JÖNKÖPING INTERNATIONAL BUSINESS SCHOOL
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Forecasting GDP Growth

The Case of The Baltic States

Bachelor Thesis in Economics

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Titel: Prognostisera BNP tillväxt – En studie om de Baltiska Staterna

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Sammanfattning

Syftet med den här uppsatsen är att fastställa en generell modell för att prognostisera BNP-tillväxten för de tre Baltiska Staterna, Estland, Lettland och Litauen. Om modellen ger bra resultat för de Baltiska Staterna antas det att modellen även kommer att ge tillförlitliga prognoser för andra länder av intresse. För att prognostisera BNP tillväxten används en reducerad vektor autoregressions (VAR) modell. VAR modellen använder tidigare värden av BNP-Inflation-Arbetslöshet som förklarande variabler.

De utförda prognoserna ger goda resultat upp till t+8. Prognoserna för 2009 (t+12) är i linje med flera andra aktörers prognoser. En del av prognoserna upp till t+16 antas ha tillförlitliga resultat. Prognosen för Litauen visar på ett fall i BNP på 12.51 procent 2009 och en BNP tillväxt på 4.23 procent för 2010. För Estland är prognosen ett fall i BNP på 1.49 procent för 2009 och 12.72 procent för 2010. Till sist visar prognosen för Lettland ett BNP fall på 3.1 procent under 2009 och 18 procent för 2010. Från resultaten kan man dra slutsatsen att den valda modellen ger tillförlitliga prognoser av framtida nivåer av BNP för båda de Baltiska Staterna och jämförelse länderna. Detta visar att modellen kan appliceras på andra länder av intresse.

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Abstract

The purpose of this thesis is to identify a general model to forecast GDP growth for the Baltic States, Estonia, Latvia and Lithuania. If the model provides reliable results for these states, then the model should be able to forecast GDP growth for other countries of interest. Forecasts are made by using a reduced vector autoregressive (VAR) model. The VAR models make use of past values of Gross Domestic Product-Inflation-Unemployment as explanatory variables.

The performed forecasts have provided good results for horizons up to t+8. The forecasts for 2009 (t+12) are in line with those of several other actors. It is reasonable to assume that some of the forecasts for t+16 have reliable results. The Lithuanian forecast show a fall in GDP with 12.51 per cent in 2009 and a GDP growth of 4.23 per cent in 2010. The forecast for Estonia show that the GDP will decrease with 1.49 per cent in 2009 and 12.72 per cent in 2010. Finally the forecast for Latvia show a fall in GDP of 3.1 per cent in 2009 and 18 per cent in 2010. From the findings it is possible to conclude that the model provided reliable estimates of future levels of GDP for the Baltic States and the benchmark countries. This indicates that the model should be applicable on other countries of interest.

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We cannot end without thanking our families and friends, whose constant encouragement and love we have experienced during our years at the University.

Patrick Pilström & Sebastian Pohl
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As we know,
there are known knowns.
There are things we know we know.
We also know
there are known unknowns.
That is to say
we know there are some things
we do not know.
But there are also unknown unknowns,
The ones we don't know
we don't know.

- Donald Rumsfeld

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Tables and figures

1. Introduction

A large part of the work in applied economic analysis for large businesses and governments of today is to forecast a future course for key macroeconomic variables such as Gross Domestic Product (GDP), inflation and unemployment to more effectively adjust policies. Forecasts are used to support politicians who need information of unemployment in order to set the right policies. Central banks need information about a future path of inflation in order to adjust its interest rate, and companies forecast future sales in order to adjust their production.

Even though forecasting clearly has an important purpose to fill within a large field of business, public service and policy making it has according to Bergheim (2008) been forgotten as subject. According to Bergheim most econometric and growth theory books only discuss the subject briefly and few economics departments offer courses in the field.

The main objective of this thesis is therefore to identify a general model to forecast quarterly GDP growth for Estonia, Latvia and Lithuania. The model used to forecast quarterly GDP growth is a vector autoregression (VAR), applied to three variables GDP, inflation (HICP) and unemployment (UN).

The Baltic States are of interest for a number of reasons. They have a relatively short history with large changes in the institutional environment but they are also among the fastest growing regions in the world. They are also new members of the EU and will most likely become members of the EMU as soon as they meet the Maastricht criteria. Forecasting GDP growth for the Baltic States will include challenges that a forecast of a large and stabile country will not offer. There is also a limited amount of previous research that focuses solely on the Baltic States.

The national central banks and other international actors provide forecasts of a large set of variables, however not much theoretical research is done regarding the choices of models, accuracy or other issues related to GDP forecasting. This could be explained by the limited amount of data available. In 2005 the European Central Bank (ECB) evaluated the tools available for forecasting macroeconomic variables in the 10 new member states of the EU. The ECB choose to exclude the Baltic States (Cyprus and Malta was also excluded) due to the limited amount of data available (Banerjee, Marcellino & Masten, 2005).

The three Baltic States have had a highly volatile GDP growth but have also experienced large fluctuations in other macroeconomic variables. If the computed forecasts are satisfactory for the Baltic States, the model should also be able to forecast GDP growth for other countries of interest. To test the model further it is used to forecast GDP growth in three large European Monetary Union (EMU) countries. France, Germany and Italy are chosen as representatives for EMU since they are the largest economies in this group and account for about 70 per cent of total GDP in the Euro area. Another advantage of choosing these three is that the model is applied to countries with completely different features, since the EMU members have had a stable inflation rate and GDP growth.

A greater volatility and uncertainty is assumed in the forecast of the Baltic States compared to the three large EMU countries. The main reason for this expectation is that the Baltic States are new economies with a relatively short history and many institutional changes within the analyzed time period. According to Krkoska and Teksoz (2007) the forecast accuracy of macroeconomic variables in transition countries tend to increase with the level of transition

and the variability of output growth decline with time. The high volatility and uncertainty make it reasonable to expect that the financial crisis in 2008-2009 will impact the Baltic States to a greater extent compared to the large EMU members.

In the next section forecasting theory and other issues related to the theory are discussed. In section three previous research is reviewed. Section four present the data and descriptive statistics. This is followed by section five where the method is described in detail together with the results from the forecasts and the analysis. Finally section six summarizes the thesis with conclusions drawn.

2. Theoretical Framework

In this section the theory behind forecasting is presented. Time series modeling, forecasting with time series models and leading indicators that are used whilst forecasting is also discussed.

2.1 Forecasting theory

There are a wide range of methods available for forecasting macroeconomic variables. Two of the most common methods are the so-called Judgment-based forecast and the Model-based forecast. The result of a Judgment-based forecast is primarily dependent on a specific forecaster's ability to observe empirical irregularities and regularities in the economy which makes it difficult for an outsider to observe the model and data used (Robertson & Tallman, 1999).

The other alternative, the Model-based forecast is based on a statistical approach which makes it easier to trace sampling errors and therefore the performance of the model can be evaluated. The most common Model-based forecast is a vector autoregression (VAR) model. A general VAR model is formulated like Equation (1);

$$\gamma_t = \alpha + \beta_1 \gamma_{t-1} + \cdots + \beta_p \gamma_{t-p} + \mu_t \qquad (1)$$

Where γ at time t depends on past values of γ up to a lag length of p, α is a constant and β is a regression coefficient that symbolizes the contribution of the independent variable to predict the dependent variable γ and μ_t is the error term (Robertson & Tallman, 1999).

Within the Model-based forecasting there are a variety of forecast methods, Marcellino, Stock and Watson (2005) mention the iterated and direct methods of forecasts. The most widely used model is the iterated model, where forecasts are made by using a one-period-ahead model, and then iterates forward for the desired number of periods, until $t+h$ (in this thesis h is measured in quarters). The direct forecasts are created using an exact horizon-specific estimated model, where the dependent variable is being forecasted. An example of an iterated forecast method was given in Equation (1) which imply that forecast horizons greater than one are based on actual and forecasted values of the dependent and the explanatory variables.

In a VAR model the variables are endogenous and affect each other. In the methodology section (5.1) a reduced vector autoregression model is explained which is used in this thesis where the equations are estimated by Ordinary Least Squares (OLS). When the equations are estimated with OLS the critical t-values are often low because of the lags on the dependent variable and therefore the estimated coefficients may not be statistically significant because of the possibility of multicollinearity. The F-stat values tend to be high, which means that it is not possible to reject the hypothesis that all variables may be statistically significant on the basis of a standard F-test (Gujarati, 2004).

One of the most important things to state about forecasting is that it assumes that the model is properly structured. It needs to be so not only for the complete sample period but also for the complete forecast horizon. In reality the variables that affect the dependent variable have a tendency to change over time. Special events such as shocks will also affect the forecast in ways that cannot be predicted. It is important to state that just because a set of variables might

explain historical values of the dependent variable there is nothing that says that it will explain future values just as good (Bergheim, 2008).

It is important to stress that when constructing a vector autoregressive model one has to decide on which variables to use, and which variables to omit. Consequently it is common practice to depend on some basic economic theory when the relation of the variables are taken into account (Lütkepohl and Krätzig, 2004). Further reasons to why it is important to rely on economic theory when the model is constructed, is that the communication process of the computed material becomes fairly straightforward. Bergheim (2008) stress that it is easier to rely on a forecast when making policy decisions if it builds on sound economic theory than if it is constructed with no logic even if it creates quality forecasts.

2.2 Lag length selection

According to Holmberg & Johansson (2007) the problem with lag length selection is that if there is a lag length of *p* and the VAR model contains *n* equations, then every equation will include *np* coefficients. This means that a VAR model with three variables and eight lags will consist of 24 parameters in every equation. The more variables and more lags added to the model, the more degrees of freedom are consumed. Therefore to efficiently evaluate the vector autoregressive model one has to decide on the optimal level of lags used. Where the number of lags used indicate how many previous values that are taken into account of the independent variables to explain the dependent variable. With the lag structure, one always go from the latest to the earliest, where the latest observation has the most explanatory power.

To decide on the optimal level of lags the most widely used criterion is the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC), which says that the model with the lowest number of these criterions should be used, which inevitably is found by some trial and error (Gujarati, 2004).

2.3 Leading indicators

One can explain a leading indicator as a variable that include information of how other variables are affected by it. The VAR model in the current thesis makes use of past values of GDP, inflation and unemployment as explanatory variables. These variables were chosen because inflation and unemployment have influenced GDP in the past, and will most certainly influence GDP in the future. To confirm that GDP is affected by unemployment and inflation a hypothesis test has been conducted. The result of the test is that the coefficients are significant, that is, the variables have a relationship. The hypothesis test can be found in Appendix 1 – Causality.

The relationship between GDP and unemployment is negative because when unemployment increases, GDP will fall. The inverse relationship has been a central object in varieties of discussions that try to estimate how much GDP *should* decrease with a one per cent increase in unemployment. The relationship is proven to show different result depending on country and time taken into consideration (Cuaresma, 2003).

Inflation was chosen as the other variable of interest because of it being one of the most widely used macroeconomic indicator of an economy. For instance, when Latvia experienced rapid growth over most of the 21st century, employment increased. When firms struggle to find workers for the increased output, salaries will increase which will spur firms to increase their prices to afford the increased salaries. This will lead to an inflationary pressure in the economy.

3. Previous Research

Previous research includes different forecasting methods, log transformation, how to overcome technical hurdles and forecasting in transition countries and choice of variables.

Andersson (2007) performed a study to evaluate the best linear time series model to forecast Swedish real GDP growth. The study included models of random-walk; autoregressive and vector autoregressive models that used forward looking surveys as explanatory variables. The forward looking surveys in the study included businesses and consumer confidence surveys as leading indicators of GDP. The surveys are based on the optimism of businesses and consumers on the current and future conditions of the economy. Andersson show that the most vital macroeconomic variables used in forecasting Swedish real GDP growth are GDP, unemployment and inflation. Andersson found that even though the performance differences were small, the vector autoregressive models outperformed other models. Granger and Newbold (1986) states that simple models are frequently only marginally less precise than forecasts made by complex models (cited in, Andersson, 2007).

In macroeconomic forecasting with VAR models log-transformed data has become standard to avoid harmful effects of heteroscedasticity and skewness in the level data. Mayr and Ulbricht (2007) researched the appropriateness of level versus log-transformed data. In the research the authors examined a wide range of models which were employed over different estimation periods and forecast horizons, with the use of VAR models. The results show that the forecasts based on level models slightly outperform models in log-transformed data.

Robertson and Tallman (1999) say that a large part of the applied economics for governments and businesses includes the construction of forecasts for real GDP growth, inflation and unemployment. The Model-based forecast research in their report is a vector autoregression of six U.S. macroeconomic variables which is used to forecast real GDP growth, inflation and unemployment. According to Robertson and Tallman forecasting with a VAR model is done to summarize the dynamic correlation patterns among the observed data series, and then use this observed data to forecast future values for each series. The article has its focus on how to overcome technical hurdles that needs to be addressed when producing real-time forecasts with a VAR model.

Marcellino, Stock and Watson (2001) describe the increasing importance of forecasting European economic performance with respect to the European Central Bank's inflation target of the Euro. The increased European integration means that business and political decisions increasingly relies on the aggregate economic activity in the Euro area, which means that there is an increasing interest of forecasting these economic activities. Marcellino et al. (2001) discuss the uncertainty of the best approach of forecasting and therefore they examine several time series methods for forecasting four Euro-area variables: real GDP, industrial production, inflation and the unemployment rate. They apply these variables to a set of models to forecast one-, two- and four-quarters ahead. The VAR model included variables of GDP, inflation and unemployment. Marcellino et al. (2001) said that the small scale VAR model could miss important information in the omitted variables, which is said to be included in the error term.

Krkoska and Teksoz (2007) analyzed how accurate GDP forecasts have been in a sample of 25 transition countries from 1994 to 2004. The forecast sample includes a large part of the former Soviet Union states including the three Baltic States. They were interested in how the forecasts were affected by large institutional changes and where only short time series for a limited amount of variables were available. They reached the conclusion that forecasts made by the European Bank for Reconstruction and Development (EBRD) have been successful.

Forecast errors that have occurred have not been auto correlated but instead followed a random walk. They found that the accuracy of the forecasts increase with the level of transition and with the level of available data. The article also includes an extensive summary of previous research on forecasting and a summary of the problems related to forecasting macroeconomic variables for developing countries. The main problems identified include models with short time series and lack of variables. Transition reforms also contribute to the forecasting uncertainty: this is mainly shown as the high output volatility that can be identified at early stages of transition. Krkoska and Teksoz (2007) also prove that the variability of the output growth decline with time, the average absolute difference in GDP growth for their sample decreased from eight per cent in 1995 to an average of two per cent in 2003.

4. Data analysis

In this section data and descriptive statistics are presented with regards to quarterly changes in GDP, quarterly inflation rates and quarterly unemployment.

4.1 Data

For all data the sample period has been chosen to be from 1998Q1 to 2008Q4. The choice of sample period was made purely on data availability. The Baltic States are relatively new nations and data from earlier than 1998 are hard to find and might even be less accurate. The data has been collected from www.ec.europa.eu/eurostat.

Data on GDP were collected from Eurostat National account statistics on February 24, 2009. The data takes the form of seasonally adjusted quarterly data, measured in current prices and millions of Euro.

As a measure of inflation Harmonized Indices of Consumer Prices (HICP) are used, these also collected from Eurostat on February 24, 2009. The HICP show the percentage change in inflation for all goods/services and with the base year set to 2005. The data retrieved were in monthly form and were manually transformed to quarterly data.

Finally data for quarterly unemployment rates were collected from Eurostat on March 9, 2009. The data takes the form of percentage unemployment, seasonally unadjusted data, for the entire work force.

4.2 Descriptive statistics

In this section quarterly change in GDP, quarterly inflation rates and quarterly unemployment rates for the sample countries are discussed. The countries considered are Estonia, Latvia, Lithuania, France, Germany and Italy, with the emphasis on the Baltic States. The quarterly change in GDP for country *j* has been measured by Equation (2):

$$\Delta GDP = \frac{GDP_t^j}{GDP_{t-1}^j} - 1 \qquad (2)$$

where ΔGDP is a change in GDP between time *t* and *t-1*, GDP_t^j is GDP for country *j* at time *t* and GDP_{t-1}^j is GDP for country *j* at time *t-1*.

With Equation (2) the quarterly changes in GDP for the sample countries has been calculated and are presented in Figure 1.

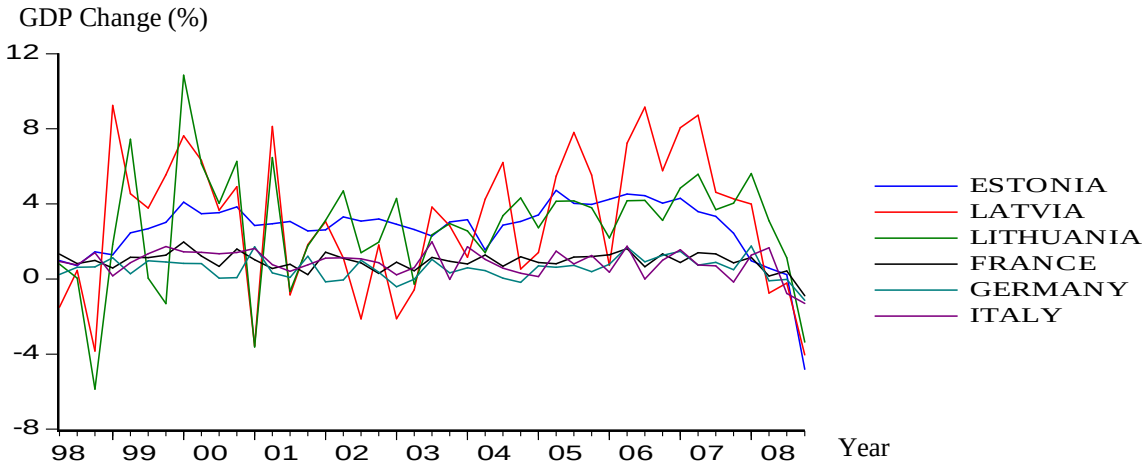

Figure 1. *Quarterly percentage change in GDP, 1998-2008*
Source: Data from Eurostat

The most obvious trend that can be observed in Figure 1 is the large fluctuations in the three Baltic States compared to the large EMU members (France, Germany and Italy) that are used as benchmark countries. The Baltic States have experienced high GDP growth throughout the sample period, where Latvia experienced the highest growth and Estonia the most stable growth after the inclusion in the European Union (in 2004). Lithuania experienced the highest growth before joining the EU, peaking at roughly eleven per cent in 1999. The Baltic States all have had a positive GDP growth after the inclusion in the European Union, up until the financial crisis in 2008. The benchmark countries have throughout the sample had a positive but not as high growth as the Baltic States.

As seen in the Figure 1 there have been large variations in quarterly GDP growth throughout the sample period. The change is better illustrated in Table 1 where the sample has been divided in to two groups. One group consists of data from 1998 – 2003 and one from 2004-2008. In Table 1 it is possible to observe the large increases in the level of quarterly GDP that has taken place since 1998. For example Lithuania had a maximum level of quarterly GDP of 4260.7 in the first period compared to the lowest level observed in the second period of 4369.6. In other words, the highest levels observed in the first period are lower than the lowest levels observed in the second period. Another indication of the increased quarterly

GDP levels is the mean values that for all the Baltic States have at least doubled between the two periods. For example Latvia had a mean of 2103.8 in the first period compared to 4213.3 in the second.

Table 1. *Descriptive Statistics, quarterly GDP for the Baltic States (in millions of Euro)*

GDP	Sample period 1998-2003				Sample period 2004-2008			
	Min.	Mean	Max.	Std.Dev.	Min.	Mean	Max.	Std.Dev.
Estonia	1227.0	1657.6	2261.6	338.8	2333.0	3255.1	4055.7	628.7
Latvia	1460.2	2103.8	2583.6	391.5	2613.6	4213.3	5884.3	1205.2
Lithuania	2389.1	3240.6	4260.7	616.4	4369.6	6198.2	8311.6	1345.5

Source: Data from Eurostat

Table 2 provides the total growth in GDP during the period 1998-2008. Latvia has had the highest growth with 303 per cent. Overall the Baltic States have had a tremendous growth over ten years (Estonia 230 per cent and Lithuania 247 per cent), but with the current financial crisis it is not likely that they will have an equal strong growth for the coming ten years. The financial crisis will have a negative impact on GDP growth, but with the Euro adoption at least in sight, it is likely that this will boost their economies once again.

Table 2. *Total percentage GDP growth (in per cent)*

	Estonia	Latvia	Lithuania	Germany	France	Italy
1999-2008	230	303	247	28.7	51.2	48.1

Source: Data from Eurostat

The inflation rates for the sample countries are presented in Figure 2. The most apparent trends are that the Baltic States have had a much more volatile inflation rate compared to the benchmark countries.

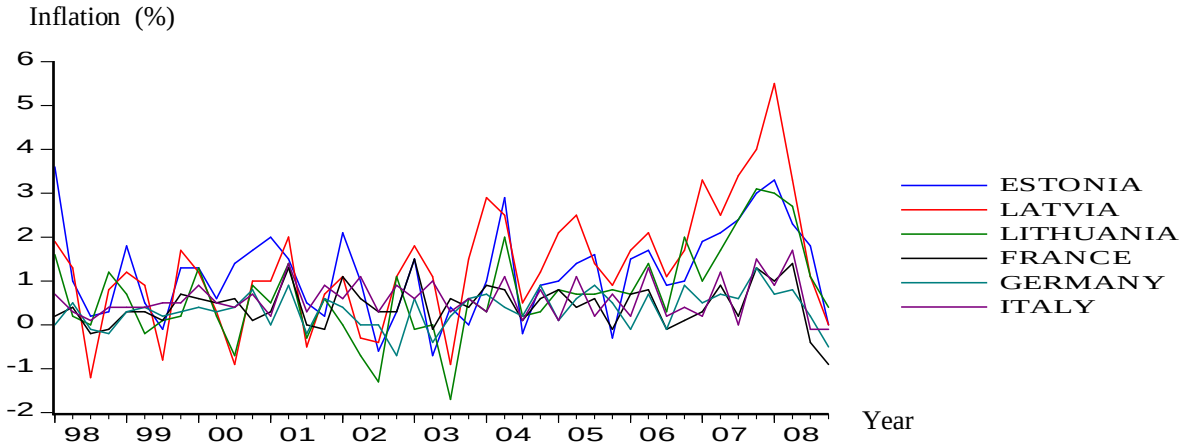

Figure 2. *Quarterly inflation rates, 1998-2008*
Source: Data from Eurostat

In Figure 2 it is possible to see that the high growth rates identified in Figure 1 for the Baltic States have resulted in greater inflation rates. As a result of the high inflation rates the Baltic States have not met the Maastricht criteria with respect to their inflation rates. After joining EU in 2004 the Baltic States strived to attain lower inflation rates, but growth rates made it

difficult[1]. Germany, Italy and France have had stable inflation rates during the sample period presumably because the ECB has inflation targeting as its main objective.

In Table 3 the inflation rates has been divided in to two groups in a similar fashion as for the GDP data in Table 1. There has been a drastically increase in inflation between the periods. Latvia for example had a mean of 0.6 in the first period compared to 2.2 in the second. Interesting to look at is the standard deviation. The relative small changes in standard deviation between the two periods indicate that the range of the observed inflation has not changed much between the periods. What has happened is that the range has shifted upwards to higher levels of inflation but the range of observed inflation is almost unchanged. For example Lithuania had an almost unchanged standard deviation between the periods but the range has shifted from -1.7 – 1.6 to 0.2 – 3.1.

Table 3. *Descriptive Statistics, quarterly inflation for the Baltic States (in per cent)*

Inflation	**Sample period 1998-2003**				**Sample period 2004-2008**			
	Min	Mean	Max	Std.Dev	Min	Mean	Max	Std.Dev
Estonia	-0.7	0.9	3.6	0.9	-0.3	1.5	3.3	1.0
Latvia	-1.2	0.6	2.0	0.9	0.0	2.2	5.5	1.3
Lithuania	-1.7	0.2	1.6	0.8	0.2	1.3	3.1	0.9

Source: Data from Eurostat

In Figure 3 the quarterly unemployment rates in per cent are presented. With regards to the increased GDP growth the quarterly unemployment rates have decreased since the end of 2001 with some minor fluctuations throughout the sample. During 2008 when the first signs of a recession appeared unemployment began to increase in all of the sample countries, and did so throughout the year. The exception is Germany that according to the data has decreased their unemployment every year since 2005. The unemployment rate for Germany during 2008 compared to the sample countries contributes to the low decrease in GDP observed in 2008. Most likely a continuing negative trend in unemployment will be observed in 2009 which then probably also will include Germany. It is possible that there will be a decrease in unemployment during the last quarters of 2009 or in the early 2010 when most economists assumes that an upward trend in the business cycle may be observed.

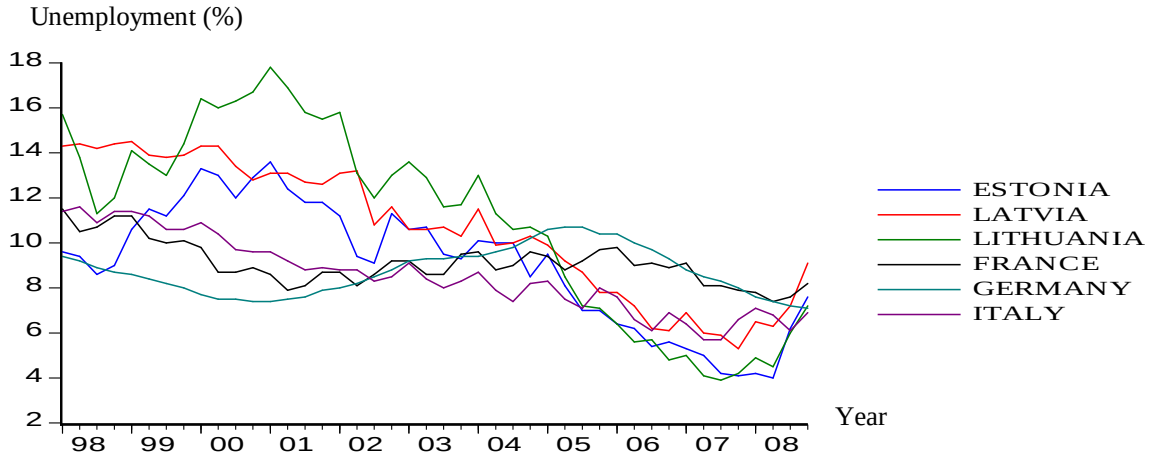

Figure 3. *Quarterly unemployment rates, 1998-2008*
Source: Data from Eurostat

[1] For a deeper discussion about the for high inflation countries to join a monetary union with low inflation countries see *Economics of Monetary Union* by Paul De Grauwe (2007).

Looking at the unemployment statistics it is possible to identify another trend. Up to around 2003/2004 all the Baltic States experienced greater unemployment compared to the three EMU members. The Baltic States all experienced lower levels of unemployment than France, Germany and Italy after their EU membership in 2004. There are several possible reasons for this but since the benchmark countries have had a relatively stable unemployment throughout the period 1998Q1-2008Q4, it is likely that the answer is to be found in the Baltic States.

In 1998 when the time period starts the Baltic States were recovering from the Russian financial crisis. It might be the case that the high unemployment levels arose from this and that the drastic fall in unemployment is a return to the normal levels. This is probably a part of the answer, though several other factors should also be brought up as possible explanations. The most drastic drop in unemployment is observed in 2004 when the three Baltic States joined the European Union. The EU membership both expanded the labor market but also resulted in increased trade integration with the EU that probably lead to increased employment. Another possible explanation is structural changes in labour market institutions that resulted in increased employment. As mentioned above the real answer is probably a combination of all these factors.

The unemployment data is presented in Table 4, divided in to two time periods. From the table the features discussed above about a decreasing unemployment after the inclusion in the monetary union is identified. All the Baltic States have a much lower unemployment in the second period compared to the first. For example Lithuania had a mean unemployment of 14.3 per cent in the first period compared to only 7 per cent in the second, a decrease of more than 50 percent.

Table 4. *Descriptive Statistics, quarterly unemployment for the Baltic States (in per cent)*

Unemployment	**Sample period 1998-2003**				**Sample period 2004-2008**			
	Min	Mean	Max	Std.Dev.	Min	Mean	Max	Std.Dev.
Estonia	8.6	11.0	13.6	1.5	4.0	6.7	10.1	2.0
Latvia	10.3	12.9	14.5	1.4	5.3	7.9	11.5	1.8
Lithuania	11.3	14.3	17.8	1.9	3.9	7.0	13.0	2.7

Source: Data from Eurostat

5. Empirical forecasting of GDP growth

In this section the methodology is presented. To forecast GDP growth for individual countries a vector autoregressive model is used.

5.1 Methodology

Several authors (see Andersson, 2007; Robertson & Tallman, 1999) have suggested that a vector autoregression model is most accurate for forecasting GDP growth. According to Marcellino et al. (2005) the iterated method of forecast is the most widely used and therefore it is used in this thesis instead of a model with a direct approach.

Forecasts are made one-step-ahead (horizon *t+1)* and iterates forward. The first forecast for t+1 is based on the primary estimated parameters and the information available at time t. Then the updated estimated parameters are used to make one-step-ahead forecasts for the desired number of periods, until *t+h*. A one step horizon (t+1) show that the forecast is made for one quarter ahead. Forecasts in this thesis are performed for horizons up to t+16, which is 16 quarters ahead. Forecasts start in 2007 and ends in 2010. The performance of the forecast has been evaluated by a comparison of real observed GDP and forecasted values between 2007 and 2008.

Similar to Marcellino, Stock and Watson (2001) a three variable VAR model is used with GDP, unemployment and inflation. Adding more variables does not necessary give better results since simple models are frequently only marginally less precise than forecasts made by complex models. Also Andersson (2007) reach to the conclusion that these variables are the most vital when forecasting GDP growth.

The current paper uses a reduced form of VAR to forecast future values of GDP. A reduced VAR model express each variable used for the forecast as a linear function of its own historical values. This way all previous data for all the variables are taken into account and the error term is said to include all omitted variables that affect a change in GDP. The error term is said to explain shocks and other unexpected movements in the variables that occur when previous values are taken in to account (Stock & Watson, 2001).

The VAR model used to produce forecasts in this thesis are given by Equation (3):

$$\mathrm{GDP}_{1t} = \alpha + \beta_1 \mathrm{GDP}_{t-1} + \beta_2 \mathrm{GDP}_{t-2} + \cdots + \beta_j \mathrm{GDP}_{t-j} + \gamma_1 \mathrm{HICP}_{t-1} + \gamma_2 \mathrm{HICP}_{t-2} + \cdots + \gamma_j \mathrm{HICP}_{t-j} + \delta_1 \mathrm{UN}_{t-1} + \delta_2 \mathrm{UN}_{t-2} + \cdots + \delta_j \mathrm{UN}_{t-j} + \mu_t \quad (3)$$

which implies:

$$\mathrm{GDP}_{1t} = \alpha + \sum_{j=1}^{k} \beta_j \mathrm{GDP}_{t-j} + \sum_{j=1}^{k} \gamma_j \mathrm{HICP}_{t-j} \sum_{j=1}^{k} \delta_j \mathrm{UN}_{t-j} + \mu_t \quad (4)$$

Where GDP at time *t* depends on past values of the explanatory variables GDP, inflation and unemployment up to a lag length of *k*, α is a constant term, μ_t is the stochastic error term, k is the number of lags selected. β, γ and δ are coefficients that represent the individual contributions of the independent variables to the prediction of the dependent variable. *j* is the notation, in this case it means that the series starts from j and ends in k.

To forecast more than one period ahead it is also necessary to forecast the other variables, inflation and unemployment. This is done automatically in the program of choice, E-views, but in practice it creates three different equations and sets inflation (HICP) and unemployment (UN) as dependent variables in a similar fashion as Equation (4). The relationship between the variables in the three automatically generated equations is from an economic point of view not so strong. Diebold (1998) reaches the conclusion that there is no support that high reliance on economic theory will create better forecasts. A good forecast is a model that quickly changes to shifts in the economy, not models that relies on good economic theory (cited in, Bergheim 2008).

The main problem of selecting the number of lags is that selecting too many lags will consume degrees of freedom. Selecting too few lags could lead to specification errors. It is possible to choose number of lags after the Akaike and Schwarz criterions, which states that the model with the lowest values of these criteria should be used, which are found by trial and error (Gujarati, 2004). In the forecast models both the criteria's indicated the use of the same number of lags, where the Akaike Information Criterion numbers are presented with the forecast.

With support of Mayr and Ulbricht (2007), the data is not LOG transformed since models with level data outperforms models with log-transformed data.

5.2 Analysis

The financial crisis in 2008-2009 has made most forecasting uncertain and created problems for everyone that relies on accurate forecasts to make the right decisions. In general, forecasts are more reliable the shorter time in to the future you want to take under consideration (O´Connor & Remus 2000). The high volatility and large movements that have been observed in almost all markets have made even short forecasts unreliable. All efficient markets are assumed to follow a random walk but it is usually still possible to identify trends. In many cases during the financial crisis this has not been possible. Most forecasting models are constructed to identify and predict the normal case and can almost never identify shocks of such magnitude as observed today. In the Figures in the forthcoming sections the confidence intervals indicates how the uncertainty (confidence intervals) become larger the longer in to the future the forecasts aims to predict. Due to the market conditions it might be the case that the confidence intervals should be wider in the beginning of the forecast, to reflect the special circumstances and increased volatility that the financial crisis brought about.

It is assumed that if the world had not experienced such a large crisis as it did the results of this thesis would have become even better. The actual forecasted values would most likely have followed its old trend and the confidence intervals would presumably have become tighter. Because the more volatile the historic values have been the wider the confidence intervals became when the forecasts were performed. France (Figure 7) and Italy (Figure 9) that has an almost straight line to illustrate their historical GDP values also have tight confidence intervals. On the other hand Latvia that has a volatile history as expected also has wide confidence intervals. As stated in the theory section, Krkoska and Teksoz (2007) conclude that forecast accuracy increase with transition, since transition periods for several reasons are more volatile. This supports the finding that the developed countries in the sample (Germany, France and Italy) have much tighter confidence interval than the less developed countries (Estonia, Latvia and Lithuania).

In all the GDP Figures in the forthcoming sections it is easy to see how they follow a general business cycle. By looking at Germany (Figure 8) a steep increase in GDP in the second half of 2007 is observed that arose from the overheated market the world experienced. Also the drastic falls observed in most markets during the financial crisis are easy to identify as the drop in GDP in the second half of 2008. For all countries in the sample the initiation of the financial crisis and the crisis itself can easily be identified as the increased volatility observed between 2007 and 2009.

The following sections display the forecasts of quarterly GDP growth in Estonia, Latvia and Lithuania. The confidence intervals for these Baltic States are as already concluded very wide. Narrow confidence intervals should indicate a greater precision of the forecast. Even though the confidence intervals are wide and market fluctuations are large the forecasts have performed well for forecast periods up to at least t+12 and in some cases for periods up to t+16. The results make it reasonable to assume that it is possible to use the model to create good predictions about the future levels of GDP even if the confidence intervals are wide.

By including a longer data sample it is likely that forecasts would have improved further. In the relatively small data sample large unusual events take place that creates the large variations observed in the descriptive statistics and in the forecasts. The Baltic States have within the sample period experienced the Russian financial crisis, EU membership and the financial crisis of 2008. All these events must be seen as unusual with increased volatility that in turn created wider confidence intervals and greater uncertainty in the sample. In other words these extraordinary events have had a large impact on the forecasts.

5.3 Lithuania

Figure 4 illustrates the forecasted future levels of GDP in Lithuania where the blue line show the forecast, the black line represent the real GDP. The red line represents the 90% confidence interval. The Akaike Information Criterion (12.6) indicated the use of three lags and the high F-statistic (749.2) indicates that all variables are statistically significant.

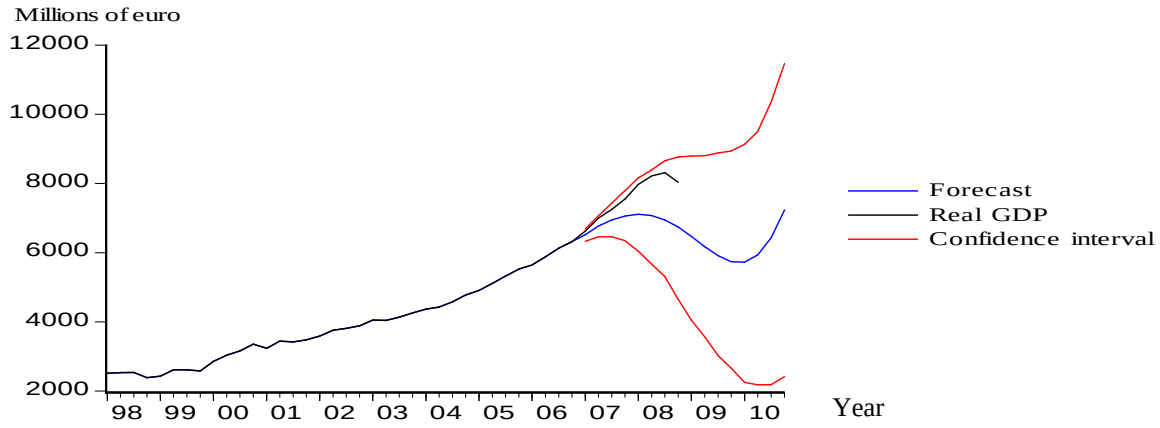

Figure 4. *Quarterly GDP of Lithuania and forecast of Lithuanian GDP for the period 2007-2010*
Source: Data from Eurostat

Figure 4 shows how the model underestimates the true value of GDP in Lithuania during 2007 and 2008, which probably depends on the drastically increase in unemployment that was observed during the same period. The sharp increase in unemployment will naturally result in a fall in domestic demand which will cause a reduction of the multiplier and a reduction in GDP. The current financial crisis has had large influence on business and consumer confidence, which have further worsened the economic conditions.

The forecast underestimates the increase in GDP in 2007-2008 and predicts the fall observed in the end of 2008 a bit too early compared to the real GDP for Lithuania. The shape of the forecasted line is to be stressed and it is reasonable to assume that this is the best forecast and probably the best fitted line to reality that is found in the sample group. The forecast foresees an upward trend in the fourth quarter of 2009. A trend that is likely to be observed also in the real world. Most forecasting institutions assume that the world will see an upturn or at least a stabilization of the economic conditions in the end of 2009 and 2010. This upward trend is probably due to normal business cycle fluctuations and also that stimulation packages that has been initiated around the world start to have effect.

Table 5 provides the forecast comparison for the period 2007-2008. The table includes a percentage difference between the forecasted and the real GDP values. In 2007Q1 the forecast is only 1.49 per cent away from the real GDP for Lithuania, but because of the underestimation of the Lithuanian economy in 2008 the forecast differs more in the end of 2008 and is 16.5 per cent away from the real GDP.

Table 5. *Lithuanian forecast comparison for the period 2007-2008 (in millions of Euro)*

Lithuania	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008 Q4
Real GDP	6625.9	6995.8	7253.9	7547.3	7971.5	8219.0	8311.6	8032.2
Forecast	6526.954	6770.905	6944.196	7053.217	7100.159	7053.579	6918.987	6700.364
Diff +-%	-1.49	-3.2	-4.26	-6.5	-10.9	-14	-16.7	-16.5

Source: Data from Eurostat

Table 6 show the GDP forecast for Lithuania during 2009 and 2010. The table shows the quarterly change in GDP and the forecasted levels of GDP. The forecast show that in 2010Q4 the Lithuanian economy will be similar to levels before the financial crisis. The upward trend identified in Figure 4 is identified in 2010Q2 were an increase in GDP is expected with a quarterly change of 3.7 per cent. The upward trend continues during 2010, where a quarterly increase of 12.4 per cent is observed 2010Q4.

Table 6. *Lithuanian forecast for the period 2009-2010 (in millions of Euro)*

GDP	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1	2010Q2	2010Q3	2010Q4
Forecast	6469.921	6174.528	5915.167	5737.209	5724.769	5937.172	6431.437	7231.308
% Change	-3.5	-4.7	-4.2	-3.0	-0.2	3.7	8.3	12.4

Source: Data from Eurostat

The forecast for Lithuania show a total fall in GDP with 12.51 per cent, from €M 27773.09 in 2008 to €M 24296.83 in 2009. The Finance Ministry of Lithuania forecast a fall in GDP with 10.5 per cent. The projection for 2010 is that the Lithuanian economy will slowly recover and have a stable growth of 4.23 per cent to €M 25324.69, whereas the Finance Ministry in Lithuania projects a fall of 2.6 per cent[2].

As a result of the crisis the availability of credit has been tight for businesses, leading to a fall in investments. The decreased GDP growth in the forecast indicates that Lithuania will be put under pressure as tax revenues decrease and increased social transfers among other things will most likely lead to an increase of government deficit and an increase of gross public debt. Lithuania has to be careful the next two years as they strive to meet the convergence criteria to be a member of the European Monetary Union (EMU).

[2] http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika

5.4 Estonia

Figure 5 illustrates the forecasted future levels of GDP in Estonia, where the blue line show the forecast, the black line represent the real GDP. The red line represents the 90% confidence interval. The Akaike Information Criterion (8.6) indicated the use of two lags and the high F-statistic (1719.3) indicates that all variables are statistically significant.

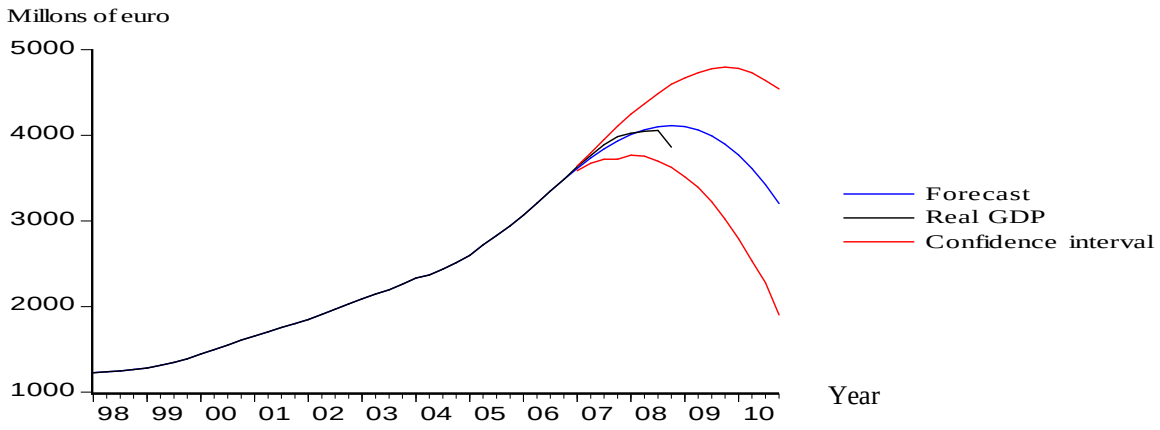

Figure 5. *Quarterly GDP of Estonia and forecast of Estonian GDP for the period 2007-2010*
Source: Data from Eurostat

In Figure 5 the forecast for Estonia is close to identical with the observed GDP up to the last quarter of 2008, where the model starts to overestimate the true GDP and therefore miss the financial crisis which hit Estonia in the third quarter 2008. The forecast predicts a slowdown of the economy in the first quarter of 2009 where GDP is expected to fall 1.46 per cent, from €M 16287.91 in 2008 to €M 16048.86 in 2009 according to the forecast. Bank of Estonia had a forecast that estimated a fall in GDP of 2.1 per cent[3].

From the results in Figure 5 and Table 7 one can see that the VAR model forecast performance is good between 2007 and 2009, which is up to t+12. Between t+13 and t+16 the performance is not as good, and forecasts a fall in GDP with 12.72 per cent down to €M 14007.61 during 2010. The shape of the forecast is nearly as expected even though that it were assumed that GDP would decrease more in 2009, and then stabilizing in the last quarter of 2009. Important to stress is that the forecasts are affected by the high volatility on the financial markets which has increased the uncertainty when forecasting for longer horizons.

Estonia has not experienced such a drop in GDP growth in 2008 since the Russian financial crisis in the end of the 1990's which severely hit Estonia because of the heavy decrease in exports to Russia. The weak increase in GDP as the graph indicates between 1998 and 2000 might arise from the Russian financial crisis. A large part of Estonia's export during this time was to Russia so their GDP was hit hard by the decrease in exports that followed the crisis. Intuitively the increase in GDP from 2000 until 2004 can to a large extent be explained by the recovery of the Russian economy. In 2004 when Estonia joined the European Union a large increase in GDP growth is seen as expected from the increased trade integration and confidence a European Union membership brings.

[3] http://www.dnbnord.com/multimedia/BRE_Weekly_No226.pdf

Table 7 includes a comparison between the forecasted GDP values and the real observed GDP for the period between 2007 and 2008. The table also illustrates the percentage difference between the forecasted GDP and real GDP. The percentage difference indicates that the performance of the forecast is high. The largest difference between the forecast and the real GDP is observed in 2008Q4 (6.5 per cent) where the forecast overestimated the real GDP.

Table 7. *Estonian forecast comparison for the period 2007-2008 (in millions of Euro)*

Estonia	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008 Q4
Real GDP	3633.1	3763.7	3889.3	3984.3	4023.1	4046.3	4055.7	3860.6
Forecast	3613.486	3735.803	3843.445	3935.665	4010.054	4065.968	4100.399	4111.489
Diff +-%	-0.54	-0.84	-1.18	-1.22	-0.32	0.49	1.1	6.5

Source: Data from Eurostat

Table 8 show the GDP forecast for Estonia during 2009 and 2010. The table shows the quarterly change in GDP and the forecasted levels of GDP. The table shows that Estonia will experience a negative GDP growth during the forecasted period with as much as 6.34 per cent in 2010Q4. Unlike Lithuania no growth is in sight for Estonia. The forecasted GDP for Estonia in 2010 show that the Estonian quarterly GDP will be equal to quarterly GDP levels of 2006, which also is seen in Figure 5.

Table 8. *Estonian forecast for the period 2009-2010 (in millions of Euro)*

GDP	**2009Q1**	**2009Q2**	**2009Q3**	**2009Q4**	**2010Q1**	**2010Q2**	**2010Q3**	**2010Q4**
Forecast	4100.037	4060.658	3992.759	3895.408	3769.108	3612.003	3423.391	3203.106
% Change	-0.02	-0.96	-1.67	-2.44	-3.24	-4.17	-5.22	-6.34

Source: Data from Eurostat

Estonia has overall the same problems as Lithuania when it comes to the sharp drop in GDP, this will most likely result in a detoriation of government deficit, increased welfare payments and a decrease of tax revenues.

5.5 Latvia

Figure 6 illustrates the forecasted future levels of GDP in Latvia, where the blue line show the forecast, the black line represent the real GDP. The red line represents the 90% confidence interval. The Akaike Information Criterion (12.1) indicated the use of three lags and the high F-statistic (893.7) indicates that all variables are statistically significant.

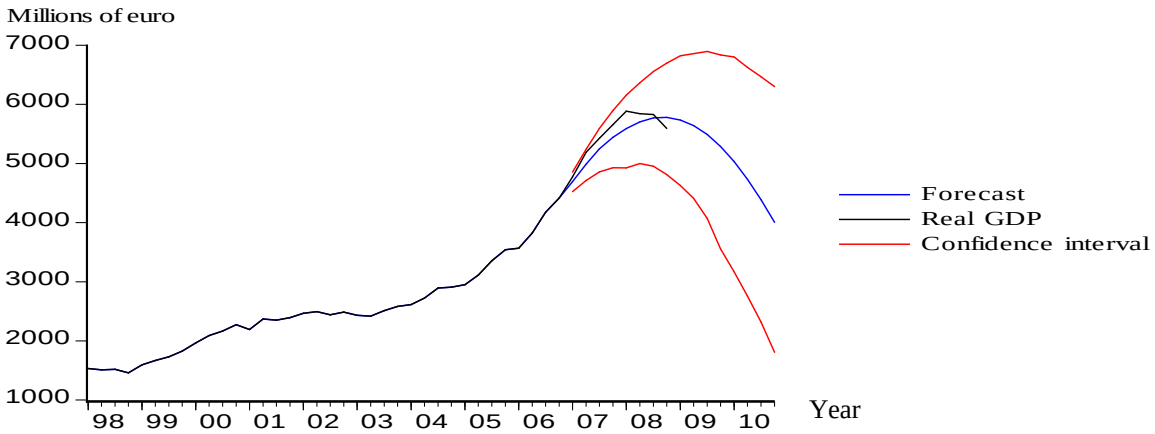

Figure 6. *Quarterly GDP of Latvia and forecast of Latvian GDP for the period 2007-2010*
Source: Data from Eurostat

In Figure 6 the forecast for Latvia is presented who has a similar forecast as Estonia. The forecast slightly underestimates the true GDP growth up until the last quarter of 2008 where it instead overshoots the observed values. The prediction of the forecast is a fall in GDP with 3.1 per cent from €M 22865.28 in 2008 to €M 22152.8 in 2009, compared to Bank of Latvia who predicted a fall in GDP with 5 per cent[4]. It is important to stress that the VAR model does not perform as good between t+13 and t+16 which results in a heavy underprediction of the Latvian economy in 2010, and forecasts a drop of 18 per cent in GDP to €M 18158.19. In 2010 a scenario as in Lithuania is expected with a slow increase or at least stabilization of the GDP from the end of 2009, or the beginning of 2010. It is important to point out the uncertainty in forecasting so many periods ahead during this financial climate.

As noticed for Estonia, GDP growth rates for Latvia increased after the EU membership in 2004. The growth in 2006 and 2007 is likely to have been caused by a great inflow of capital from foreign investors, which targeted the Baltic States after the inclusion in the European Union. As a result of this Latvia has had the highest growth in GDP for the six sample countries during the 21st century (see Table 1) but also the highest inflation, and is therefore far away from the Maastricht criteria that regulate the necessary conditions for EMU membership. Latvia had a GDP growth of 27.6 per cent in 2007 which also is identified in Figure 6 were the Real GDP line is almost vertical.

Latvia entered a recession in the third quarter of 2008 and should be faced with more severe problems than Estonia and Lithuania in terms of the government deficit, since the projected forecast show that Latvia is facing a deeper and prolonged recession than the other Baltic States.

[4] http://www.bank.lv/eng/main/all/sapinfo/commentary/2008/gdp_forecast_budget_2009/

Table 9 includes a comparison between the forecasted GDP values for Latvia and the real GDP for the period between 2007 and 2008. The table also shows the percentage difference between the forecasted GDP and real GDP. The greatest difference in the forecast compared to the real GDP is observed during 2008Q1 (-4.8 per cent) where the forecast underestimated the real GDP. The over prediction of the Latvian economy is observed in 2008Q4, where the forecast missed that Latvia was hit by the financial crisis. The financial crisis is seen in Table 10 where a negative growth is identified during 2009 and 2010.

Table 9. *Latvian forecast comparison for the period 2007-2008 (in millions of Euro)*

Latvia	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008 Q4
Real GDP	4771.0	5187.2	5427.1	5658.7	5884.3	5840.3	5827.7	5592.2
Forecast	4695.002	4991.265	5256.751	5450.608	5598.967	5712.928	5774.661	5778.723
Diff +-%	-1.6	-3.8	-3.1	-3.6	-4.8	-2.1	-0.9	3.3

Source: Data from Eurostat

Table 10 show the GDP forecast for Latvia during 2009 and 2010. The table shows the quarterly change in GDP and the forecasted levels of GDP. The table indicates that during 2010 Latvia will experience GDP levels equal to that of 2006. As observed for Estonia, no upturn of the Latvian economy is expected in the foreseeable future. The observed scenario in 2009 for Latvia is likely to be seen, with four quarters of negative growth, from -0.07 per cent to -3.68 per cent. It is assumed that the Latvian economy will slowly stabilize during 2010, and the increased negative growth observed in the table is not expected.

Table 10. *Latvian forecast for the period 2009-2010 (in millions of Euro)*

GDP	**2009Q1**	**2009Q2**	**2009Q3**	**2009Q4**	**2010Q1**	**2010Q2**	**2010Q3**	**2010Q4**
Forecast	5733.263	5641.109	5490.25	5288.181	5033.552	4731.497	4387.761	4005.38
% Change	-0.07	-1.61	-2.67	-3.68	-4.82	-6.01	-7.26	-8.71

Source: Data from Eurostat

The increasing unemployment (see Figure 3) in Latvia during the last quarter's creates uncertainty about the future which have caused businesses and consumers confidence to decrease which lead to a reduction in their spending. This is also confirmed by the Latvian central bank that observed that trade heavily slowed down in all commodity groups with roughly 30 per cent[5].

The highly volatile inflation should have caused some problems for the Latvian government, and they should adopt some anti-inflation policies to meet the Maastricht criteria as they strive to join the currency union.

[5] http://www.bank.lv/eng/main/all/sapinfo/presrunas/receco/

5.6 Analysis Benchmark Countries

The results from the forecasts of the Baltic States support the choice of model since the forecasted data is similar to the real observed data. Looking at the three benchmark countries France, Germany and Italy it is possible to see that the model used is even better for these countries during the comparison period.

The result from the GDP forecast for France is presented in Figure 7 where the blue line shows the forecast; the black line represents the real GDP. The red line represents the 90% confidence interval. This is the most accurate forecast of all the countries during the comparison period.

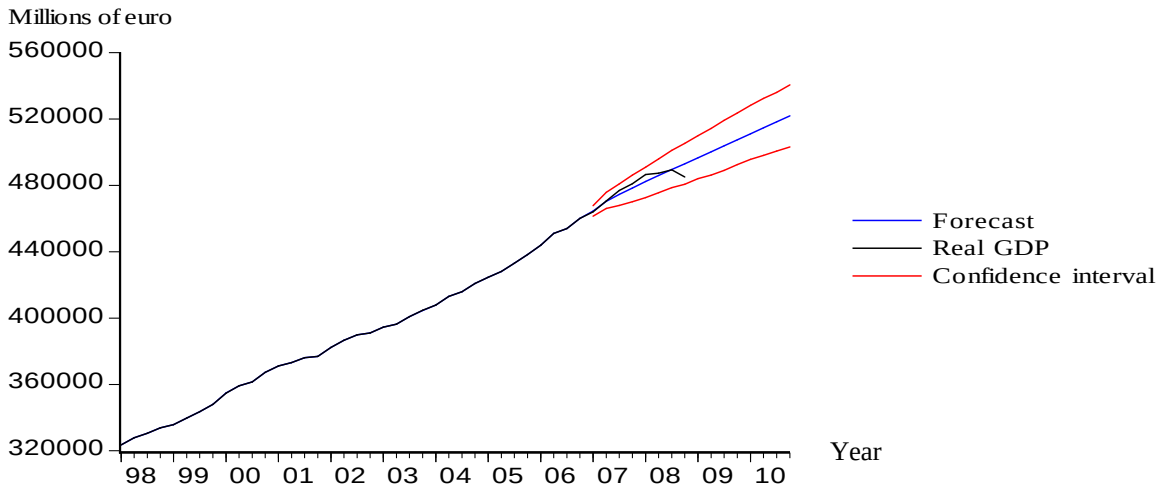

Figure 7. *Quarterly GDP of France and forecast of French GDP for the period 2007-2010*
Source: Data from Eurostat

The French economy is according to the European Commission (2009) expected to have a drop in real GDP of 1.8 per cent in 2009 while the forecast in this research estimate an increase by 2.9 per cent. If the projections of the European Commission fall out it would be the first decline in GDP growth in France since 1993. Such a fall in GDP growth would if not cross the lower confidence interval of the forecast, then at least get close to it. The reasons behind the fall in France are probably similar to most other European countries, uncertainty about the future for both companies and individuals that decrease spending. France also has a large automobile industry, a sector that is usually hit hard during recessions.

As seen in Table 11 the difference in 2007Q1 between the real GDP and the forecast is only 0.01 per cent and the differences are on average only 0.45 per cent (the difference percentage from the table transformed in to absolute numbers, summarized and divided by 8) and this must be seen as accurate. Unfortunately the forecast miss the downturn in GDP growth observed in the second half of 2008, where the model forecasts a GDP increase. There are several probable reasons to why the forecast misses the fall in GDP. For instance it could be caused by the VAR model which only foresees an upward trend looking at previous values up until 2006Q4 where the model start forecasting, and therefore miss out on asymmetric shocks (financial crisis) that are hiding in the error term.

Table 11. *French forecast comparison for the period 2007-2008 (in millions of Euro)*

France	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008 Q4
Real GDP	464040.0	470550.0	476844.0	480954.0	486479.0	487257.0	489337.0	484997.0
Forecast	464499.3	470381.1	474704.4	478699.5	482574.1	486264.3	489902.0	493263.4
Diff +-%	0.01	-0.03	-0.40	-0.40	-0.80	-0.20	-0.10	1.7

Source: Data from Eurostat

Table 12 shows the forecast for France during the period 2009 and 2010. The table shows that the French economy will continue to grow at a steady pace during the forecast period, with quarterly changes in the range from 0.65 per cent to 0.73 per cent.

Table 12. *French forecast for the period 2009-2010 (in millions of Euro)*

GDP	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1	2010Q2	2010Q3	2010Q4
Forecast	496501.7	500145.7	503786.2	507424	510996.8	514609.9	518212.6	521843.2
% Change	0.65	0.73	0.73	0.72	0.71	0.71	0.70	0.70

Source: Data from Eurostat

The GDP forecast for Germany is presented in Figure 8 where the blue line shows the forecast; the black line represents the real GDP. The red line represents the 90% confidence interval. This forecast is the most uncertain of the three benchmark countries as indicated by the widest confidence intervals. They also have the most volatile history of these countries so a wider interval is expected.

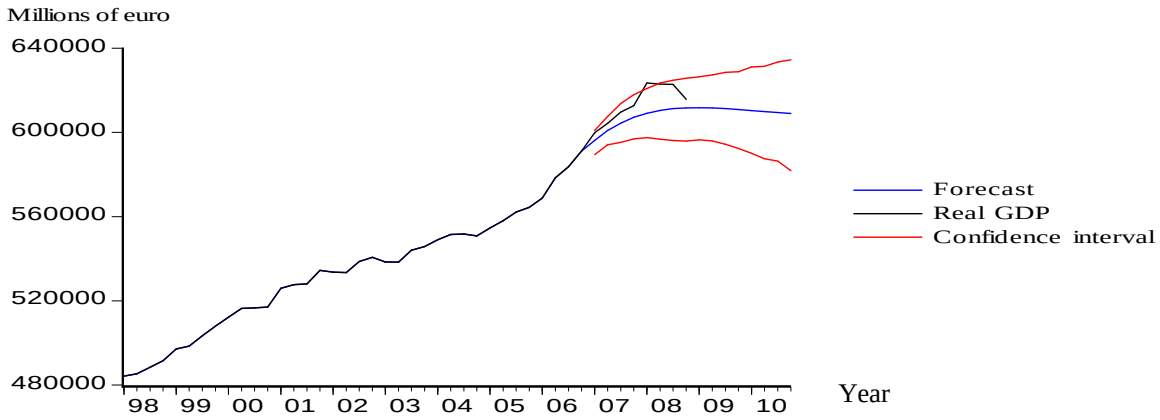

Figure 8. *Quarterly GDP of Germany and forecast of German GDP for the period 2007-2010*
Source: Data from Eurostat

For a large part of the comparison period between 2007 and 2008 the model underestimate the growth in GDP as seen in Table 13. Germany experienced an extreme growth rate in 2007 and especially during the first half of 2008. The forecast for Germany is the only one of the benchmark countries that identifies the financial crisis and forecasts a decrease in GDP growth. The decrease is not as extreme as for the real GDP observed but it occurs at the right time in the second half of 2008. In Table 13 the forecasted quarterly levels of GDP differ more (from -0.5 - -2.2 per cent) from the real observed GDP than it did for France, this is because of the forecasted underestimation of the GDP growth.

Table 13. *German forecast comparison for the period 2007-2008 (in millions of Euro)*

Germany	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008 Q4
Real GDP	599860.0	604300.0	609660.0	612670.0	623460.0	622910.0	622770.0	615710.0
Forecast	596142.8	600964.3	604574.4	607477.8	609566.7	611017.3	611901.4	612336.4
Diff +-%	-0.6	-0.6	-0.8	-0.8	-2.2	-1.9	-1.7	-0.5

Source: Data from Eurostat

Table 14 show the GDP forecast for Germany during 2009 and 2010. The forecast shows that Germany GDP will experience a negative quarterly growth ranging from -0.01 per cent to -0.08 per cent. The forecasted values for 2009 and 2010 predict a decline in GDP by 0.12 per cent in 2009 and 0.28 per cent in 2010. For 2009 it is probably correct to assume a fall in GDP even if the fall is assumed to be larger. The European Commission (2009) did in their January forecast predict a fall of 2.3 per cent in 2009. It is likely that Germany will be hit hardest by the financial crisis of the benchmark countries. This since Germany is an extremely export oriented country that to a large extent has specialized in investment goods.

Table 14. *German forecast for the period 2009-2010 (in millions of Euro)*

GDP	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1	2010Q2	2010Q3	2010Q4
Forecast	611708,6	611588,1	611299,7	610868,5	610358	609859,2	609403,6	609004,3
% Change	-0,01	-0,02	-0,05	-0,07	-0,08	-0,08	-0,07	-0,07

Source: Data from Eurostat

The GDP growth forecast for Italy is presented in Figure 9 where the blue line shows the forecast; the black line represents the real GDP. The red line represents the 90% confidence interval. It is possible to identify large similarities between the forecasts of Italy and France, something that probably arise from the resemblance of historical values and similarities between the market compositions. Italy has for example, exactly like France, a large car industry.

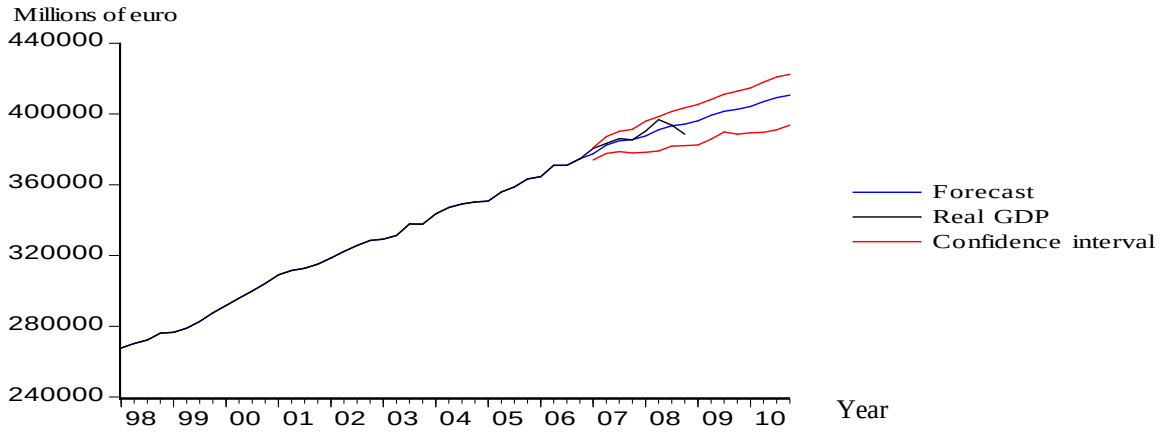

Figure 9. *Quarterly GDP of Italy and forecast of Italian GDP for the period 2007-2010*
Source: Data from Eurostat

Just as for France the forecast for Italy has a good fit throughout the comparison period between 2007 and 2008 as seen in Table 15. The forecast miss to identify the fall in GDP that arose in the second half of 2008. The reasons for this failure are probably the same as presented above for France. As in the case of France the forecasted growth in 2009 and 2010 is not likely to be observed in reality. GDP forecasts produced by the European Commission

(2009) in January 2009 estimated a fall in GDP with 2 per cent compared to the forecast that predicts an increase in GDP with 2.13 per cent. As can be observed in Table 15 the forecasted values for 2007Q4 and 2008Q3 are identical with real GDP for Italy, where the difference is 0.04 per cent. This once again emphasizes the quality of the forecasting model.

Table 15. *Italian forecast comparison for the period 2007-2008 (in millions of Euro)*

Italy	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1	2008Q2	2008Q3	2008Q4
Real GDP	380537.4	383379.8	386050.6	385417.9	390318.7	396781.6	393729.8	388605.7
Forecast	377510.9	382478.2	384856.5	385595.6	387754.3	391378.5	393558.2	394537.5
Diff +-%	-0.7	-0.2	-0.3	0.04	-0.6	-1.3	-0.04	1.5

Source: Data from Eurostat

Table 16 show the GDP forecast for Italy during 2009 and 2010. The table shows that Italy will have a positive GDP growth during 2009 and 2010, where the GDP growth is greater in the beginning of 2009 (0.79 per cent) than in the end of 2010 (0.33 per cent).

Table 16. *Italian forecast for the period 2009-2010 (in millions of Euro)*

	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1	2010Q2	2010Q3	2010Q4
Forecast	396143,9	399274,2	401499,3	402639,2	404279,2	406973,3	409271,5	410625,7
% Change	0.04	0.79	0.56	0.28	0.41	0.67	0.56	0.33

Source: Data from Eurostat

5.7 Limitations

Readers should have in mind that the limitations of the forecasts are mainly due to data availability that gives the model a relatively short data sample to work with. Before 1998 it is almost impossible to find complete data sets for the Baltic States. It is important to stress that the Baltic States became independent from the Soviet Union as late as 1991. Another limitation arises from the fact that forecasting is not an exact science; there are no precise models or rules to follow.

Also important to stress is that with the current financial crisis, central banks and other forecasting institutes release new and updated forecasts whenever there is new information available, which changes the outcome of their forecasts. Therefore when comparing the computed forecast results with that of other forecasting institutions, the comparisons are made at the time at which the data were collected, and therefore exclude forecasts from central banks after the data has been gathered.

6. Conclusions

The purpose of this thesis was to identify a model to forecast GDP growth for a set of countries, where the focus was on the Baltic States (Estonia, Latvia and Lithuania).

Forecasts were performed on countries with different features and the result show that the small scale VAR model has performed good for horizons up to t+12. The forecasts for 2007-2008 are close to real GDP for Estonia, Latvia, Lithuania, France, Germany and Italy. The forecasts for 2009 are in line with those of several central banks, which have access to more advanced models. It was shown that VAR forecasts are more reliable the shorter time horizon you investigate. Horizons greater than t+12 are highly uncertain and the uncertainty is increased by the current financial crisis. This result was also proven by the forecasts. Even for the long horizon some forecasts have reliable values, for example the forecast for Lithuania show a GDP growth of 4.23 per cent in 2010.

The findings are also in line with that of Krkoska and Teksoz (2007) in that transition reforms contribute to forecasting uncertainty, where high output volatility can be found at the early stages of transition. This relationship was identified for Lithuania, Latvia and to some degree Estonia which have had a highly volatile GDP growth during the sample period, resulting in greater uncertainty and wider confidence intervals. As expected a greater volatility and uncertainty in the forecast for the Baltic States was found, and smaller confidence intervals for the three EMU members were identified.

The forecasting results could possibly have been improved with a larger data set and the inclusion of other variables that have an effect on GDP. Larger data sets would most likely decrease the confidence intervals since periods of high volatility would be given less weight.

From the findings it is possible to conclude that the chosen model provided results that were reliable estimates of future levels of GDP, where the reliability of the forecast is greater the shorter period in to the future one forecast. As assumed the model did perform well for other countries than the Baltic States, that is, a good general model for forecasting GDP growth was found.

By using the forecasts as a starting point it is possible to identify shocks in the Baltic States and also in the incumbent members of the EMU (Germany, France and Italy). It would be interesting to evaluate when these shocks have occurred, of which type they are and their magnitude. By comparing these results between the Baltic States and the large incumbent members of the EMU it is possible to evaluate exactly how large the cost of losing the independent monetary policy would be. Say for example that shocks that affect the Baltic States occur at the same time, to the same magnitude and are of the same type as the shocks that occur in the incumbent countries then the cost would be lower than if the case had been the reversed.

The two most cited articles in this field are Blanchard and Quah (1989) and Bayoumi and Eichengreen (1993). Their approach has many similarities with the model above. What they did was to use a type of vector autoregression to isolate disturbance (the error term in the model above) and by adding identifying restrictions to this term it was possible for them to draw conclusion regarding when shocks occur, how large they are and of with type they are. There is previous research that has looked in to this; however no one has focused solely on the Baltic States. This is quite remarkable since the forthcoming membership for the Baltic States should have made this a well investigated question, therefore it would be interesting to study this further.

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Appendix 1 Causality

At a 5% level of significance, we tested the following hypothesis:
H_0: β=0 ≈ *this means that there is no relationship between GDP and HICP*
H1: β≠0 ≈ *this means that there is a relationship between GDP and HICP*

Dependent Variable: LATVIA_HICP
Method: Least Squares
Date: 04/20/09 Time: 15:13
Sample: 1998Q1 2008Q4
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.424264	0.425210	-0.997775	0.3241
LATVIA_GDP	0.000579	0.000127	4.551804	0.0000

R-squared	0.330346	Mean dependent var	1.347727
Adjusted R-squared	0.314401	S.D. dependent var	1.370196
S.E. of regression	1.134534	Akaike info criterion	3.134710
Sum squared resid	54.06105	Schwarz criterion	3.215810
Log likelihood	-66.96363	F-statistic	20.71892
Durbin-Watson stat	1.441584	Prob(F-statistic)	0.000045

In this case we have a p-value for the β-coefficient that is less than 0.05 (0.0000<0.05), that is, we believe in H_1.

At a 5% level of significance, we tested the following hypothesis:
H_0: β=0 ≈ *this means that there is no relationship between GDP and UN*
H1: β≠0 ≈ *this means that there is a relationship between GDP and UN*

Dependent Variable: LATVIA_UN
Method: Least Squares
Date: 04/20/09 Time: 15:19
Sample: 1998Q1 2008Q4
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.74358	0.486422	34.42194	0.0000
LATVIA_GDP	-0.001991	0.000145	-13.69333	0.0000

R-squared	0.816999	Mean dependent var	10.64545
Adjusted R-squared	0.812642	S.D. dependent var	2.998407
S.E. of regression	1.297856	Akaike info criterion	3.403694
Sum squared resid	70.74610	Schwarz criterion	3.484793
Log likelihood	-72.88127	F-statistic	187.5072
Durbin-Watson stat	0.332686	Prob(F-statistic)	0.000000

In this case we have a p-value for the β-coefficient that is less than 0.05 (0.0000<0.05), that is, we believe in H_1.