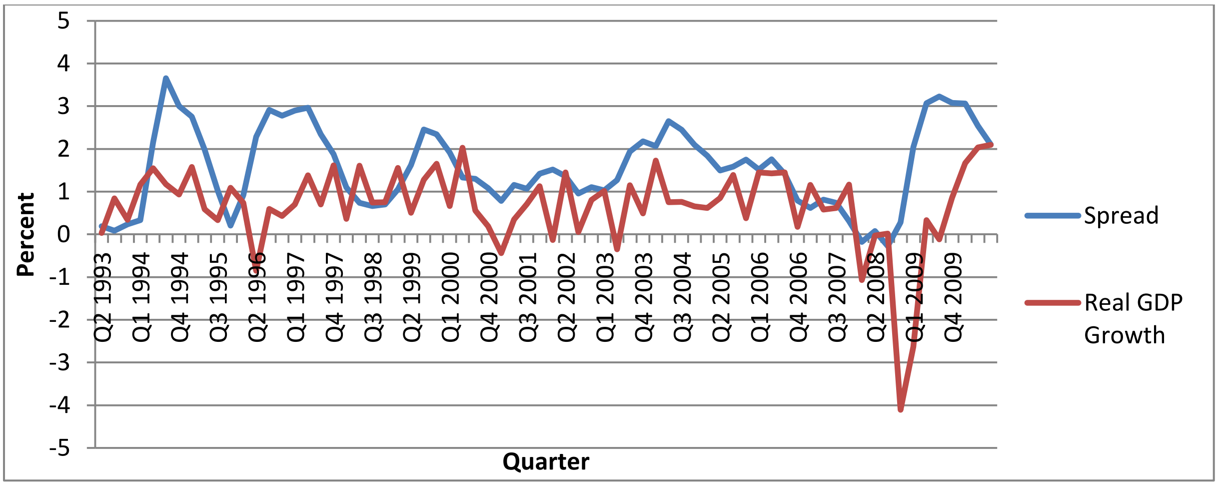
In the following chapter the regression results are presented and discussed. The first part of the chapter gives an overall view of the data and in the second part the actual results are presented. The third part deals with hypothesis testing whereas the fourth and final part investigates the forecasting model and its fit.

4.1 Overall View of the Data

Before beginning with a detailed statistical analysis, a casual view of the data is presented. Figure 4 displays the relationship between the yield spread of the 10-year Treasury bond and the 3-months Treasury bill and the quarter growth rate of real GDP.

Figure 4: ***Real GDP Growth and Spread***

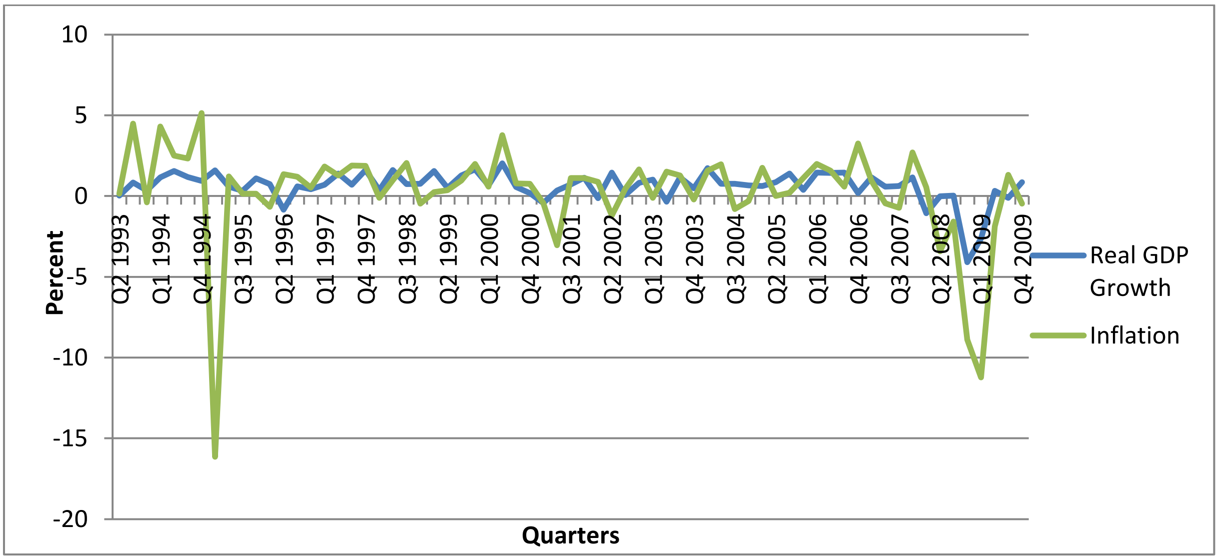
The figure shows the relationship between the yield spread and real GDP growth. The relationship is based upon the quarterly sample period from 1993:1 to 2009:4. The yield denotes the slope of the yield curve, which is the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate. Real GDP growth is given as the quarterly percentage change in GDP.



Even thought it might be difficult to draw an exact conclusion from the figure above, it is somewhat clear that the movements in the spread precede changes in real GDP growth. An example of this behaviour is the drop of real GDP growth during Q4 1995, which was indicated as the yield spread was flattened significantly four quarters earlier. The recession during 2008-2009 is another visual aid for the relationship between the yield spread and GDP growth. Prior to the great fall in real GDP during Q3 2008, the yield spread has flattened for several quarters and inverted with the short-term rate exceeding the long-term rate during Q4 2007 to Q2 2008, indicating recessionary times. As the recession progressed the yield spread began to steepen, an indication of renewed strength in the economy, followed by a rise in real GDP growth. The precision and consistency of how well the yield spread performs as an indicator of economic activity is however questioned. It did not perform well prior to the peaks of 1957 and 1960 and was inverted during 1967 although the economy remained strong.[57] Nevertheless, the yield spread has inverted prior to most recessions and steepened prior to most business cycles in the United States, proving itself to be a useful but imperfect indicator of future economic activity.

Figure 5: ***Real GDP Growth and Inflation***

The figure shows the relationship between inflation and real GDP growth. The relationship is based upon the quarterly sample period from 1993:1 to 2009:4. Inflation is measured as the quarterly percentage change in Consumer Price Index. Real GDP growth is given as the percentage quarterly change in GDP.



The relationship between inflation and real GDP growth is difficult to interpret and has been of subject to considerable interest and debate. However, extensive research has been done in this area and the findings have uncovered that inflation has a negative effect on medium and long term growth. This relationship is an important reason of why low inflation in conjunction with strong growth of output is the central aim of macroeconomic policy. Nevertheless, research has shown that with low levels of inflation this relationship is positive, suggesting a non-linear relationship. This was shown by Fisher(1993) amongst others. The relationship in

[57] Dotsey Michael (1998), p. 34

figure 5 is not entirely percipient, but in some periods inflation seems to have some tendencies of a negative effect on real GDP growth.

4.2 In-sample Results

The first estimated model consists of a single explanatory variable, the yield spread, defined as the difference between the 10 year Treasury bond and the 3 month Treasury bill. The model has the following form:

$$Y_{t,t+k} = \beta_0 + \beta_1 SPREAD_t + \varepsilon_t$$

The dependent variable in the estimated model is the cumulative GDP growth, calculated as follows:

$$Y_{t,t+k} \equiv \left(\frac{400}{k}\right) [\log(y_{t+k}/y_t)]$$

The regression is run for the entire sample, which is quarterly from 1993 Q2 through 2009 Q4. The in-sample results are presented in Table 1.

Table 1: ***In-sample results of model 1***

The sample is quarterly from 1993:1 through 2009:4. The estimated models are as follows:

Cumulative change: $\left(\frac{400}{k}\right)$ $[\log(y_{t+k}/y_t)] = \beta_0 + \beta_1 SPREAD_t + \varepsilon_t$

The spread is the single explanatory variable in the model given above, defined as the slope of the yield curve, which is the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate. The interest rates are annualized quarterly average. β_0 and β_1 are the coefficients of the intercept and the spread respectively. Inside the parentheses are Newey and West (1987) corrected standard errors. The adjuster R^2 is the coefficient of determination and SEE is the regression standard error. The F-statistic of the regression and the probability of the F-statistic are also given in the table.

Quarters	β_0	β_1	Adjusted R^2	*SEE*	*F-statistic*	*Prob.*
1	0.071	0.730	0.147	1.594	12.424	0.000
	(0.071)	(1.920)				
2	0.310	0.510	0.111	1.292	9.223	0.003
	(0.524)	(1.938)				
3	0.198	0.595*	0.194	1.111	16.902	0.000
	(0.324)	(2.163)				
4	0.166	0.629*	0.247	1.017	22.636	0.000
	(0.270)	(2.222)				
5	0.218	0.597*	0.252	0.938	22.947	0.000
	(0.355)	(2.061)				
6	0.298	0.547	0.235	0.880	20.669	0.000
	(0.513)	(1.959)				
7	0.403	0.478	0.200	0.834	16.794	0.000
	(0.749)	(1.836)				
8	0.493	0.422	0.181	0.783	14.687	0.000
	(1.011)	(1.799)				

Notes: Standard errors (Newey and West, 1987) in parentheses

* Significant at the 5% level

The second estimated model consists of two explanatory variables, the yield spread, being the difference between the 10 year Treasury bond and the 3 month Treasury bill, and inflation measured as the percentage change in consumer price index. The model has the following form:

$$Y_{t,t+k} = \beta_0 + \beta_1 SPREAD_t + \beta_2 CPI_t + \varepsilon_t$$

The dependent variable in the estimated model is the cumulative GDP growth, calculated as follows:

$$Y_{t,t+k} \equiv \left(\frac{400}{k}\right) [\log(y_{t+k}/y_t)]$$

The regression is run for the entire sample, which is quarterly from 1993 Q2 through 2009 Q4. The in-sample results are presented in Table 2.

Table 2: ***In-sample results of model 2***

The sample is quarterly from 1993:2 through 2009:4. The estimated models are as follows:

Cumulative change: $\left(\frac{400}{k}\right) [\log(y_{t+k}/y_t)] = \beta_0 + \beta_1 SPREAD_t + \beta_2 CPI_t + \varepsilon_t$

The spread and inflation are the explanatory variables in the model given above. The spread is defined as the slope of the yield curve, which is the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate. The interest rates are annualized quarterly average. Inflation is given as the percentage quarterly change in Consumer Price Index. β_0, β_1 and β_2 are the coefficients of the intercept, the spread and inflation respectively. Inside the parentheses are Newey and West (1987) corrected standard errors. The adjuster R^2 is the coefficient of determination and SEE is the regression standard error. The F-statistic of the regression and the probability of the F-statistic are also given in the table.

Quarters	$\boldsymbol{\beta_0}$	$\boldsymbol{\beta_1}$	$\boldsymbol{\beta_2}$	***Adjusted*** $\boldsymbol{R^2}$	***SEE***	***F-statistic***	***Prob.***
1	0.077	0.732	-0.013	0.136	1.594	6.196	0.003
	(0.785)	(0.383)	(0.009)				
2	0.307	0.509	0.007	0.098	1.292	4.578	0.014
	(0.598)	(0.265)	(0.007)				
3	0.190	0.593*	0.016*	0.187	1.111	8.608	0.000
	(0.616)	(0.277)	(0.006)				
4	0.162	0.628*	0.009	0.237	1.017	11.257	0.000
	(0.621)	(0.285)	(0.006)				
5	0.215	0.596*	0.006	0.242	0.938	11.359	0.000
	(0.619)	(0.292)	(0.006)				
6	0.295	0.545	0.009	0.226	0.880	10.327	0.000
	(0.587)	(0.281)	(0.005)				
7	0.401	0.477	0.007	0.189	0.834	8.351	0.000
	(0.544)	(0.262)	(0.005)				
8	0.490	0.420	0.420*	0.171	0.783	7.404	0.001
	(0.492)	(0.236)	(0.004)				

Notes: Standard errors (Newey and West, 1987) in parentheses

*Significant at the 5% level

The coefficients of the intercept, the yield spread and inflation are given by β_0,β_1 and β_2 respectively. The adjusted R^2 measures the proportion of the total variation in the dependent variable, the Cumulative GDP growth, explained by the explanatory variables, the Spread and inflation, jointly.[58]

As seen above, the coefficient of the Spread is positive on all horizons in both models. This is consistent evidence that the relationship between the yield curve and future economic growth is positive and confirms the results of previous research.[59] However it is observed that there is a slight decrease in the effect of the Spread as the horizon extends. This is based upon the fact that the coefficient values of the spread decreases slightly with the number of horizons and is at its lowest value for quarter 8 in model 1 as well as in model 2. The coefficient of the inflation in model 2 is positive for quarter two to quarter eight, although much smaller than the coefficient of the spread. The adjusted R^2 values for both models are highest for quarters three to seven.

Each of the coefficients, β_i, shows the average change in the dependent variable Y_i given a one unit change in the independent variable X_i while holding everything else constant.[60] Hence, the interpretation of the slope coefficients is that while holding all other variables constant, the coefficient of the Spread, β_1, shows how much real GDP growth changes following a change of one percent in the yield spread. The adjusted R^2 value of model 2 is approximately 20 percent, meaning that the two explanatory variables account for about 20 percent of the variation in the cumulative GDP growth. This value is somewhat higher for model 1, where the spread alone accounts for approximately 23 to 25 percent of the variation in the cumulative GDP growth. These values are lower compared to research performed for the United States. However as explained in previous chapters the yield spread as a leading indicator has shown to have stronger predictive power for Canada and United States than other industrialized countries. Further, previous research suggests that the goodness of fit varies for the countries in Europe and is dependent on which measure of economic activity is chosen. In a study by Bonser-Neal and Morely (1997) the explanatory power of the yield spread is presented for different measures of economic activity and different countries over a one year forecast. They showed that for countries such as the United States and Canada the yield spread explains about 40 to 50 percent of the variation of all three measures, namely of GDP growth, Industrial Production growth and change in unemployment rate. For other countries such as France and Netherlands, it was shown that the yield spread had a stronger explanatory power when Industrial Production growth was chosen as the measure of

[58] Gujarati D.N. (2006), p. 228
[59] Estrella Arturo, Mishkin S. Frederic (1997), p. 1385
[60] Gujarati D.N. (2006), p. 211

economic activity, with an adjusted R^2 of 35 present for France and approximately 22 percent for the Netherlands. The change in unemployment rate was shown to be the most effective measure of economic activity for Sweden and Germany with an adjusted R^2 of approximately 27 percent for Sweden and about 40 percent for Germany.[61]

Although the adjusted R^2 value gives us a hint of goodness of fit of the estimated regression line, it does not provide information about the coefficients being statistically significant. This is done by a joint hypothesis test.[62]

The F-test, which is a measure of overall significance of the estimated regression line, is used in order to test the following joint hypothesis for model 2:

$$H_0 : \beta_i = 0 \qquad i = 1,2$$

$$H_1 : \beta_i \neq 0$$

If our null hypothesis holds, there is no linear relationship between the dependent variable Y_i and any of the independent variables x_1 and x_2. This would mean that all slope coefficients would be equal to zero and therefore$Y_i = \beta_i + \varepsilon_i$, which implies that the variation in Y_i can be explained by random deviations from the interceptβ_0. However, if the null hypothesis is rejected, there is evidence for a linear relationship between Y_i and at least one of the independent variables.[63] By the values given in table 1 and at a significance level of 5%, H_0 is rejected, which means that at least one of the independent variables is not equal to zero.

To examine if the independent variables can explain the variation in Y_i individually, in other words, to find out if the independent variables each have a statistically significant relationship to the dependent variable, the following hypothesis is tested:

$$H_0 : \beta_i = 0 \qquad i = 1,2$$

$$H_1 : \beta_i \neq 0$$

As indicated in Table 2, the yield spread is significantly related to the dependent variable during quarters three to five. Same results are reached for model1, where the yield spread is the only explanatory variable. A factor of interest here is also that as the yield curve is

[61] Bonser-Neal Catherine, Morley R. Timothy (1997), p. 46
[62] Gujarati D.N. (2006), p. 220
[63] Westerlund Joakim (2005), p. 152

significant by itself, it retains its significance with inflation as an additional variable. Inflation is however non-significant for the majority of the horizons exclusive of quarter three and eight. This implies that inflation as an explanatory variable in this given model is not very helpful for explaining the variation in the dependent variable, namely the cumulative GDP growth. The spread seems to have some explanatory power during quarters three to five, but the overall results are not nearly as strong as expected. These results can however be dependent on which measure of economic activity is chosen as well as the number and type of explanatory variables included in the model. Also, a larger sample could benefit the yield spread and its performance.

4.3 Forecasting

In this section both models are used to predict growth in cumulative GDP over one to eight quarters ahead. The forecasts are based on the parameters of regressions from Q2 1993 to Q1 2005 for predicting cumulative growth during Q2 2005 to Q4 2009.

Table 3: ***Out-of-sample Forecasting Results***

The sample is quarterly from through 2005:2 through 2009:4, based on parameters of regression from 1993:2 through 2005:1. α and β denote the coefficients of the intercept and the explanatory variable respectively. Model 1include the spread as the single explanatory variable whereas model 2 includes both the spread and inflation as its explanatory variables.

Forecast Horizon: k Quarters Ahead	Model 1		Model 2	
	Intercept α	x-variable β	Intercept α	x-variable β
1	-0.754 (-0.929)	1.234* (2.360)	-0.754 (0.809)	1.248 (0.520)
2	0.383 (0.289)	-0.005 (0.016)	0.359 (0.311)	0.016 (-0.005)
3	0.688 (0.562)	-0.270 (-0.196)	0.595 (0.649)	-0.179 (-0.293)
4	0.815 (0.801)	-0.349 (-0.371)	0.790 (0.832)	-0.322 (-0.403)
5	0.460 (0.421)	-0.087 (-0.079)	0.446 (0.440)	-0.072 (-0.096)
6	-0.209 (-0.199)	0.435 (0.435)	-0.262 (-0.159)	0.478 (0.393)
7	-1.757 (-1.197)	1.631 (1.357)	-1.820 (-1.159)	1.678 (1.320)
8	-2.875 (1.838)	2.449** (1.838)	-2.896 (-1.674)	2.458** (1.791)

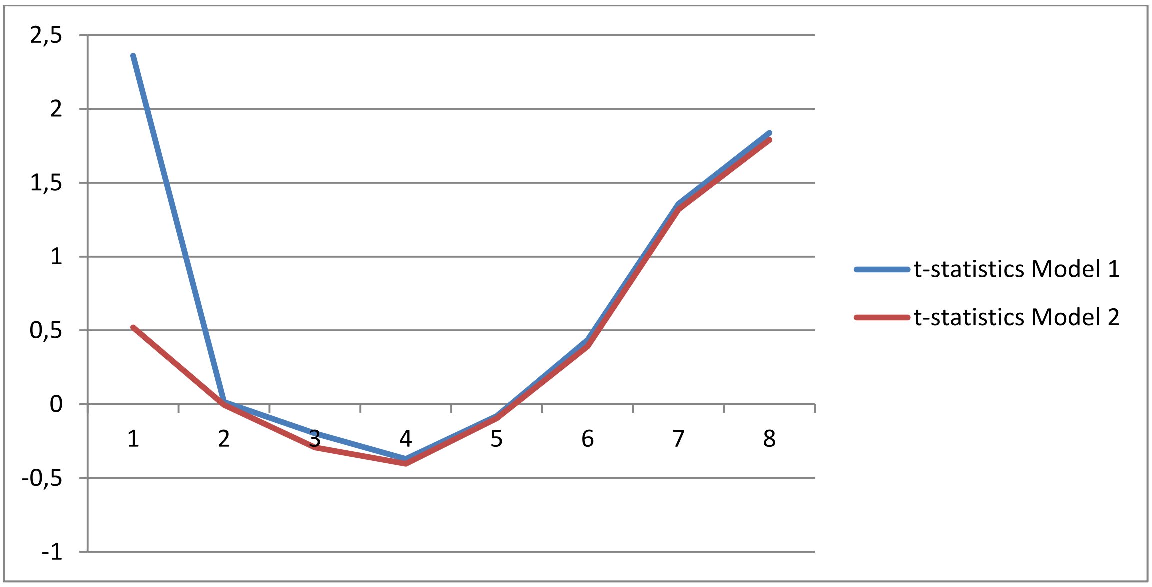
Notes: The t-statistics are given in the parentheses.
*Significant at the 5% level
*Signifikant at 10% level

The coefficient of the intercept is denoted as α, and the coefficient of the explanatory variable is denoted as β. Hence β in model 1 is based on the yield spread as the only explanatory variable, and β in model 2 is based on both yield spread and inflation as explanatory variables. As discussed before, the size of the coefficients for each explanatory variable gives the effect that variable has on the dependent variable. The signs of the coefficients give the direction of this effect. The results in Table 3 show that the coefficients of the independent variable are not positive throughout all horizons. β is positive during quarters 1 and 6-7 for model 1, forecasting an increase in cumulative GDP growth during these quarters. The results of model 2 are similar to those of model 1. β is positive during quarters 1-2 and 6-7, and is given the same interpretation as in model 1. The size of β is also larger in all horizons in model 2, indicating a larger effect on the dependent variable. As the coefficients are non-significant on as good as all horizons[64] the t-statistics are observed to find if any further information can be given about the out-of-sample results of the models.

The t-statistic is a measure of how extreme the statistical estimate is, where t-statistics close to zero indicate that the hypothesized value is quite reasonable. Looking at the t-statistics of the coefficients, it can be concluded that model 2 has the smallest values of the two models and they are closest to zero during quarters two to six. However, during the exact same quarters the t-statistics of model 1 is closer to zero. For visual aid, the t-statistics are plotted in the figure below.

Figure 6: ***t-statistics of the out-of-sample results, Model 1 and Model 2***

The t-statistics from the out-of-sample regression run from 2005:2 through 2009:4 for model 1 and model 2. . Model 1include the spread as the single explanatory variable whereas model 2 includes both the spread and inflation as its explanatory variables.



[64] The only significant variable is β in model 1 during horizon 1.

Further, the coefficients of the forecasting results, denoted as α and β, are examined so the performance of the model can be evaluated. A value equal to zero for the alpha and a value equal to one for beta indicates that the model is strong and has very good capability for forecasting future GDP growth. Thereby the following hypothesis is tested:

H_0: α= 0

H_1: α≠0

The t-values of the coefficient α are calculated as follows:

$$t_\alpha = \frac{\alpha}{se\ (\alpha)}$$

The results of the hypothesis test give that the H_0 cannot be rejected at any horizon. The evaluation is continued by the following hypotheses test:

H_0: β=1

H_1: β≠1

The t-values of the coefficient β are calculated as outlined below:

$$t_\beta = \frac{\beta - 1}{se\ (\beta)}$$

The results are consistent with those of the previous hypothesis test regarding coefficient α; the H_0 cannot be rejected. Although the results confirm that the null hypothesis of α= 0 and β=1 cannot be rejected, they do not provide any confirmation that alpha actually is equal to zero, or that beta actually is equal to 1. As the sample size is quite small in this forecast, the test results tend to not be as trustworthy as they would have with a large sample size. With a small sample the volatility is quite high, resulting in a high level of uncertainty about the forecasting properties of the model. To further evaluate if the forecasted variables move in the same direction as the actual variables, the following hypothesis is tested:

H_0: β=0

H_1: β≠0

The H_0 cannot be rejected here either, giving no specific information about the actual direction of the forecasted variables, but does indicate that the sample size is too small and therefore the uncertainty around the estimated values are high. With the existence of high uncertainty the model can be considered to be less fit for forecasting.

Root mean square error (RMSE) is used as the statistical measure of the model's abilities of out-of-sample forecasting. RMSE is the average error of the predicted value to the actual, given as the square root of the mean sum of the square errors. The RMSE's that are calculated are based on the parameters of regressions from Q2 1993 to Q1 2005 for predicting cumulative growth during Q2 2005 to Q4 2009. The RMSEs of both models are calculated to be compared with each other, giving a proper indication on which model performs better. The RMSEs are calculated with the following equation:

$$RMSE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(\hat{y}_{t,t+k}^{c} - y_{t,t+k}^{c})^2}$$

Where T is the number of out-of-sample forecasts, $\hat{y}_{t,t+k}^{c}$ is the predicted cumulative GDP growth and $y_{t,t+k}^{c}$ is the actual GDP growth. The results from the calculations are presented below.

Table 4: ***Root Mean Square Errors in Out-of-sample Forecasts***

The RMSEs are calculated from 2005:2 through 2009:4 based on parameters of regression from 1993:2 through 2005:1

Forecast Horizon: k Quarters Ahead	***Model1:*** $Y_{t,t+k} = \beta_0 + \beta_1 SPREAD_t + \varepsilon_t$		***Model 2:*** $Y_{t,t+k} = \beta_0 + \beta_1 SPREAD_t + \beta_2 CPI_t + \varepsilon_t$	
	RMSE	**Adjusted R^2**	**RMSE**	**Adjusted R^2**
1	2.382	0.202	2.380	0.205
2	2.373	-0.059	2.296	-0.059
3	2.112	-0.056	2.120	-0.054
4	2.033	-0.050	2.034	-0.049
5	1.844	-0.062	1.843	-0.062
6	1.707	-0.053	1.707	-0.056
7	1.587	-0.053	1.586	-0.047
8	1.530	0.145	1.530	0.136

As seen in Table 4, the RMSE values of both models lie very close to each other. Model 2 seems to have slightly lower RMSEs for horizons 1-2 and 5-8. Model 2 is thereby a slightly better model based on the RMSE values. However, the differences between the RMSE values of the two models are too small to draw any certain conclusions.

5. CONCLUSION AND FURTHE RESEARCH

The following chapter concludes the study and topics for further research are suggested.

5.1 Conclusion

This paper has investigated the abilities of the yield spread together with inflation and their forecasting properties for economic activity in Sweden. To do so, both single and multiple regressions were performed where the cumulative change in GDP growth was chosen as the measure of economic activity. Model 1 included the spread as its only explanatory variable whereas model 2 included both the yield spread and inflation as the explanatory variables. The investigation mainly concludes that the yield spread in this study contains some information about the variation in cumulative GDP growth, but does not confirm the strong relationship shown by previous research done for other countries. The relationship between the yield spread and cumulative GDP growth is shown to be significant for forecasting horizons three to five quarters in the future. The inflation on the other hand, seems to not contain significant information about future economic activity as it was shown to be non-significant in this study for the majority of the quarters examined.

The adjusted R^2 values of both models have their highest values during quarters four to six, a value of just over 20 percent for model 2, and around 23-25 percent for model 1. This is a fairly sufficient goodness of fit but still quite low compared to countries such as the United States, Canada and Germany. One reason for this could be the difference between different countries' monetary policies. As highlighted in this study the yield spread is influenced quite strongly by monetary policy and previous research has shown that the predictive power of the yield spread for future economic activity and inflation is much stronger for countries which have an independent monetary policy, such as the United States and Germany. However, an investigation of this matter lies beyond the scope of this paper. Another reason for the difference in performance of the yield spread might be that Sweden is a small open economy who's yield curve is highly influenced by movements in the international yield curve, whereas the United States, where the yield curve is a strong leading indicator of economic activity, is a large and closed economy with an influential financial market. The final and main reason of why the forecasting results and the performance of the yield spread is weak in this study, is because of the sample size not being large enough. Large sample size is what insures the predictive power of the yield spread.

5.2 Further Research

There are many aspects of the yield spread's power to predict future economic activity that can be of object for further research. One aspect is to further investigate how its power of forecast changes as other variables with predictive properties are added to the model. It is also of great interest to evaluate why the spread performs so differently in different countries and how different measures of economic activity can be of great importance for its forecasting ability. The relationship between the yield spread and monetary policy can be analysed in great detail as the results would provide very important and useful information about its performance. Further research can also be done about the relationship between observed rates of inflation and expectations of future inflation which is a significant part of the information contained by the spread. Evidently, there is a great interest in investigating how the yield spread can be used for predictions of recessionary times, another important aspect for further research.

6. REFERENCES

Published Sources

Bonser-Neal Catherine, Morley R. Timothy (1997), "Does the Yield spread Predict Real Economic Activity? A Multicountry Analysis", Federal Reserve Bank of Kansas City *Economic Review,* Vol. 82

Bordo D. Michael, Haubrich G. Joseph (2004), "The Yield Curve, Recessions, and the Credibility of the Monetary Regime: Long-run evidence 1875-1997", Federal Reserve Bank of Cleveland *Working Paper Series* nr. W10431

Dotsey Michael (1998), "The Predictive Content of the Interest Rate Term Spread for Future Economic Growth", Federal Reserve Bank of Richmond *Economic Quarterly,* Vol.84, nr.3

Estrella Arturo, Hardouvelis Gikas (1991), "The Term Structure as a Predictor of Real Economic Activity", *The Journal of Finance*, Vol. 46 nr. 2

Estrella Arturo, Mishkin Fredric S. (1996), "The Yield Curve as a Predictor of U.S. Recessions", Federal Reserve Bank of New York *Current Issues in Economics and Finance,* Vol. 2, nr. 7

Estrella Arturo, Mishkin Frederic S. (1997), "The predictive power of the term structure of interest rates in Europe and the United States: Implications for the European Central Bank", *European Economic Review,* Vol. 41

Estrella Arturo, Mishkin Fredric S. (1998), "Predicting U.S. Recessions: Financial Variables as Leading Indicators", *Review of Economics and Statistics*, Vol. 41

Estrella Arturo, Trubin Mary (2006), "The yield Curve as a Leading Indicator: Some Practical Issues", Federal Reserve Bank of New York *Current Issues in Economics and Finance*, Vol. 12, nr. 5

Hardouvelis Gikas A., Malliaropulos Dimitrios (2005), "The Yield Spread as a Symmetric Predictor of Output and Inflation", *C.E.P.R. Discussion Paper no. 4314*

Kozicki Sharon (1997), "Predicting Real Growth and Inflation with the Yield Spread", Federal Reserve Bank of Kansas City *Economic Review,* Volume 82

Lakshman Alles (1995), "The Australian term Structure as a Predictor of Real Economic Activity"*, The Australian Economic Review*

Plosser Charles I., Rouwenhorst Geert K. (1994), "International Term Structures and Real Economic Growth", *Journal of Monetary Economics,* Vol. 33

Stock James H., Watson Mark W. (1989), "New Indexes of Coincident and Leading Economic Indicators", *NBER Macroeconomics Annual*, Vol. 4 nr.1

List of Literature

Gujarati D.N. (2006), *Essentials of Econometrics*, International Edition, Singapore, McGraw-Hill

Westerlund Joakim (2005), *Introduktion till Ekonometri*, Lund, Studentlitteratur

Electronic Sources

http://www.investopedia.com/terms/y/yieldcurve.asp

www.riksbanken.se

www.datastream.com

http://www.newyorkfed.org/research/index.html

7. APPENDIX

Table 7.1: Data

Sample size: 1993:2 through 2009:4

Spread: the slope of the yield curve, which is the difference between the 10-year Treasury bond rate and the 3 month Treasury bill rate, given as quarterly average.

Inflation: The percentage change in Consumer Price Index, given quarterly.

QUARTER	GDP	SPREAD	INFLATION
Q2 1993	515799	0,192	0,136
Q3 1993	520148	0,088	4,490
Q4 1993	521911	0,233	- 0,391
Q1 1994	527980	0,336	4,314
Q2 1994	536172	2,154	2,506
Q3 1994	542469	3,656	2,323
Q4 1994	547530	3,002	5,137
Q1 1995	556181	2,757	- 16,136
Q2 1995	559435	1,982	1,220
Q3 1995	561282	1,025	0,134
Q4 1995	567389	0,202	0,134
Q1 1996	571584	0,921	- 0,668
Q2 1996	566705	2,287	1,344
Q3 1996	570081	2,914	1,194
Q4 1996	572531	2,775	0,524
Q1 1997	576552	2,897	1,825
Q2 1997	584522	2,965	1,280
Q3 1997	588609	2,344	1,896
Q4 1997	598101	1,878	1,861
Q1 1998	600268	1,098	- 0,122
Q2 1998	609943	0,741	0,976
Q3 1998	614475	0,665	2,053
Q4 1998	619114	0,701	- 0,473
Q1 1999	628743	1,050	0,238
Q2 1999	631944	1,623	0,356
Q3 1999	640002	2,459	0,946
Q4 1999	650600	2,345	1,991
Q1 2000	654914	1,916	0,574
Q2 2000	668217	1,334	3,767
Q3 2000	671926	1,303	0,770
Q4 2000	673216	1,084	0,764
Q1 2001	670274	0,782	- 0,433
Q2 2001	672587	1,156	- 3,047
Q3 2001	677358	1,069	1,122
Q4 2001	684994	1,420	1,110

Q1 2002	684073	1,520	0,878
Q2 2002	693998	1,363	- 1,197
Q3 2002	694383	0,953	0,441
Q4 2002	699996	1,109	1,645
Q1 2003	707099	1,031	- 0,108
Q2 2003	704612	1,269	1,512
Q3 2003	712712	1,939	1,277
Q4 2003	716192	2,177	- 0,210
Q1 2004	728558	2,064	1,579
Q2 2004	734022	2,648	1,969
Q3 2004	739616	2,450	- 0,813
Q4 2004	744461	2,099	- 0,307
Q1 2005	749071	1,838	1,747
Q2 2005	755436	1,498	-
Q3 2005	765924	1,584	0,202
Q4 2005	768844	1,749	1,109
Q1 2006	780023	1,522	1,994
Q2 2006	791174	1,762	1,564
Q3 2006	802643	1,416	0,577
Q4 2006	804039	0,791	3,254
Q1 2007	813379	0,618	0,927
Q2 2007	818085	0,812	- 0,459
Q3 2007	823129	0,735	- 0,738
Q4 2007	832702	0,307	2,695
Q1 2008	823801	-0,175	0,543
Q2 2008	823608	0,078	- 3,420
Q3 2008	823782	-0,274	- 1,584
Q4 2008	789972	0,282	- 8,902
Q1 2009	769173	2,040	- 11,227
Q2 2009	771720	3,069	- 1,874
Q3 2009	770837	3,232	1,313
Q4 2009	777453	3,081	- 0,471

Table 7.2: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=1

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y1
Method: Least Squares
Date: 01/03/11 Time: 13:23
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.731507	0.383252	1.908684	0.0608
X21	-0.012516	0.009308	-1.344607	0.1835
C	0.077107	0.784869	0.098241	0.9220

R-squared	0.162215	Mean dependent var	1.182324
Adjusted R-squared	0.136034	S.D. dependent var	1.714589
S.E. of regression	1.593707	Akaike info criterion	3.813745
Sum squared resid	162.5536	Schwarz criterion	3.912462
Log likelihood	-124.7604	Hannan-Quinn criter.	3.852807
F-statistic	6.195949	Durbin-Watson stat	1.430965
Prob(F-statistic)	0.003469		

Table 7.3: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=2

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y2
Method: Least Squares
Date: 01/03/11 Time: 13:24
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.508751	0.264543	1.923131	0.0589
X21	0.007281	0.007012	1.038356	0.3030
C	0.307184	0.598403	0.513340	0.6095

R-squared	0.125196	Mean dependent var	1.085738
Adjusted R-squared	0.097859	S.D. dependent var	1.359760
S.E. of regression	1.291516	Akaike info criterion	3.393253
Sum squared resid	106.7528	Schwarz criterion	3.491970
Log likelihood	-110.6740	Hannan-Quinn criter.	3.432316
F-statistic	4.579629	Durbin-Watson stat	0.602384
Prob(F-statistic)	0.013840		

Table 7.4: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=3

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y3
Method: Least Squares
Date: 01/03/11 Time: 13:25
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.593311	0.276684	2.144366	0.0358
X21	0.016125	0.005827	2.767432	0.0074
C	0.190243	0.616189	0.308742	0.7585

R-squared	0.211979	Mean dependent var	1.102928
Adjusted R-squared	0.187353	S.D. dependent var	1.232212
S.E. of regression	1.110801	Akaike info criterion	3.091783
Sum squared resid	78.96827	Schwarz criterion	3.190500
Log likelihood	-100.5747	Hannan-Quinn criter.	3.130846
F-statistic	8.608040	Durbin-Watson stat	0.345539
Prob(F-statistic)	0.000489		

Table 7.5: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=4

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y4
Method: Least Squares
Date: 01/03/11 Time: 13:25
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.627860	0.284807	2.204507	0.0311
X21	0.008965	0.005549	1.615550	0.1111
C	0.161959	0.621439	0.260619	0.7952

R-squared	0.260238	Mean dependent var	1.122777
Adjusted R-squared	0.237121	S.D. dependent var	1.163915
S.E. of regression	1.016598	Akaike info criterion	2.914543
Sum squared resid	66.14218	Schwarz criterion	3.013261
Log likelihood	-94.63720	Hannan-Quinn criter.	2.953606
F-statistic	11.25717	Durbin-Watson stat	0.341025
Prob(F-statistic)	0.000065		

Table 7.6: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=5

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y5
Method: Least Squares
Date: 01/03/11 Time: 13:26
Sample (adjusted): 1 66
Included observations: 66 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.595991	0.291541	2.044278	0.0451
X21	0.006230	0.005555	1.121431	0.2664
C	0.214565	0.618984	0.346640	0.7300

R-squared	0.265031	Mean dependent var	1.111037
Adjusted R-squared	0.241699	S.D. dependent var	1.077174
S.E. of regression	0.938008	Akaike info criterion	2.754272
Sum squared resid	55.43110	Schwarz criterion	2.853802
Log likelihood	-87.89098	Hannan-Quinn criter.	2.793601
F-statistic	11.35897	Durbin-Watson stat	0.278497
Prob(F-statistic)	0.000061		

Table 7.7: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for k=6

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y6
Method: Least Squares
Date: 01/03/11 Time: 13:27
Sample (adjusted): 1 65
Included observations: 65 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.545049	0.280868	1.940587	0.0569
X21	0.009194	0.005266	1.745706	0.0858
C	0.294583	0.586843	0.501980	0.6175

R-squared	0.249884	Mean dependent var	1.102319
Adjusted R-squared	0.225687	S.D. dependent var	0.999623
S.E. of regression	0.879619	Akaike info criterion	2.626399
Sum squared resid	47.97124	Schwarz criterion	2.726756
Log likelihood	-82.35797	Hannan-Quinn criter.	2.665996
F-statistic	10.32697	Durbin-Watson stat	0.251947
Prob(F-statistic)	0.000135		

Table 7.8: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for *k=7*

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y7
Method: Least Squares
Date: 01/03/11 Time: 13:27
Sample (adjusted): 1 64
Included observations: 64 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.476857	0.262281	1.818115	0.0740
X21	0.006727	0.004851	1.386575	0.1706
C	0.400937	0.543536	0.737646	0.4636

R-squared	0.214942	Mean dependent var	1.095009
Adjusted R-squared	0.189202	S.D. dependent var	0.925674
S.E. of regression	0.833516	Akaike info criterion	2.519414
Sum squared resid	42.37972	Schwarz criterion	2.620612
Log likelihood	-77.62125	Hannan-Quinn criter.	2.559281
F-statistic	8.350630	Durbin-Watson stat	0.248409
Prob(F-statistic)	0.000623		

Table 7.9: E-views - Regression results of model 2 for Q2 1993 to Q4 2009 for *k=8*

The table gives the regression results for model 2. The sample is quarterly from 1993:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and inflation. X11, X21, and C are the coefficients for the spread, inflation and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y8
Method: Least Squares
Date: 01/03/11 Time: 13:28
Sample (adjusted): 1 63
Included observations: 63 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.420088	0.236128	1.779064	0.0803
X21	0.009115	0.004119	2.212755	0.0307
C	0.489946	0.492186	0.995448	0.3235

R-squared	0.197952	Mean dependent var	1.099694
Adjusted R-squared	0.171217	S.D. dependent var	0.860109
S.E. of regression	0.783022	Akaike info criterion	2.395135
Sum squared resid	36.78737	Schwarz criterion	2.497189
Log likelihood	-72.44676	Hannan-Quinn criter.	2.435273
F-statistic	7.404257	Durbin-Watson stat	0.221329
Prob(F-statistic)	0.001337		

Table 7.10: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=1*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y1
Method: Least Squares
Date: 01/11/11 Time: 14:21
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.730149	0.380255	1.920155	0.0592
C	0.071426	0.778245	0.091778	0.9272

R-squared	0.160468	Mean dependent var	1.182324
Adjusted R-squared	0.147553	S.D. dependent var	1.714589
S.E. of regression	1.583047	Akaike info criterion	3.785976
Sum squared resid	162.8925	Schwarz criterion	3.851788
Log likelihood	-124.8302	Hannan-Quinn criter.	3.812018
F-statistic	12.42412	Durbin-Watson stat	1.443569
Prob(F-statistic)	0.000782		

Table 7.11: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=2*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y2
Method: Least Squares
Date: 01/11/11 Time: 14:22
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.509541	0.262856	1.938475	0.0569
C	0.310489	0.592178	0.524318	0.6018

R-squared	0.124256	Mean dependent var	1.085738
Adjusted R-squared	0.110784	S.D. dependent var	1.359760
S.E. of regression	1.282231	Akaike info criterion	3.364476
Sum squared resid	106.8675	Schwarz criterion	3.430287
Log likelihood	-110.7099	Hannan-Quinn criter.	3.390518
F-statistic	9.222645	Durbin-Watson stat	0.594775
Prob(F-statistic)	0.003438		

Table 7.12: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=3*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y3
Method: Least Squares
Date: 01/11/11 Time: 14:22
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.595061	0.275103	2.163044	0.0342
C	0.197563	0.609997	0.323875	0.7471

R-squared	0.206366	Mean dependent var	1.102928
Adjusted R-squared	0.194156	S.D. dependent var	1.232212
S.E. of regression	1.106142	Akaike info criterion	3.069029
Sum squared resid	79.53073	Schwarz criterion	3.134841
Log likelihood	-100.8125	Hannan-Quinn criter.	3.095071
F-statistic	16.90174	Durbin-Watson stat	0.347915
Prob(F-statistic)	0.000113		

Table 7.13: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=4*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y4
Method: Least Squares
Date: 01/11/11 Time: 14:22
Sample: 1 67
Included observations: 67
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.628833	0.282957	2.222364	0.0297
C	0.166028	0.615547	0.269725	0.7882

R-squared	0.258294	Mean dependent var	1.122777
Adjusted R-squared	0.246883	S.D. dependent var	1.163915
S.E. of regression	1.010073	Akaike info criterion	2.887318
Sum squared resid	66.31603	Schwarz criterion	2.953129
Log likelihood	-94.72514	Hannan-Quinn criter.	2.913359
F-statistic	22.63579	Durbin-Watson stat	0.335688
Prob(F-statistic)	0.000011		

Table 7.14: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=5*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y5
Method: Least Squares
Date: 01/11/11 Time: 14:22
Sample (adjusted): 1 66
Included observations: 66 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.596543	0.289505	2.060564	0.0434
C	0.217512	0.613173	0.354733	0.7240

R-squared	0.263918	Mean dependent var	1.111037
Adjusted R-squared	0.252417	S.D. dependent var	1.077174
S.E. of regression	0.931355	Akaike info criterion	2.725482
Sum squared resid	55.51504	Schwarz criterion	2.791835
Log likelihood	-87.94092	Hannan-Quinn criter.	2.751702
F-statistic	22.94688	Durbin-Watson stat	0.273243
Prob(F-statistic)	0.000010		

Table 7.15: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=6*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y6
Method: Least Squares
Date: 01/11/11 Time: 14:23
Sample (adjusted): 1 65
Included observations: 65 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.546579	0.278996	1.959092	0.0545
C	0.298211	0.581546	0.512790	0.6099

R-squared	0.247034	Mean dependent var	1.102319
Adjusted R-squared	0.235082	S.D. dependent var	0.999623
S.E. of regression	0.874266	Akaike info criterion	2.599423
Sum squared resid	48.15353	Schwarz criterion	2.666327
Log likelihood	-82.48124	Hannan-Quinn criter.	2.625821
F-statistic	20.66913	Durbin-Watson stat	0.248950
Prob(F-statistic)	0.000025		

Table 7.16 E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=7*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y7
Method: Least Squares
Date: 01/11/11 Time: 14:23
Sample (adjusted): 1 64
Included observations: 64 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.478318	0.260561	1.835721	0.0712
C	0.403262	0.538639	0.748669	0.4569

R-squared	0.213137	Mean dependent var	1.095009
Adjusted R-squared	0.200445	S.D. dependent var	0.925674
S.E. of regression	0.827717	Akaike info criterion	2.490461
Sum squared resid	42.47719	Schwarz criterion	2.557926
Log likelihood	-77.69476	Hannan-Quinn criter.	2.517039
F-statistic	16.79385	Durbin-Watson stat	0.240853
Prob(F-statistic)	0.000123		

Table 7.17: E-views - Regression results of model 1 for Q2 1993 to Q4 2009 for *k=8*

The table gives the regression results for model 1. The sample is quarterly from 1993:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. X11 and C are the coefficients for the spread and the constant respectively. The standard errors are corrected by using the Newey and West (1987) standard errors.

Dependent Variable: Y8
Method: Least Squares
Date: 01/11/11 Time: 14:23
Sample (adjusted): 1 63
Included observations: 63 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11	0.422203	0.234672	1.799118	0.0769
C	0.493080	0.487697	1.011039	0.3160

R-squared	0.194053	Mean dependent var	1.099694
Adjusted R-squared	0.180841	S.D. dependent var	0.860109
S.E. of regression	0.778462	Akaike info criterion	2.368239
Sum squared resid	36.96622	Schwarz criterion	2.436275
Log likelihood	-72.59953	Hannan-Quinn criter.	2.394998
F-statistic	14.68736	Durbin-Watson stat	0.210972
Prob(F-statistic)	0.000303		

Table 7.18: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=1*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,498938319
R-kvadrat	0,248939446
Justerad R-kvadrat	0,204759413
Standardfel	2,446937622
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	33,73754549	33,73754549	5,634659621	0,029658018
Residual	17	101,7875634	5,987503728		
Totalt	18	135,5251089			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95.0%*	*Övre 95.0%*
Konstant	-0,753900509	0,808521247	-0,93244366	0,364162159	-2,459731231	0,95193	-2,45973	0,95193
X-variabel 1	1,234272371	0,519968655	2,373743798	0,029658018	0,137234402	2,33131	0,137234	2,33131

Table 7.19: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=2*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,001255763
R-kvadrat	1,57694E-06
Justerad R-kvadrat	-0,05882186
Standardfel	2,250211978
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,000135741	0,000135741	2,6808E-05	0,995929128
Residual	17	86,0787171	5,063453947		
Totalt	18	86,07885285			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*

Konstant	0,382884211	1,230493401	0,311163156	0,7594598	-2,213229911	2,978998	-2,21323	2,978998
X-variabel 1	-0,005367382	1,036645003	-0,005177647	0,995929128	-2,192497138	2,181762	-2,1925	2,181762

Table 7.20: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=3*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNIG

Regressionsstatistik	
Multipel-R	0,070870879
R-kvadrat	0,005022681
Justerad R-kvadrat	-0,053505396
Standardfel	2,030680854
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,353878945	0,353879	0,085817	0,77311
Residual	17	70,1023004	4,123665		
Totalt	18	70,45617935			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	0,687550754	1,059237389	0,6491	0,524947	-1,54724	2,922346	-1,54724	2,922346
X-variabel 1	-0,269673216	0,920560057	-0,29294	0,77311	-2,21189	1,672539	-2,21189	1,672539

Table 7.21: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=4*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,097220006
R-kvadrat	0,00945173
Justerad R-kvadrat	-0,048815816
Standardfel	1,938316122
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,609443966	0,609443966	0,162213	0,692147
Residual	17	63,8701796	3,757069388		
Totalt	18	64,47962356			

	Koefficienter	Standardfel	t-kvot	p-värde	Nedre 95%	Övre 95%	Nedre 95,0%	Övre 95,0%
Konstant	0,814897226	0,979299062	0,832122951	0,416876	-1,25124	2,881038	-1,25124	2,881038
X-variabel 1	-0,348993636	0,866513284	-0,402756245	0,692147	-2,17718	1,47919	-2,17718	1,47919

Table 7.22: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=5*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,023979251
R-kvadrat	0,000575004
Justerad R-kvadrat	-0,061889058
Standardfel	1,79224013
Observationer	18

ANOVA

	fg	KvS	MKv	F	p-värde för F
Regression	1	0,02956878	0,02956878	0,009205	0,924756
Residual	16	51,39399496	3,212124685		
Totalt	17	51,42356374			

	Koefficienter	Standardfel	t-kvot	p-värde	Nedre 95%	Övre 95%	Nedre 95,0%	Övre 95,0%
Konstant	0,460323313	1,045922311	0,440112338	0,665743	-1,75693	2,67758	-1,75693	2,67758
X-variabel 1	-0,087029159	0,907077253	-0,095944594	0,924756	-2,00995	1,835889	-2,00995	1,835889

Table 7.23: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=6*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,10084801
R-kvadrat	0,010170321
Justerad R-kvadrat	-0,055818324
Standardfel	1,622063778
Observationer	17

ANOVA

	fg	KvS	MKv	F	p-värde för F
Regression	1	0,405509752	0,405509752	0,1541223	0,700149
Residual	15	39,46636351	2,631090901		
Totalt	16	39,87187327			

	Koefficienter	Standardfel	t-kvot	p-värde	Nedre 95%	Övre 95%	Nedre 95,0%	Övre 95,0%
Konstant	-0,209417207	1,31397569	-0,159376774	0,8754982	-3,01009	2,591256	-3,01009	2,591256
X-variabel 1	0,434765053	1,107444327	0,392584117	0,700149	-1,9257	2,795227	-1,9257	2,795227

Table 7.24: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=7*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,332383043
R-kvadrat	0,110478487
Justerad R-kvadrat	0,046941236
Standardfel	1,36565393
Observationer	16

ANOVA

	fg	KvS	MKv	F	p-värde för F
Regression	1	3,242878041	3,242878041	1,738799	0,208456
Residual	14	26,11014917	1,865010655		
Totalt	15	29,35302721			

	Koefficienter	Standardfel	t-kvot	p-värde	Nedre 95%	Övre 95%	Nedre 95,0%	Övre 95,0%
Konstant	-1,756963002	1,516530825	-1,15854091	0,266025	-5,0096	1,495672	-5,0096	1,495672
X-variabel 1	1,631259468	1,237081739	1,318635153	0,208456	-1,02202	4,284536	-1,02202	4,284536

Table 7.25: Excel- Forecasting results of model 2 for Q2 2005 to Q4 2009 for *k=8*

The table gives the forecasting results for model 2. The sample is quarterly from 2005:2 through 2009:4. Model 2 includes two explanatory variables, namely the spread and the inflation. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,444917246

R-kvadrat	0,197951356
Justerad R-kvadrat	0,136255307
Standardfel	1,172026643
Observationer	15

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	4,407335318	4,407335318	3,208493	0,096555
Residual	13	17,85740388	1,373646452		
Totalt	14	22,26473919			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	-2,875153542	1,717494308	-1,674039634	0,117998	-6,58557	0,835267	-6,58557	0,835267
X-variabel 1	2,449456871	1,367474494	1,791226734	0,096555	-0,50479	5,403706	-0,50479	5,403706

Table 7.26: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=1*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,402759001
R-kvadrat	0,162214813
Justerad R-kvadrat	0,136034026
Standardfel	1,593706546
Observationer	67

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	2	31,47419	15,73709	6,195949	0,003469
Residual	64	162,5536	2,539901		
Totalt	66	194,0278			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	0,077106714	0,37259	0,206948	0,836708	-0,66723	0,821441497	-0,66723	0,8214415
SPREAD X1	0,73150738	0,208575	3,507167	0,000834	0,314831	1,148183849	0,314831	1,14818385
CIP X2	-0,012516101	0,034266	-0,36526	0,716123	-0,08097	0,055938996	-0,08097	0,055939

Table 7.27: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=2*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,003811
R-kvadrat	1,45E-05
Justerad R-kvadrat	-0,05881
Standardfel	2,250197
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,00125	0,00125	0,000247	0,987645
Residual	17	86,0776	5,063388		
Totalt	18	86,07885			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	0,359314	1,24399	0,28884	0,776196	-2,26528	2,983905	-2,26528	2,983905
X-variabel 1	0,016402	1,043735	0,015715	0,987645	-2,18569	2,218491	-2,18569	2,218491

Table 7.28: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=3*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,047422
R-kvadrat	0,002249
Justerad R-kvadrat	-0,05644
Standardfel	2,033509
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,158447	0,158447	0,038317	0,847129
Residual	17	70,29773	4,135161		
Totalt	18	70,45618			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	0,594843	1,058401	0,562021	0,581437	-1,63819	2,827875	-1,63819	2,827875
X-variabel 1	-0,17865	0,912672	-0,19575	0,847129	-2,10422	1,746916	-2,10422	1,746916

Table 7.29: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=4*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,089692
R-kvadrat	0,008045
Justerad R-kvadrat	-0,05031
Standardfel	1,939692
Observationer	19

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,518711	0,518711	0,137867	0,714998
Residual	17	63,96091	3,762407		
Totalt	18	64,47962			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	0,790399	0,986514	0,801205	0,434069	-1,29096	2,871761	-1,29096	2,871761
X-variabel 1	-0,32193	0,867012	-0,3713	0,714998	-2,15116	1,507311	-2,15116	1,507311

Table 7.30: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=5*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,019849
R-kvadrat	0,000394
Justerad R-kvadrat	-0,06208
Standardfel	1,792402
Observationer	18

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,02026	0,02026	0,006306	0,93769
Residual	16	51,4033	3,212707		
Totalt	17	51,42356			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*

Konstant	0,445514	1,057586	0,421256	0,679173	-1,79647	2,687495	-1,79647	2,687495
X-variabel 1	-0,07243	0,912062	-0,07941	0,93769	-2,00591	1,861057	-2,00591	1,861057

Table 7.31: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=6*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,111539
R-kvadrat	0,012441
Justerad R-kvadrat	-0,0534
Standardfel	1,620202
Observationer	17

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	0,496042	0,496042	0,188964	0,669969
Residual	15	39,37583	2,625055		
Totalt	16	39,87187			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	-0,26161	1,31251	-0,19932	0,844688	-3,05916	2,535937	-3,05916	2,535937
X-variabel 1	0,478123	1,099892	0,4347	0,669969	-1,86624	2,822489	-1,86624	2,822489

Table 7.32: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=7*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,341037
R-kvadrat	0,116306
Justerad R-kvadrat	0,053185
Standardfel	1,361173
Observationer	16

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	3,413942	3,413942	1,842593	0,196127

Residual	14	25,93909	1,852792
Totalt	15	29,35303	

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	-1,82044	1,520708	-1,1971	0,251145	-5,08204	1,441152	-5,08204	1,441152
X-variabel 1	1,677528	1,235819	1,357422	0,196127	-0,97304	4,328097	-0,97304	4,328097

Table 7.33: Excel- Forecasting results of model 1 for Q2 2005 to Q4 2009 for *k=8*

The table gives the forecasting results for model 1. The sample is quarterly from 2005:2 through 2009:4. Model 1 includes one single explanatory variable, namely the spread. Konstant and x-variable are the coefficients of the constant and the explanatory variable.

UTDATASAMMANFATTNING

Regressionsstatistik	
Multipel-R	0,454168
R-kvadrat	0,206269
Justerad R-kvadrat	0,145213
Standardfel	1,165934
Observationer	15

ANOVA

	fg	*KvS*	*MKv*	*F*	*p-värde för F*
Regression	1	4,592523453	4,592523	3,378343	0,089012
Residual	13	17,67221574	1,359401		
Totalt	14	22,26473919			

	Koefficienter	*Standardfel*	*t-kvot*	*p-värde*	*Nedre 95%*	*Övre 95%*	*Nedre 95,0%*	*Övre 95,0%*
Konstant	-2,89646	1,686256703	-1,71768	0,109565	-6,53939	0,74648	-6,53939	0,74648
X-variabel 1	2,458001	1,337304004	1,838027	0,089012	-0,43107	5,34707	-0,43107	5,34707