Inflation in Croatia with outlook to future

Alida Paunić

May 2007

Alida Paunić

INFLATION

IN CROATIA WITH OUTLOOK TO FUTURE

May, 2007

Inflation in Croatia with outlook to future

Abstract

Central Banks have gained much credibility in controlling one important macroeconomic variable: inflation. This paper tries to examine the relation between inflation and other economic variables in Croatia by searching for the best forecasting model.

JEL Code: E31;C53;C51
Keywords: inflation, modeling, unemployment

1. Introduction

Today we do not face the lack of materials about central banks policies and measures taken as well as the transmission mechanisms whose aim is to stabilize the economy over business cycles. By conducting and controlling monetary policy in the reliable way central banks gained much in their popularity and respectively around the world. But still, we have to admit that new situations and possibilities could arise and canals to implement certain goals can differ from situation to situation. It is of great importance for banks to implement sophisticated software and mechanisms in order to forecast main macroeconomic variables. The first steps to be taken are to build transparent mechanism for setting the policy rates. Transparency can help private agents and policymakers to adapt their expectation and for all economic subject to incline toward equilibrium value of economy.

By implementing different models that are divided into three major groups: linear, non linear, time varying; some new relations need to be tested in order to find the best fitting model and forecast future inflation. It is once again stressed the fact about usefulness of linear methods that already have a great deal of followers by their parsimony approach, but the analyses of nonlinear methods enables to capture the dissimilarities during recessions and expansions phases and on the most thorough bases explains the relations.

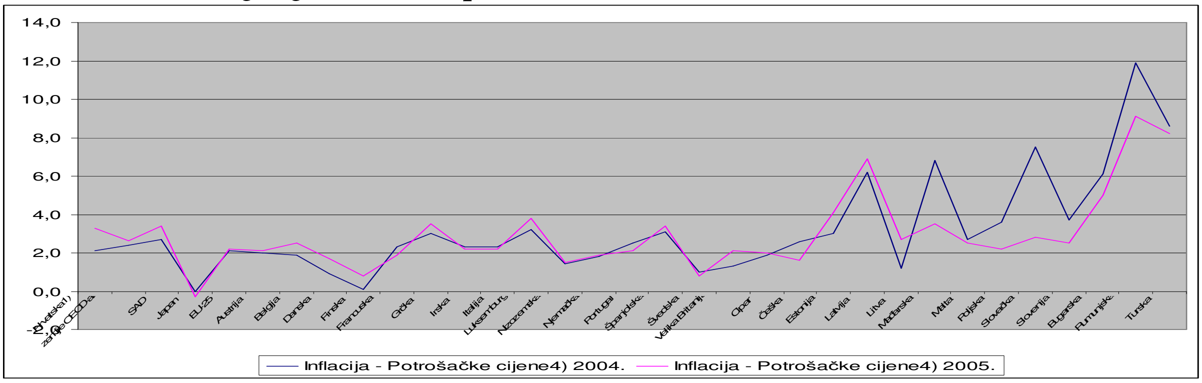
The main aim of this paper is to analyze and forecast economic variables inflation and unemployment in Croatia. It is now an accepted fact in Croatia that much was done in the central banking sector although country still deals with questions of banks privatization and ownership.
The model selection is based on information such as Akaike's, Schwarz's and Hannah-Quinn's: they are the major source of finding the right model among proposed one. Paper presumes that macroeconomic time series at the business cycles frequency exhibit asymmetry and co movements. Co movements among macro time series arise from the fact that only few shocks are responsible for fluctuations of the economy as a whole.

2. Some basic facts about Croatia economy

After coping with numerous transition problems and highly criticized privatization cycles Croatia managed to have stable inflation at the levels around 3 %. In order to fully realize this achievements some comparison is made *(Picture 1)* with neighboring countries.

Having inflation 2 % higher than majority of high income EU countries Croatia should be compared to newly members of the EU such as Estonia, Latvia, Litva, Slovakia (further new EU)or some countries candidates such as Bulgaria and Romania which all have a much higher inflation of 6%, and are headed toward 8%.
Croatia success is visible when comparing its rate of inflation with the global world rate finding that it is 2 % below worlds average and lower than any other group of countries other than higher developed countries that includes upper and middle income countries, Sub Sahara Area, Latin America and Caribbean, low and middle income countries, south Africa etc.

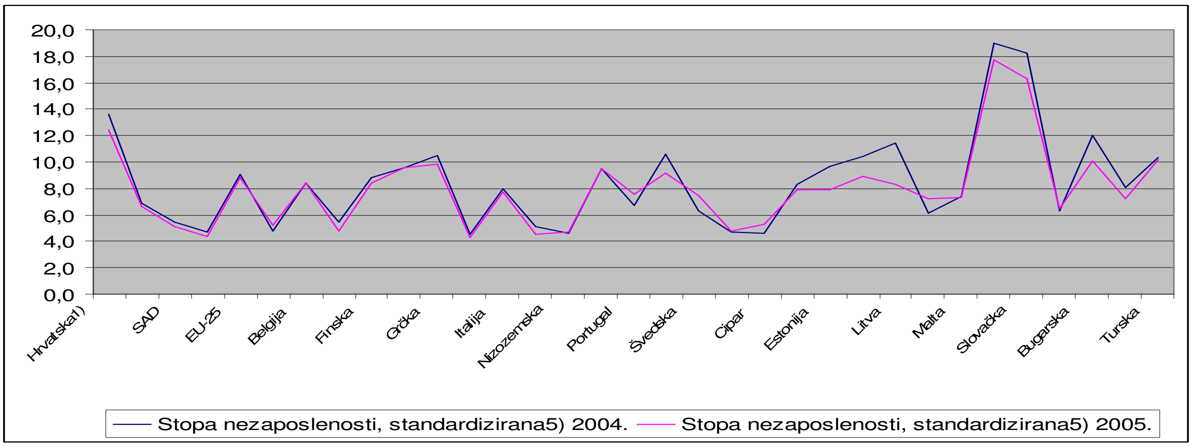
Picture 1: Rate of inflation comparison Croatia/other EU countries



Other important measures of one countries economic strength are GDP growth which shows no extra sigh of exceptional rise and equals 4,3 % as the major other much advanced economies. Still struggling with the high rate of unemployment of 12% and large current account deficit which stretches to -6, 4 % of GDP. Rate of export is only 49, 30 % of the GDP, while import prevails with 56, and 50 % of GDP.

The next important measure that describes an economy is the level of unemployment. Croatia is struggling unsuccessfully with this problem since the decision of transition from centrally planned to market oriented economy having a rate of 12-14% an average in the last couple of year of unemployed people. Still having large number of people employed in the gray economy, government is not successful in doing much about rising the employees rights and reducing the high rate of unemployment. Only the Slovakia and Bulgaria are coping with the much higher rates of 18 %, while in the EU Union only Greece and Litva reaches the peak of 10 % unemployment.

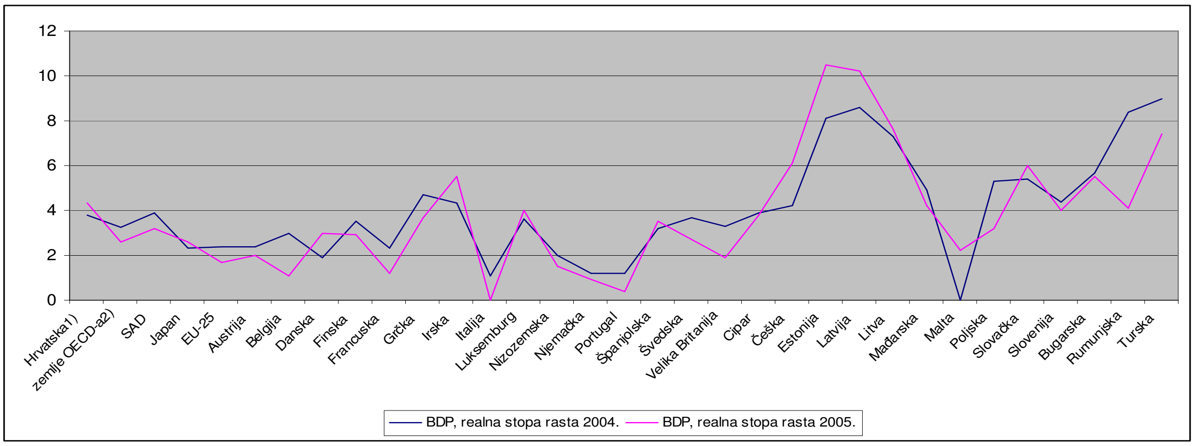
Picture 2: Rate of unemployment comparison Croatia/other EU countries



Picture 3 depicts the GDP growth of the majority of EU economies in the 2004/2005. High growth is visible in the countries of the former Soviet block that are now valid EU members. The high growth is especially significant for countries such as Estonia, Latvia and Litva with the 10% growth, after which follows countries candidates Rumania and Turkey with the 6-8 % growth of GDP.

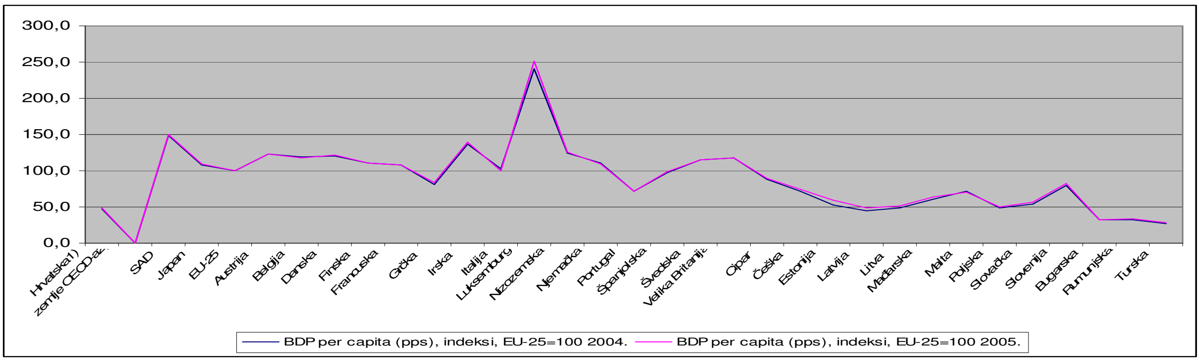
Although having higher growth than EU 25 average with 4,3 % Croatia is still behind after its goals and countries such as Ireland and Slovenia which model tries to incorporate in economic life.

Picture 3: GDP % comparison Croatia/other EU countries



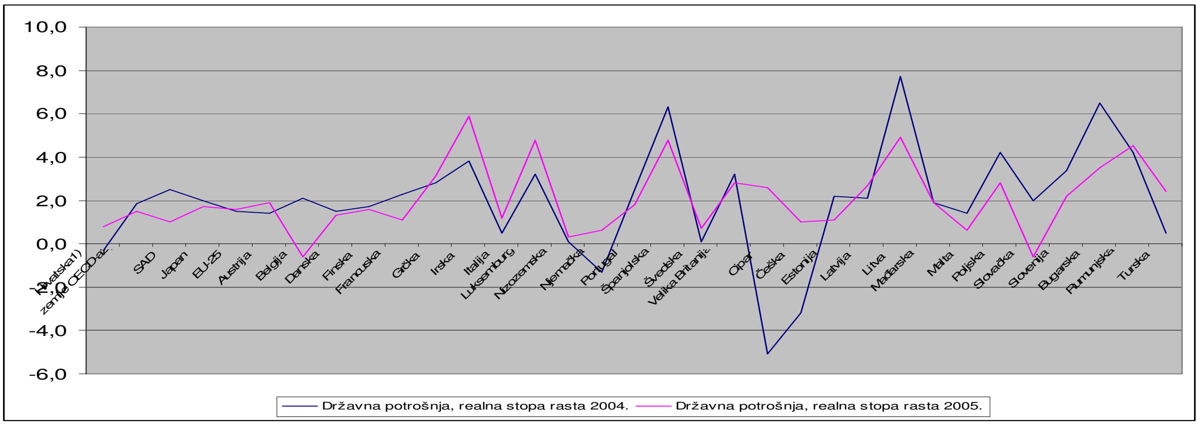
Having GPD per capita among lowest in Europe *(Picture 4)* Croatia is far away from the average EU members, with the similar standard as those of Litva, Latvia and having a little bit more than countries candidates such as Bulgaria and Turkey.

Picture 4: GDP per capita comparison Croatia/other EU countries



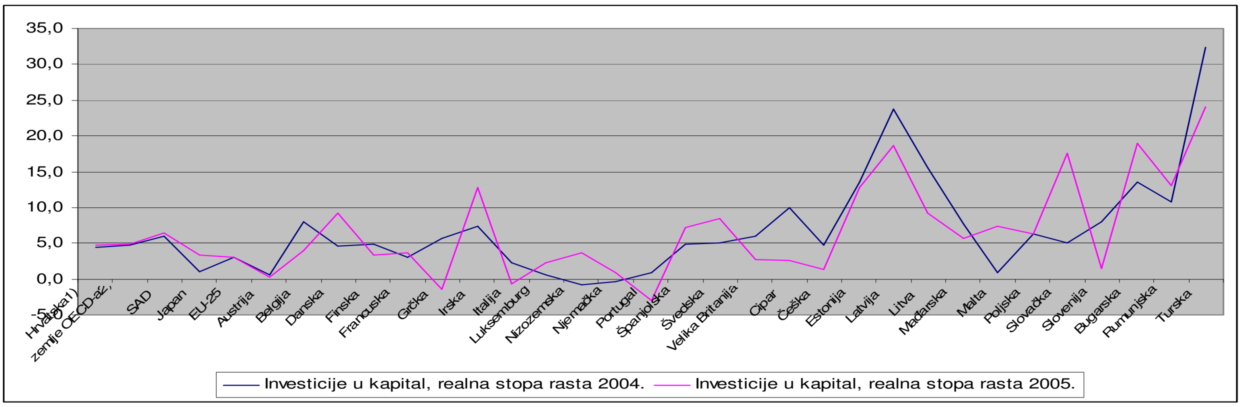
When looking at the comparison of the government growth strong cyclical movements across countries and periods observed are recognized.
(Picture 5).
Spain and Ireland leads in rise of government consumption above 4%, while East European countries all show strong growth in consumption at the rates peaked even 6%.

Picture 5: Government consumption growth % comparison Croatia/other EU countries



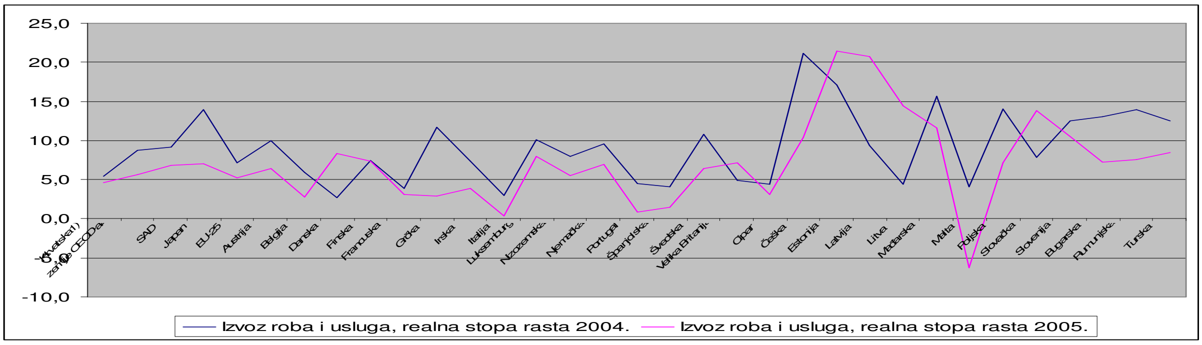
Rate of growth of investments in capital is also at the much lower levels with the amount of 5% if compared with other East European countries. Strong investments growth is much stronger in countries that attract foreign capital with the much cheaper labor and overall beneficial economic conditions such as Latvia, Litva, Turkey and Rumania.

Picture 6: Investment in capital –real rate of growth % comparison Croatia/other EU countries

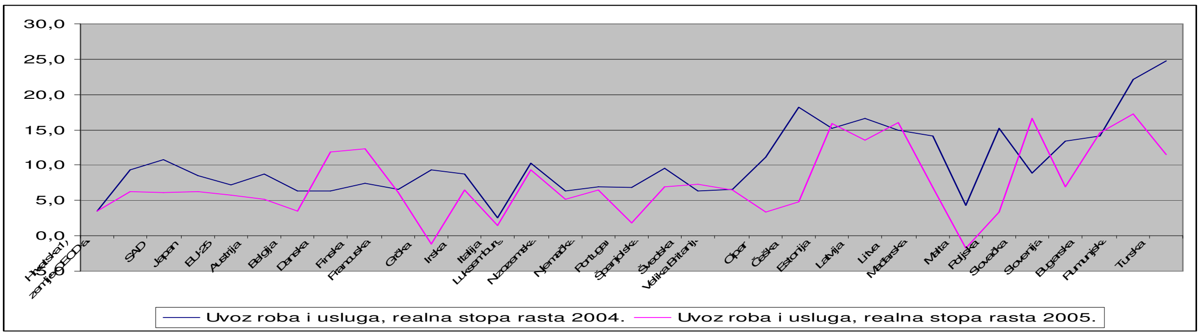


Much the same picture is visible from the comparison of Croatia and other EU when look at the numbers and pictures of the export and import growth. New EU members have attracted number of EU funds, have new market to reach with its products but also import more goods.

Picture 7: Export of goods and services real growth (%) comparison Croatia/other EU countries

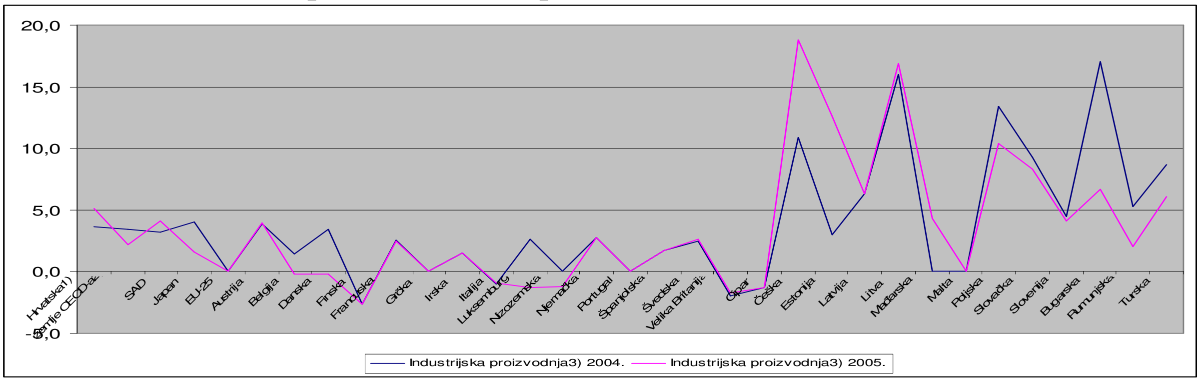


Picture 8: Import of goods and services real growth rate (%) comparison Croatia/other EU countries



The industrial production growth of Croatia is almost three times less than in the newly EU member countries such as Estonia, Latvia and Litva. Although much less than in the high income countries Croatia was faced during the last decade with many bankrupt factories and still lacks the broad strategic plan in industry.

Picture 9: Industrial production comparison Croatia/other EU countries



Source: www.HGK.hr, 2007

3. Theoy of forecasting

Before calculating and finding the model that would best describe future inflation path it is necessary to say a few words about models.

Two basic types should be recognized and taken into consideration. The first family of models are those that include following types:
autoregressive model, multivariate autoregressive models and random walk models. The non linear class includes Logistic Smooth Transition and Logistic Smooth Transition Autoregressive. Factor models are used to derive leading indicators to include in the Phillips curve specification. The Phillips curve is defined as a linear relationship between the inflation rate and distributed lags polynomials in inflation and unemployment (as deviations from the equilibrium values).Although non linear and time varying models have some advantages without respect to linear models, they suffers from short sample estimation problems.

The methodology applied for forecasts evaluation follows a real time in sample approach. The metric used in the work is based recognizing the magnitude of the forecasting failure. In other words the larger the deviation from the actual values the greater the failure. Under these metrics mean square forecast error (MSFE) and the mean absolute forecast error (MAFE) are implied.

Bayesian approach on forecasting, on the other hand, would recommend using all models and constructing combinations which weights forecasts from all the models analyzed.

The first formulation that paper states starts from the equation:

$Y_t=f(N_t;M_t)+e_t$

with the known function f (·) while forecast is expressed as

$Y_{t+h}=f(N_t;M_{h,t})+v_{t+h}$ with $E\,v_{t+h}=0$

Where N consist of variables known to forecasters and includes X which predetermined or weakly exogenous and Zt which is in general strictly exogenous. X is the collection of lagged values of Y while Z is defined as a leading indicator for the variable Y.
According to forecast theory *h* step ahead forecast implies:

$Y_{t+h/t}=f(N_t;\ M_{h,t})$ with the corresponding error

$e_{t+h}=Y_{t+h}-Y_{t+h/t}$

In order to made dynamic forecast *h* step ahead forecast is calculated. This estimation considers possibilities of misspecification errors induced by unit roots (over differencing of a stationary time series) or omitted variables problem that is bias reduction. Since sample data contain a brief history misspecification errors becomes the main causes to consider the bias reduction problem more important than the gain in efficiency from minimizing the 1 step ahead forecast error.

A real time process goes as follows:

1. First - estimated h step ahead forecast is made:

$Y_{t+h}=f(N_t,M_{h,t})+v_{t+h}$

2. Second - by increasing one step ahead up to h forecast series is calculated Since forecast were calculate in sample, a series of *h* step ahead forecast error of length can be derived as follows:

$v_{t+h}=Y_{t+h}-Y_{t+h/FT}$

3. Third - measures of forecasts accuracy can be derived by calculating MSFE and MAFE given the stochastic sequence and the following formula:

MSFE= $e_{t+h}\,e'_{t+h}/\ (T\text{-}h\text{-}FT)$

MAFE= $\sum_{j=1}^{t-H-ft} Y_{t+h}(j)-Y_{t+h/ft}(j)\ /\ (T\text{-}h\text{-}FT)$

4. Data selection and models considered

Once when data are recognized (inflation, CPI, CPI non tradable, CPI harmonized, HCPI Exc.Food and Energy) analysis goes through model selection (optimal lag length, constant, linear trend) and model validation. Calculation of the MSFE for the model estimation then forecasting by recovering unknown parameters and constructing confidence set and model evaluation by comparison among models.

The procedure of selecting a model consists of finding an optimal lag length and whether intercept or linear trend has to be included in the estimation. Depending on the information criterion (IC) penalty function differs as follows:

Akaike's AIC=k $\frac{2}{T}$

Schwarts's BIC= k $\frac{\ln(T)}{T}$

Hannan Quinn's HQ=k $\frac{\ln(\ln T)}{T}$

Multivariate models should be set up to reflect some economic theory explaining causal relationship among the variables included. Given the sample size of database some possible specifications were not considered because of the limited amount of degrees of freedom for the estimation process.

By satisfying the parsimonious principle in the class of linear models autoregressive methods are determined to keep their place among econometricians. All the measure of inflation turns to have unit root and that is the result that turn to be robust even if an alternative underlying data generating process is considered.

4.1. Linear methods

Linear methods seams to be very simple in forecasting output and in the large number of cases outperform some other methods. The calculation was mainly done by following ARIMA models in the later text. The random walk model or martingale hypothesis model sets the predicted future observations equal to the lates observation available in the information set: no-change forecast. This model is mainly used for comparison purpose even though its forecasting performance can depend on the volatility of the underlying process *(Fisher 2002).*

The starting formulation for the martingale hypothesis for the variable x is:
$E(x_{t+1}/I_t)=x_t$ where the **I** is the information set available.

The univariate linear model AR (ρ) is defined as:

$X_t = \rho(L)x_{t-1}+e_t$
where ρ (L) is a distributed lags polynomial of order ρ.

A little bit different specification is one that includes exogenous variables k_t

$X_t = \rho(L)x_{t-1}+y(L)k_t+u_t$
where q is the order of the polynomial y(L).

The VAR specification with exogenous variables is:

$Y_t = A(L)y_{t-1}+B(L)z_t+u_t$
where B(L) is a matrix- valued distributed lags polynomial of order q.

The univariate autoregressive model that is run for each series of price inflation is:
$\Delta \ln x_t = k+ \delta t+ \theta(L)\Delta \ln x_t +e_t$

While richer specification can be analyzed by adding the exogenous variable in the model:
$\Delta \ln x_t = k+ \delta t+ \theta(L)\Delta \ln x_t +y(L)z_t+ e_t$

Forecast is evaluated based on followings:

	Dependent	Exogenous variables
1	$\Delta \ln x_t$	Δln CPI
2	$\Delta \ln x_t$	Δln CPI Δln Wage

4.2.Var Models

Multivariate linear models includes in its economy of the model, so the VAR model tries to capture some of the economic relation with the variable. The first set of endogenous variables is determined according to a Micro view: CPI (consumer price index), PPI (producer price index), REEXR (real effective exchange rate) and labor cost from the vector.

The second group of variables refers to Macro view. A representation depicted by industrial production, unemployment, consumer price and money, policy rule, aggregate demand equation, feasibility condition and an equation for the quantity theory with constant velocity.

The starting system of equation for the vector autoregressive process is defined as:

Y_t=u+z *t+A(L)Y $_{t-1}$+e $_t$

While Croatia is the small open economy some exogenous variables need to be added to capture foreign dynamic effects. A distributed lag polynomial in the exogenous variable Z_t will group theses facts:
Yt= v+z*t+B(L)Y $_{t-1}$+R(L)Z $_t$+j $_t$

	Model		Dependent Variable
3	Macro view	Y macro	Ln xt;ln(U);LN(m1); ln(IP)
4	Micro view	Y micro	Ln xt;ln(CPI);Ln(PPI;Ln(REEXCH); Ln(W)
5	Var Macro	Δln Y macro	Ln U Δln M1
6	Var Micrco	Δln Y micro	Ln CPI Δln Wage Δln EXCH

4.3. Logistic Smooth Transition

The non linear methods are firstly represented by the logistic smooth transition in the following form:

$\Delta \ln x_t = k+\delta t + b^*(L)\, \Delta \ln x_{t-1} + F(z,y) q(L)\, \Delta \ln x_{t-1} + e_t$

The relevance of the variable z_t which crucially determines the transition dynamic together with the functional form of F(·).Two alternative specifications are studies by changing the set of exogenous variables z_t.
The first specification LSTAR uses lags of the dependent variables to construct z_t while the other one LSTR consists of using some valid leading indicators in the definition of z_t which could be worth in catching up the right turning points.

	Model	Exogenous variable
7	LSTAR	$z_t = x_{t-q}, x_{t-q-1} \ldots$
8	LSTR	$z_t = \Delta \ln CPI, \ \Delta \ln HICP$

4.4. Time Varying Parameters

The only parameters to be estimated are the entries in the var covariance matrices of the measurement and transition error. The unobservable time varying coefficients are retrieved by applying the Kalman filter.

$$X_t = [\, b'_t(L) \;\; Z'_t(L) \,] \begin{bmatrix} Xt-1 \\ Zt-1 \end{bmatrix} + e_t$$

The time varying parameters specifications assume a random walk evolution for the transition equation.
A VAR structure is seeing like:

$F_t = AF_{t-1} + u_t$

In the case of the small state space representation a VAR mechanism might produce good results but the procedure implemented in the paper didn't permit that because of the lag length obstacles.

4.5. Phillips curves a factor analysis.

Reverse relation between inflation and unemployment is considered under Philips curve relation. Model that adds Index of economic activity over performs in terms if MSFE other models. Given the usual definition of x_t as a measure of price inflation Phillips curve is defined as follows:

$X_t = y(L) F_t + e_t$

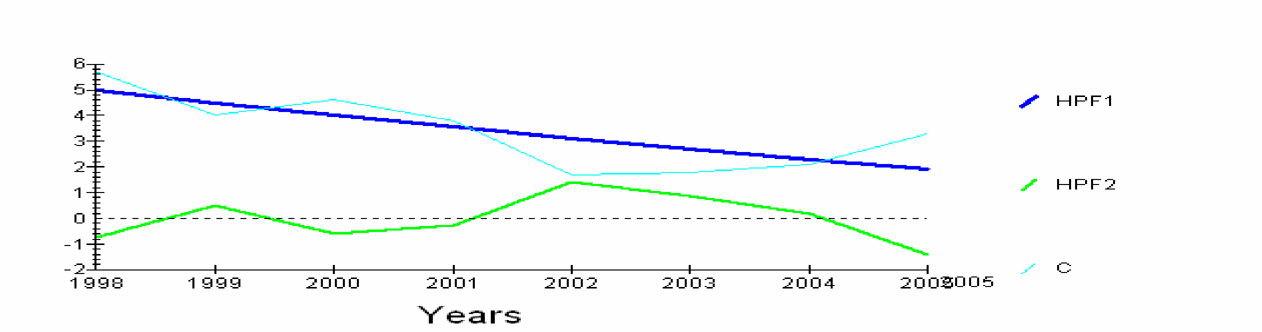
$\Delta \ln x_t = q(L) \Delta \ln X_{t-1} + p(L) F_t + v_t$

Elements of data sets are found among economic variables that determine business cycle such as: industrial production, credit flow, unemployment, money, interest rates, monetary aggregates, exchange rates. In the data time series monetary aggregates are included.

5. Evaluation

By running the real time in sample dynamic estimation it is possible to construct forecast for all models considered in the previous session. Given the actual and predicted values at time *(t+h)* the *h* step ahead forecast errors can be computed. Once forecast errors are derived metrics based on the *h* step ahead forecast errors variability are calculated for each model. For the evaluation purposes we use MSFE and MAFE .

Strong cyclical behavior and downside trend is characteristic of the Croatian inflation in the period from 1999 what is presented on Hodric Prescot detrended series.(Picture below).



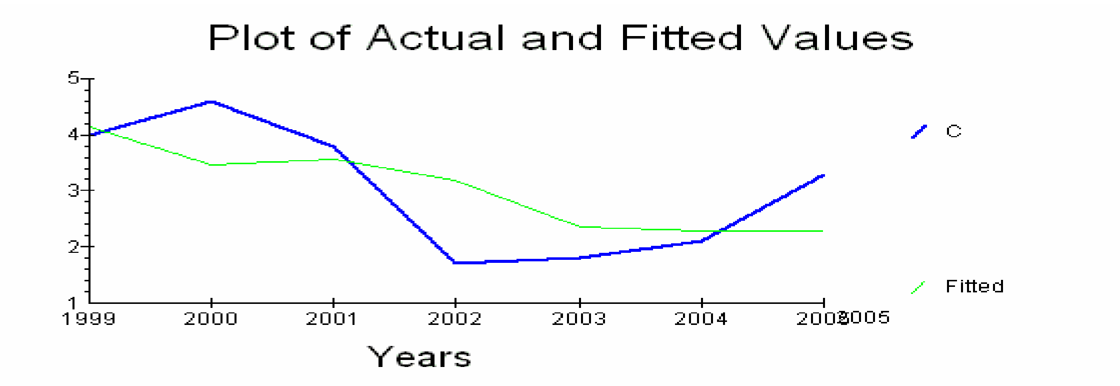
5.1. Linear regression

The simplest models are incorporated in the linear model family and their results are studied by making comparison of inflation with other macroeconomic variables.

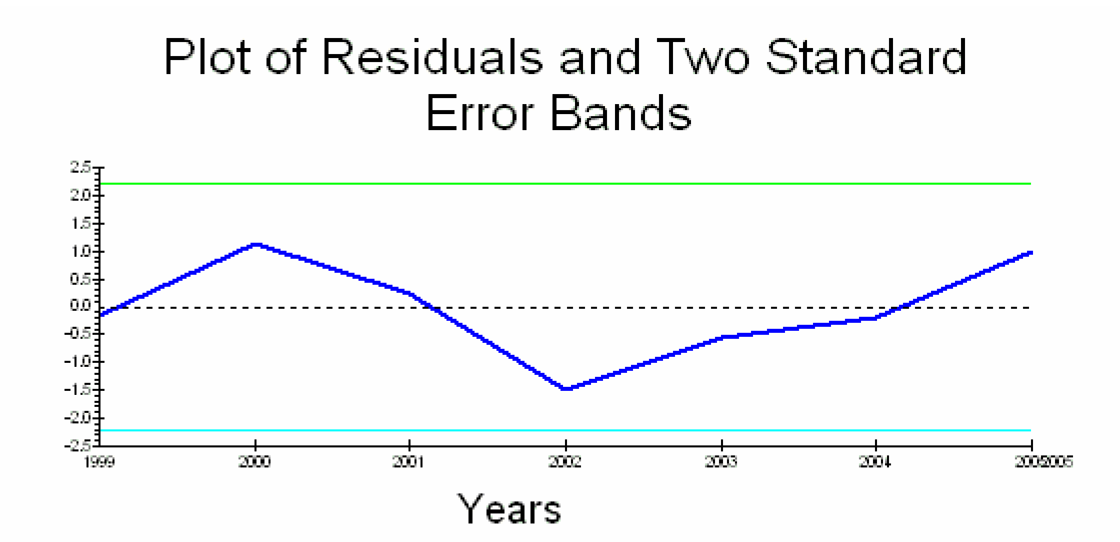
5.1.1

The following results are obtained when regressing inflation against time and lagged value of it. Graphical presentation show us that this kind of linear model is not good in capturing all relevant facts that determines current or future inflation levels.

```
Inflation =    2.4232*CON   -.10575*TIME +   .33918* Inflation (-1)
```



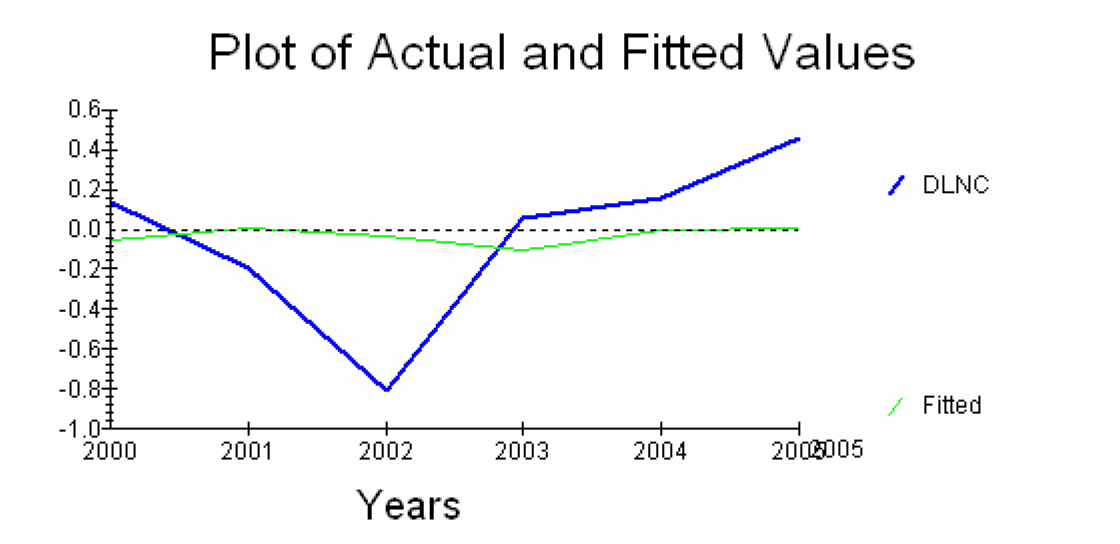
Residuals shows cyclical features but inside the two standard error bands. Unit root test is strongly dismissed with the values exceeding the 1. Akaike test confirms ADF(2) at level -6.9, Schwarz Bayesian Criterion for ADF (2) IS -5,9 while maximized log likelihood is -3,9. Trend is not stochastic or we states that it is integrated of order I(0).
With error of 2,6 and SD of errors at the 1,4079 we can confidently move forward in rejecting the model as the true representation of inflation.

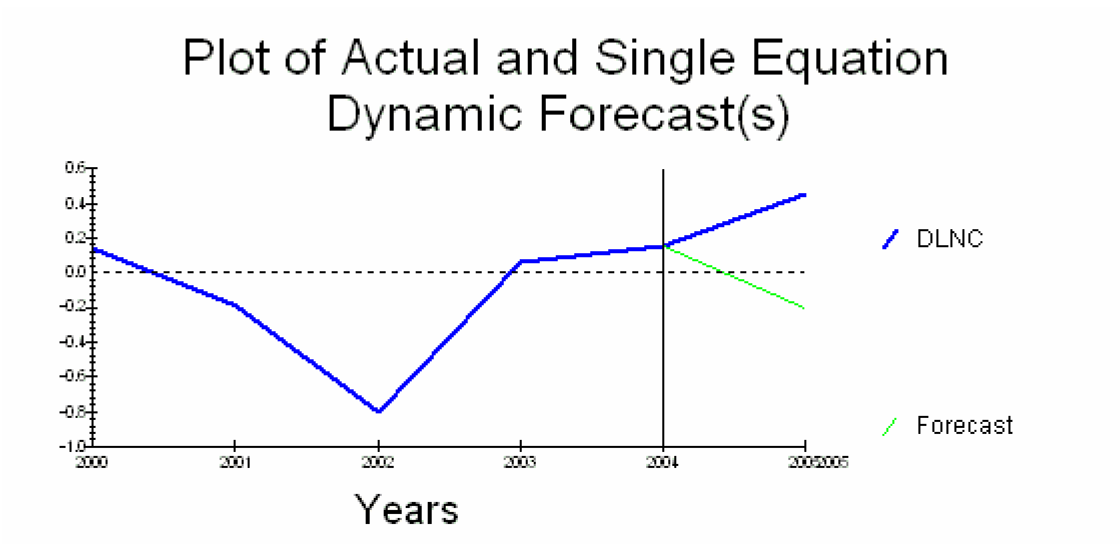


5.1.2

The second try involves calculation of the log value of inflation and finding its first difference and avoiding the time trend while modeling.
This model finds causal relation between the past and current values but is still very rigid in finding the reason for the inflation fluctuations.
With the smaller error from forecasting than the previous one equalizing 0,65 and SD of error at the level of 0,55238 it stills goes in the wrong direction when trying to find out future paths.

DLN Inflation = -.013238*CON + .11311*DLN Inflation (-1)

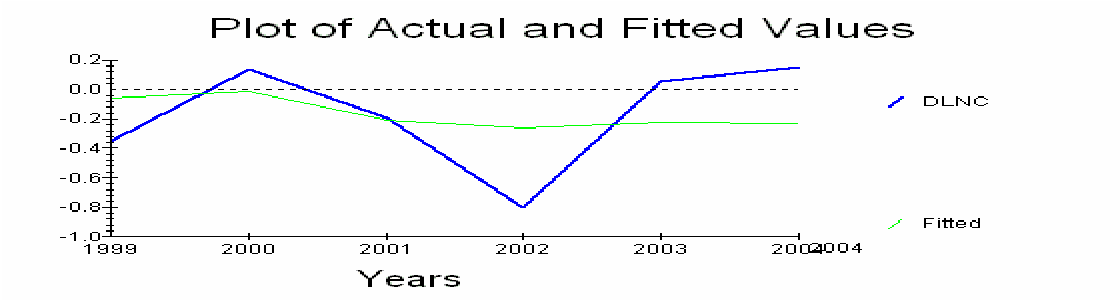


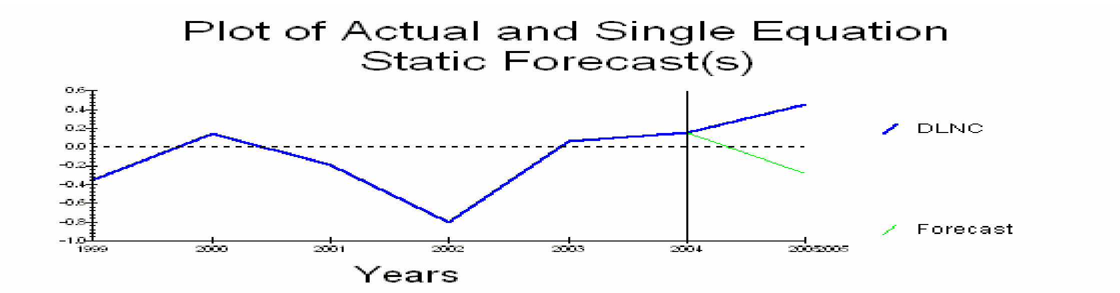


5.1.3

The third linear model is partly valuable while showing us that some movements in inflation levels are decrypted in it, but huger forecasting errors 0, 73 points us to further quest.

DLN Inflation = -.19131*CON + 1.0685*DLN unemployment

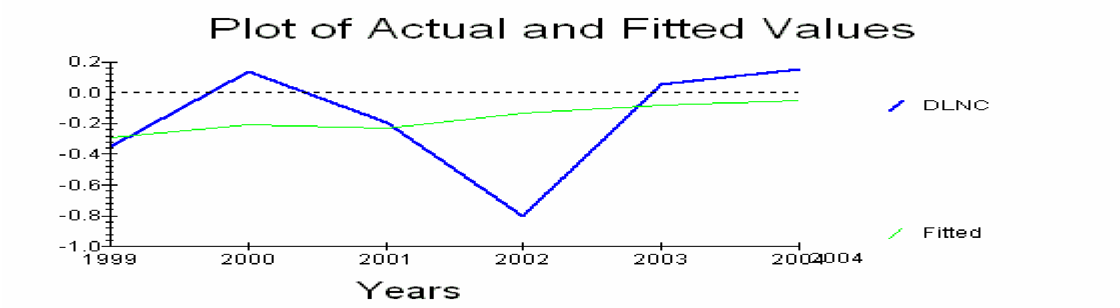


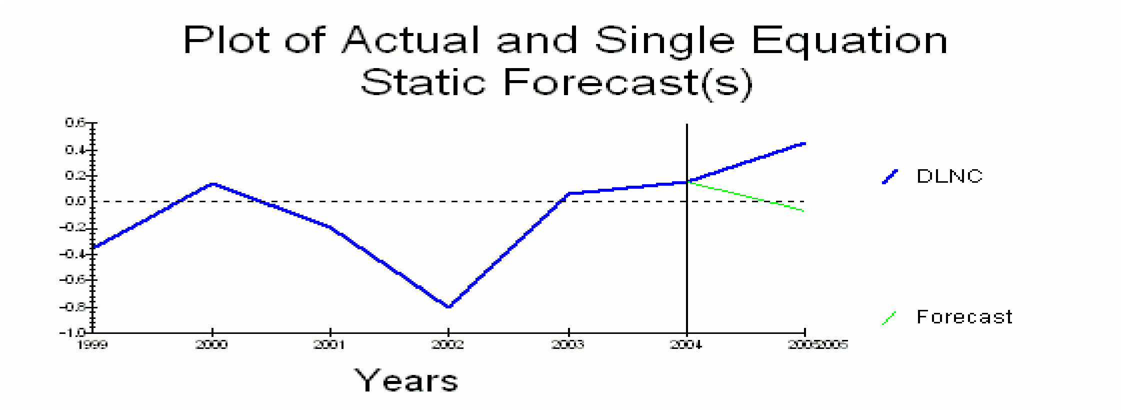


5.1.4

While trying to incorporate differenced log net wages in the same simpler linear model similar results are reached. Prediction error of 0, 51 and SD of errors at the 0, 47 levels still lacks reasonable numbers.

DLN Inflation = .063023*CON -2.2781*DLN net wages

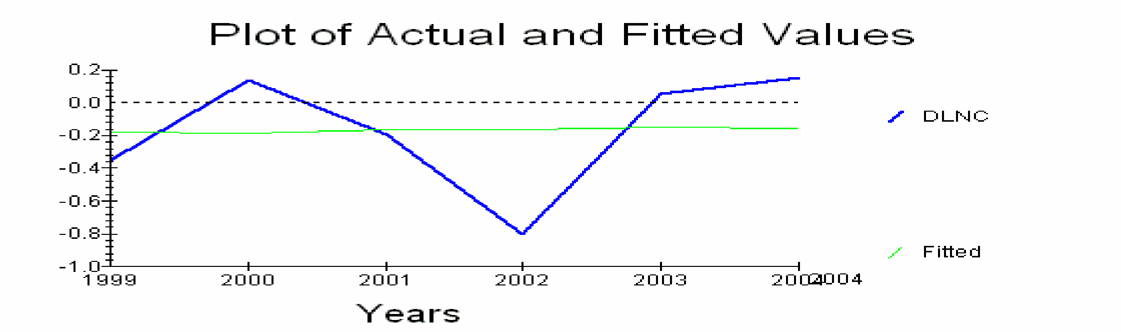


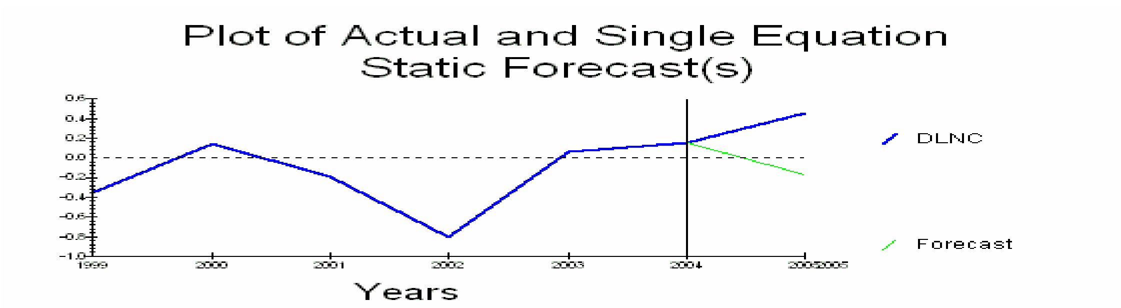


5.1.5

From theoretical points of view level of inflation is narrowly connected with the Industrial Production Index. Results smoothes cyclical behavior of inflation from the year to year period and suggest almost linear best fitting model. Unsuitable to explain it is also bad in forecasting with the high error forecasting level of 0,62272.

DLN Inflation =   -.12876*CON   -1.2873*DLN Industrial Production Index

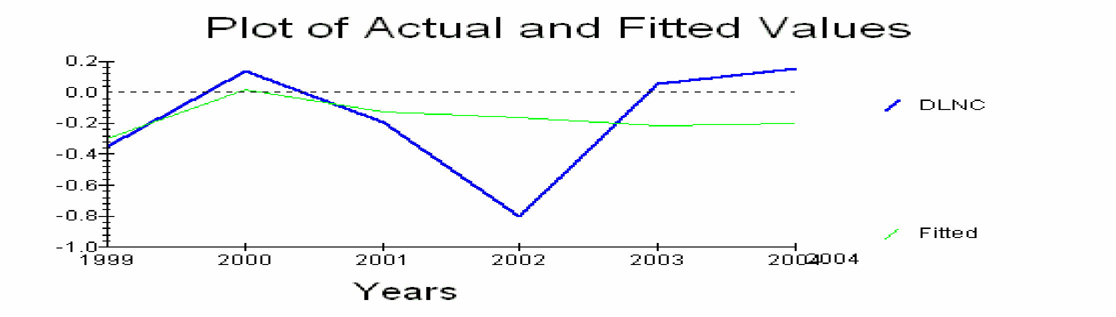


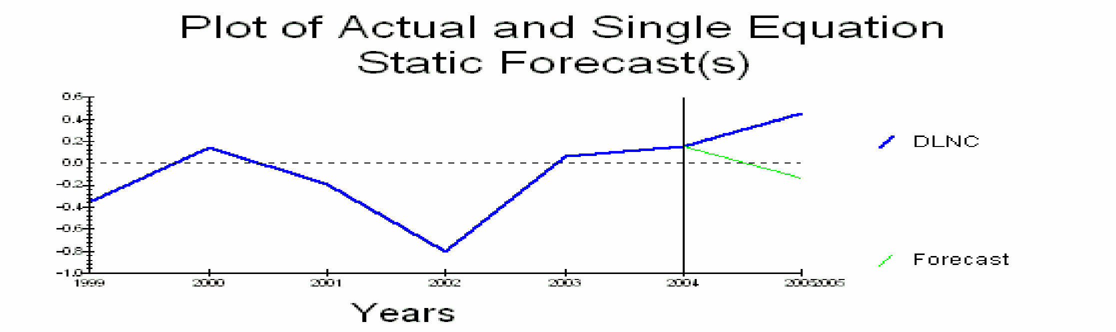


5.1.6

Exchange rates of USD and EUR to some point 2001 year nicely goes with inflation, but lack of some other important consideration is highly visibly.
The lack of forecastibility continues with 0,58848 error,

DLN Inflation = -.11147*CON + 1.0727*DLN Exchange rate EUR + .79538*DLN Exchange rate USD



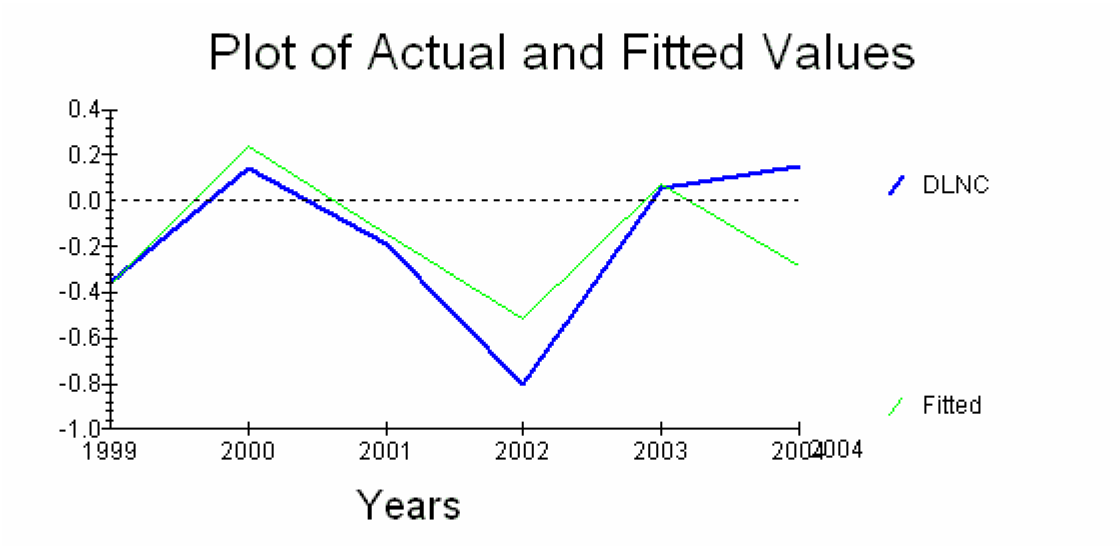


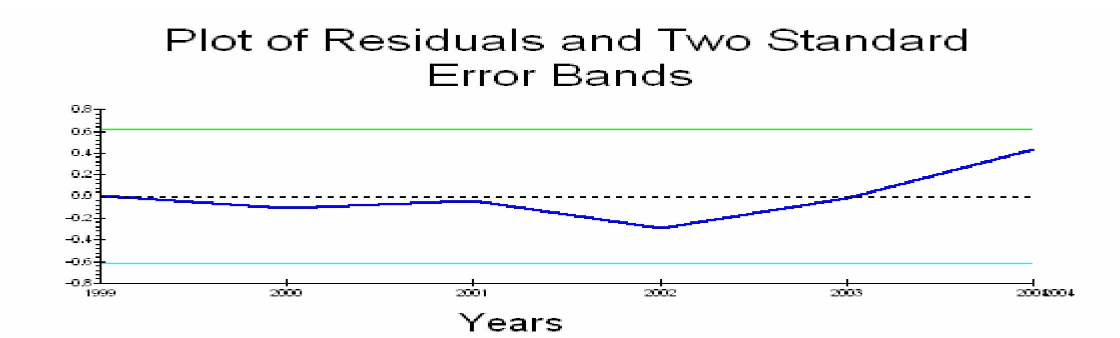
5.1.7

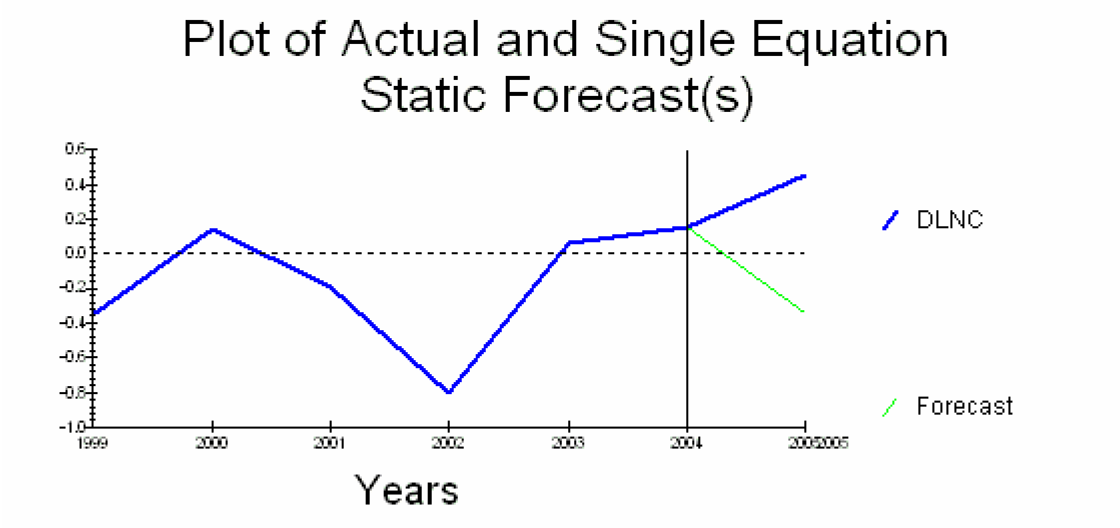
The search for other macroeconomic variables needs to be recognized and introduced n model. Being small open economy Croatia depends upon balance of payments and the level of import and export. Taking the differenced log values model that so far best fits the actual values is made.

DLN Inflation = -.28012*CON + 3.5800*DLN Export+ .29364*DLN Import

Residual values are inside the two standard errors band with increasing values the further the observation periods goes.
This further points us to observe forecasting errors and to find out that error reaching the level of 0,79 for the first period year 2005 misses a forecastibility value.
These points us to conclusion that the last periods some other variable strongly influences rise in inflation, so further research need to be conducted.







5.1.8

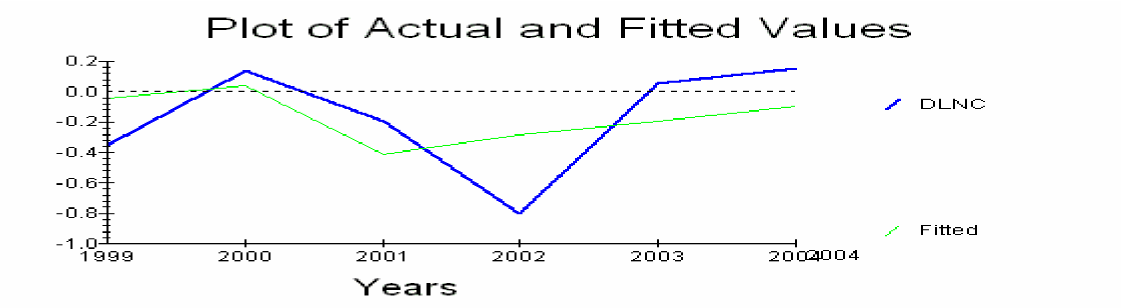
Unfortunately adding the GDP doesn't change anything in making model works.

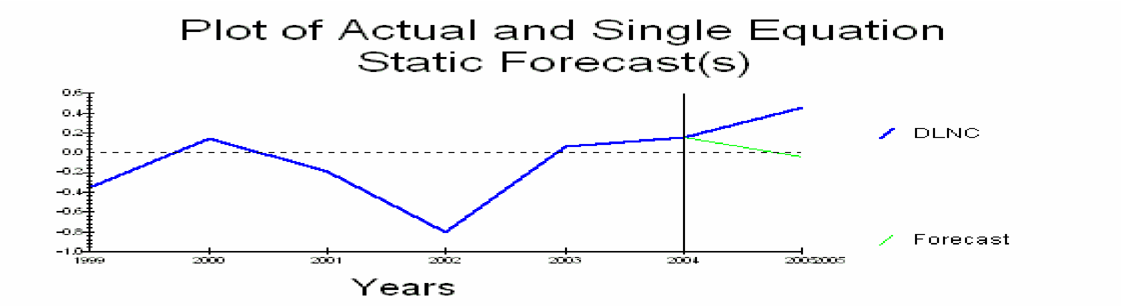
DLN Inflation = .17036*CON +3.9745*DLN Export-5.2357*DLN GDPper capita

5.1.9

Considerations so far bring us to the last linear model in which inflation is regressed on differenced log crude oil prices. With some better prospective about last period's movements and the smallest but still significant (in negative since) forecasting errors this relation points us toward further research in this direction.

DLN Inflation = -.30185*CON + .73772*DLN oil price





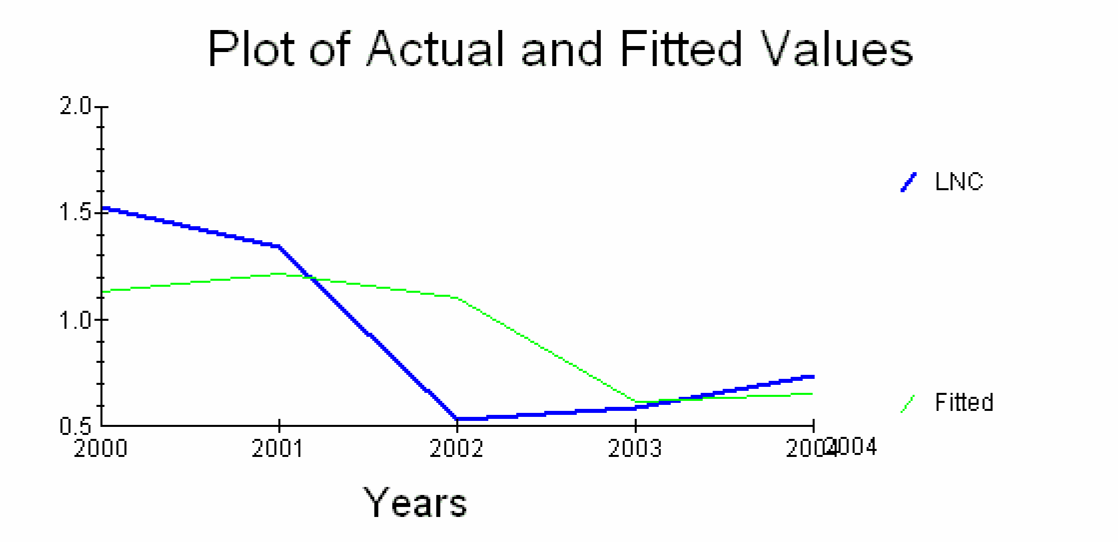
5.2. ARDL MODEL

In order to smooth our regression auto regressive distributed lag models are considered in following examples.

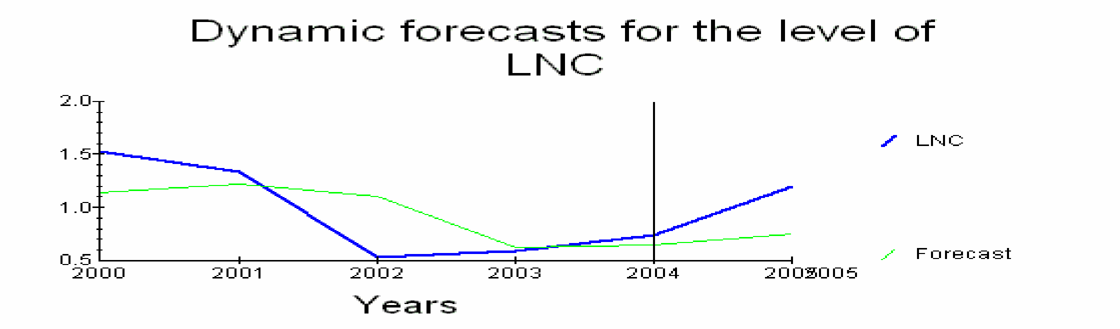
5.2.1.

Having observed ARDL (1) model of log inflation some better fitting values as well as forecasting results with 0,44 errors are obtained.

LN Inflation = .60160*LN Inflation C(-1) + .29867*CON



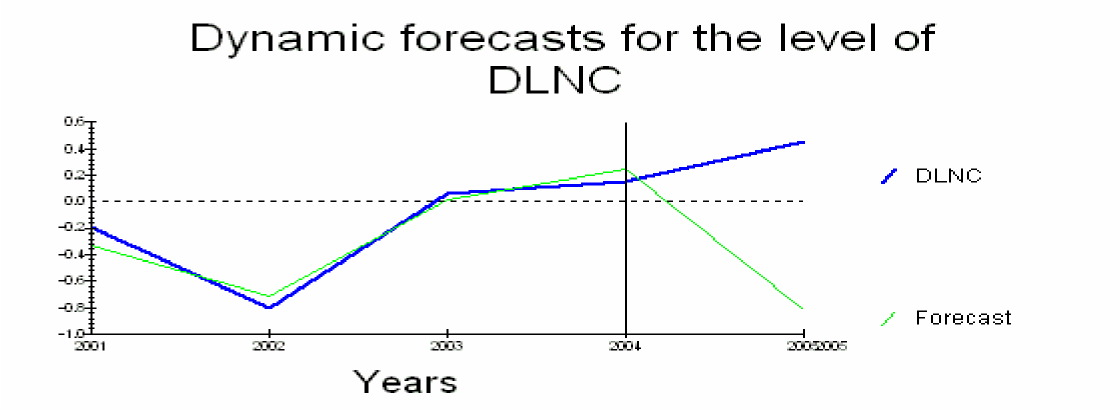

```
          Error Correction Representation for the Selected ARDL Model
            ARDL(1) selected based on Akaike Information Criterion
*******************************************************************************
 Dependent variable is dLNC
 5 observations used for estimation from 2000 to 2004
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dCON                       .29867            .49814             .59956[.591]
 ecm(-1)                   -.39840            .43162            -.92302[.424]
*******************************************************************************
 List of additional temporary variables created:
 dLNC = LNC-LNC(-1)
 dCON = CON-CON(-1)
 ecm = LNC   -.74968*CON
*******************************************************************************
 R-Squared                     .22118   R-Bar-Squared                 -.038430
 S.E. of Regression            .40985   F-stat.    F(  1,    3)    .85197[.424]
 Mean of Dependent Variable   -.12887   S.D. of Dependent Variable      .40219
 Residual Sum of Squares       .50393   Equation Log-likelihood        -1.3578
 Akaike Info. Criterion       -3.3578   Schwarz Bayesian Criterion     -2.9672
 DW-statistic                  1.7029
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNC and in cases where the error correction model is highly
 restricted, these measures could become negative.
```



5.2.2.

The second order ARDL (2) models with the same variables fits the regression perfectly but with the much lower forecasting ability than prior models having error of 1, 2..

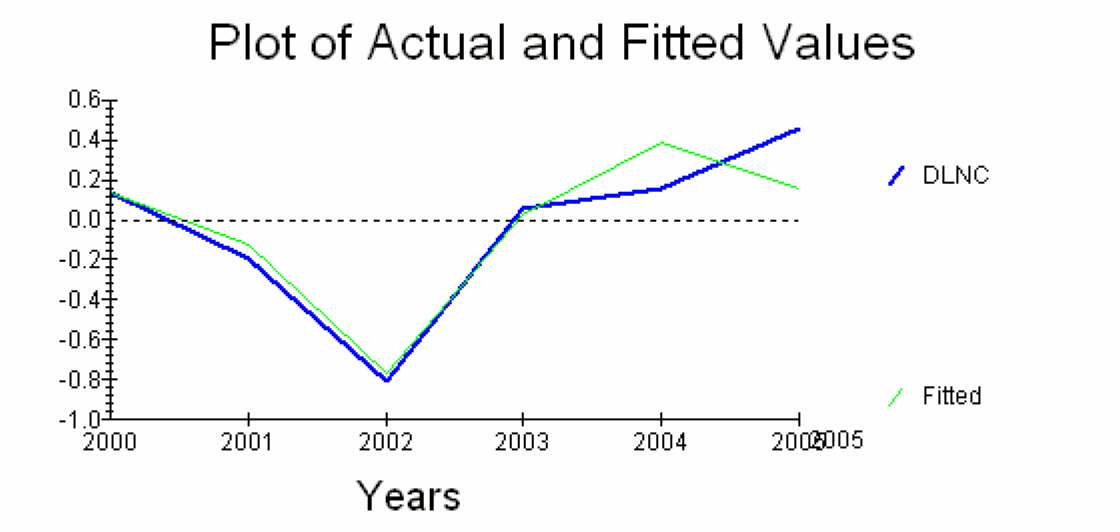
```
            Autoregressive Distributed Lag Estimates
            ARDL(2) selected based on Akaike Information Criterion
*******************************************************************************
 Dependent variable is DLNC
 4 observations used for estimation from 2001 to 2004
*******************************************************************************
 Repressor               Coefficient       Standard Error          T-Ratio[Prob]
 DLNC(-1)                   -.56686             .28278             -2.0046[.295]
 DLNC(-2)                   -1.1585             .30749             -3.7677[.165]
 CON                        -.65959             .15890             -4.1511[.150]
*******************************************************************************
 R-Squared                       .93515   R-Bar-Squared                   .80546
 S.E. of Regression              .19003   F-stat.    F(  2,    1)    7.2104[.255]
 Mean of Dependent Variable     -.19603   S.D. of Dependent Variable      .43083
 Residual Sum of Squares        .036110   Equation Log-likelihood         3.7392
 Akaike Info. Criterion          .73923   Schwarz Bayesian Criterion      1.6598
 DW-statistic                      2.3538
```



5.2.3.

ARDL model that incorporates GDP per capita and export captures the dynamics perfectly until 2004 what point us to missing macroeconomic variable.

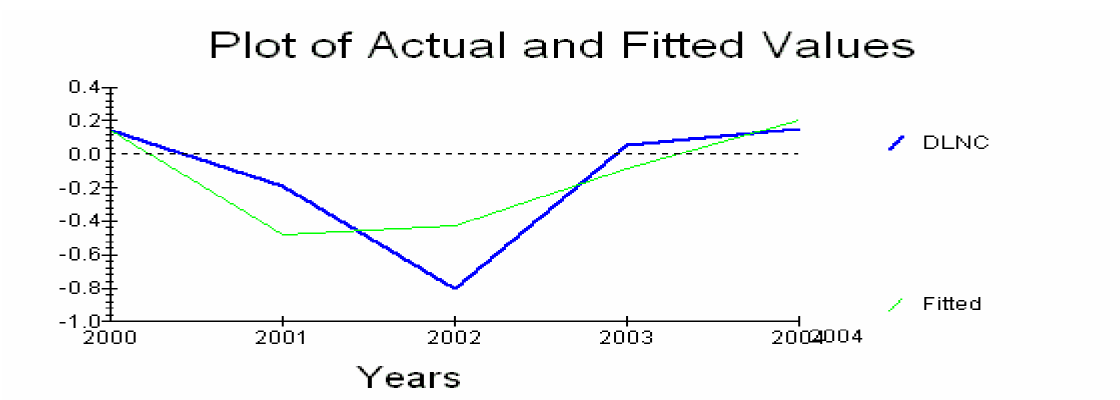
```
DLN Inflation  =    .89392*DLN Inflation (-1)  -35.9769*DLN GDP per capita
-6.5485*DLN GDP per capita(-1) +3.6618*CON +   2.3404*DLN Export
```

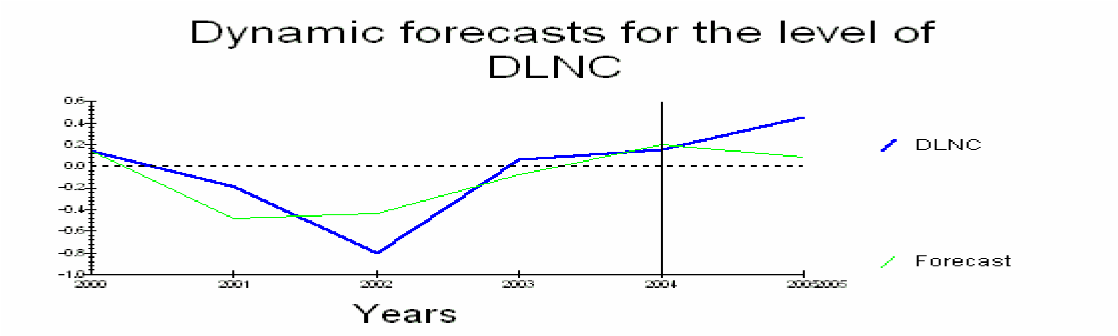


5.2.4.

Smaller error in forecasting 0,32 but a little less stable in capturing dynamics is the following ARDL model that regresses differenced log inflation on logged value of itself and Eur-o exchange rate..

```
DLN Inflation  =    2.5182*DLN Inflation (-1) +   .59458*CON +  67.3472*DLN
exchange rate EUR
```

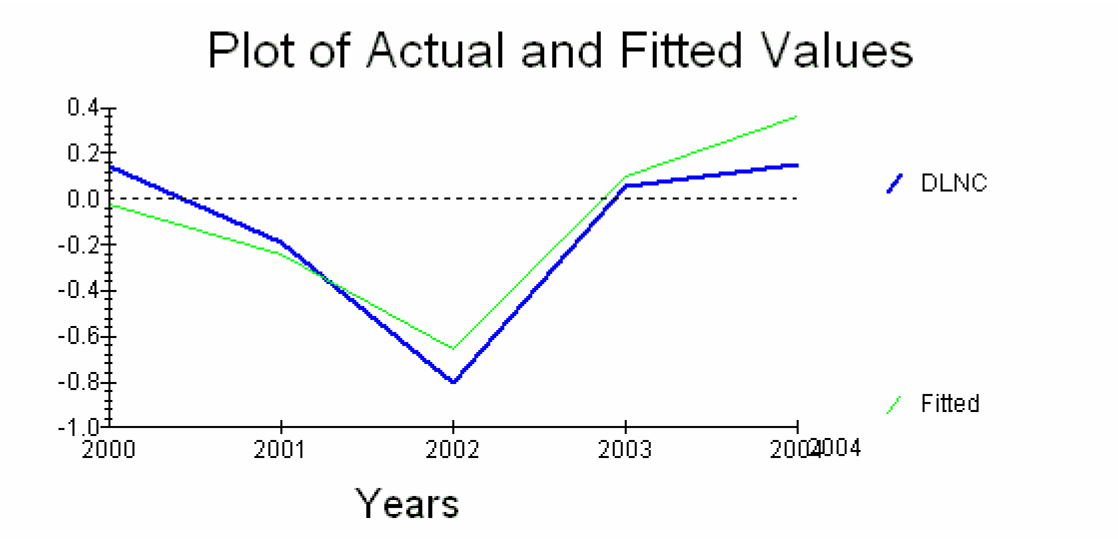


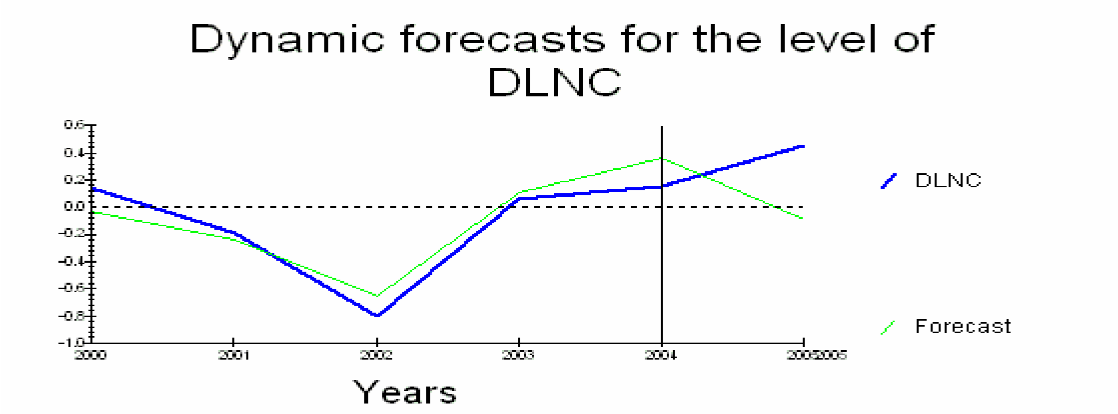


5.2.5.

ARDL model with oil prices and Industrial Price Index makes further improvements but with also possibilities to work on waiter model in order to improve forecasting. (Forecasting errors 0,54)

```
DLN Inflation  =    .43839*DLN Inflation (-1)  -66.9245*DLN IPC +
43.3386*DLN IPC(-1) +3.2579*DLN oil price
```





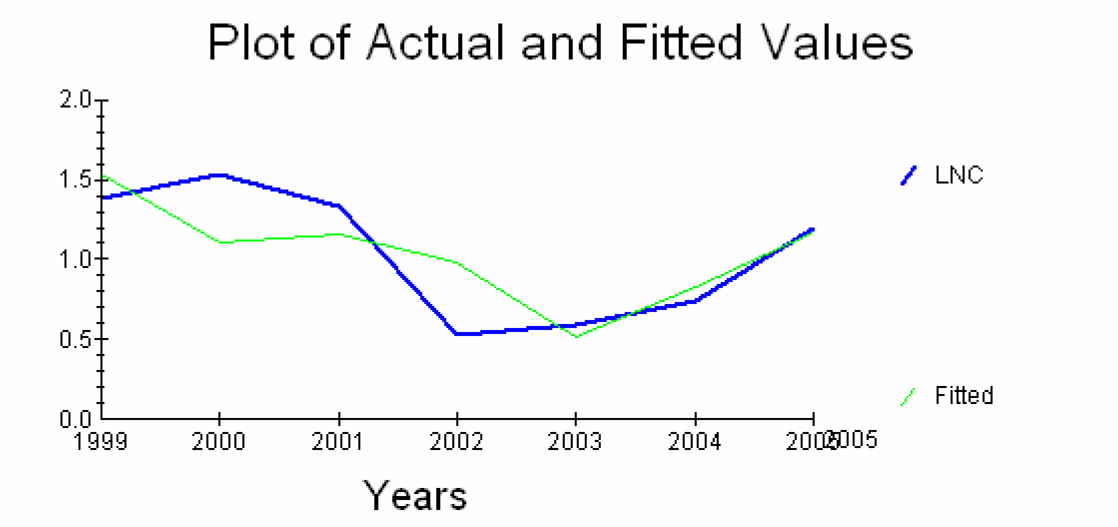
5.3. VAR MODEL

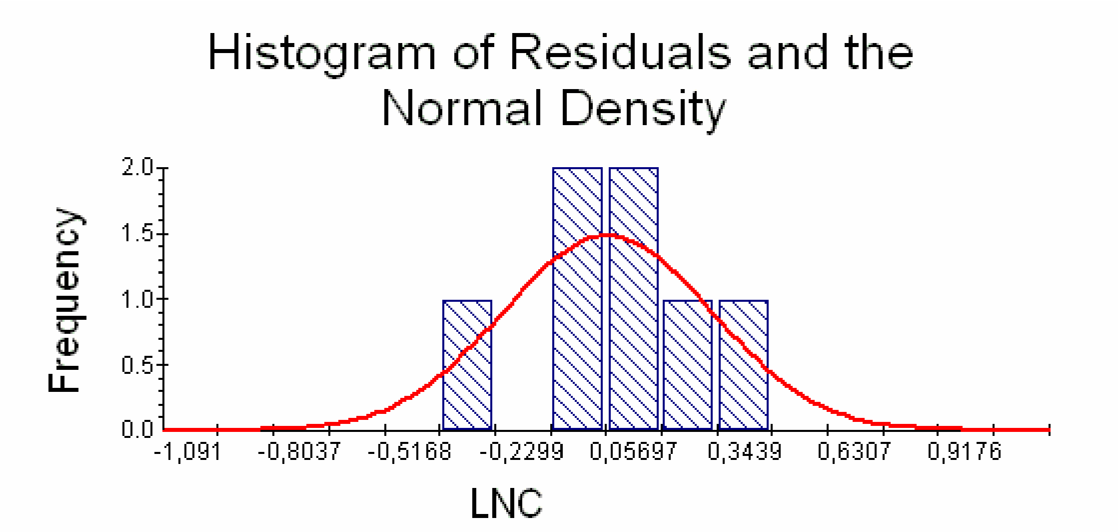
Family of multivariate models is firstly represented by Vector Auto regression Models.

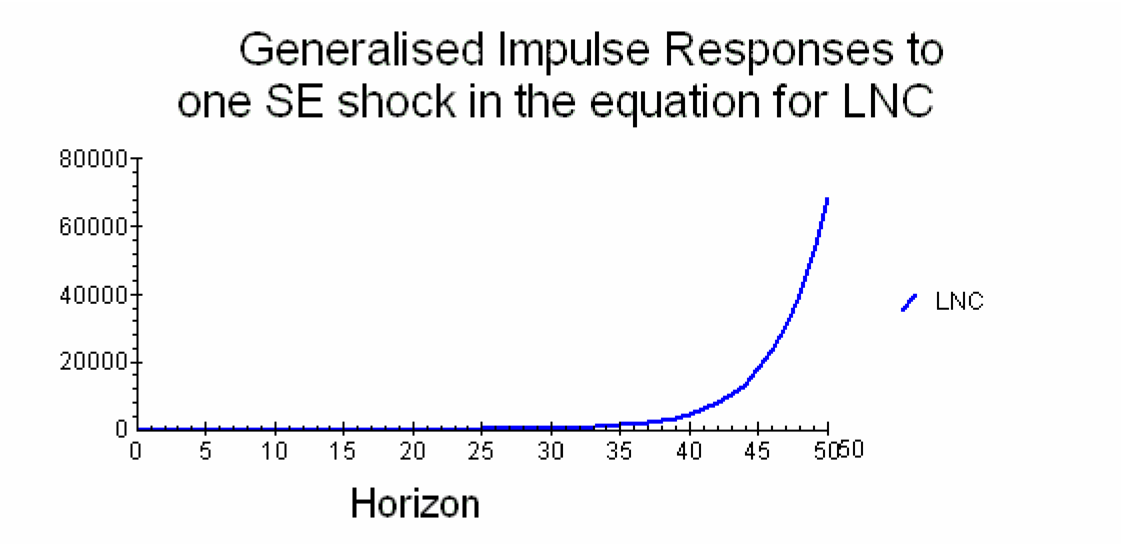
5.3.1

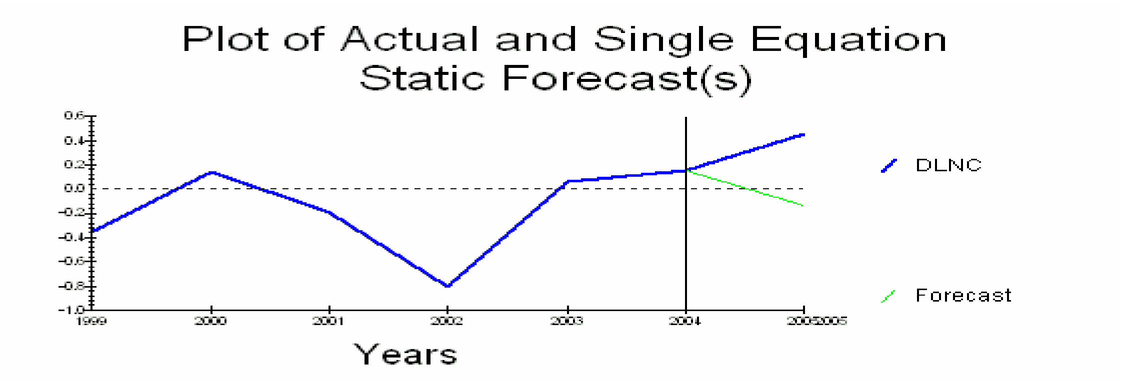
VAR model based on log ln values of inflation itself IPC and Import is improved its forecasting valuation reducing error to just 0,0906

```
LN Inflation  =    .53933*LN Inflation C(-1) +   8.1321*LN IPC(-1)   -
9.2034*LN Import
```





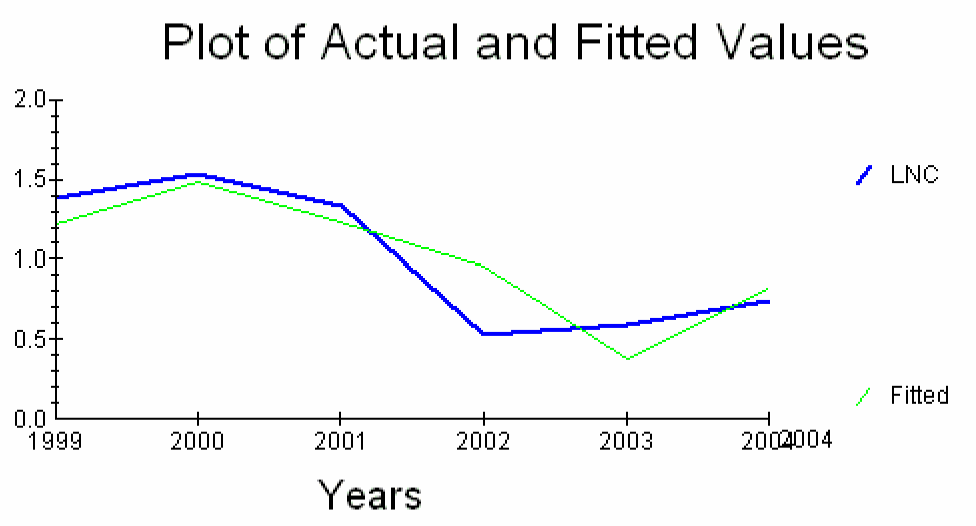




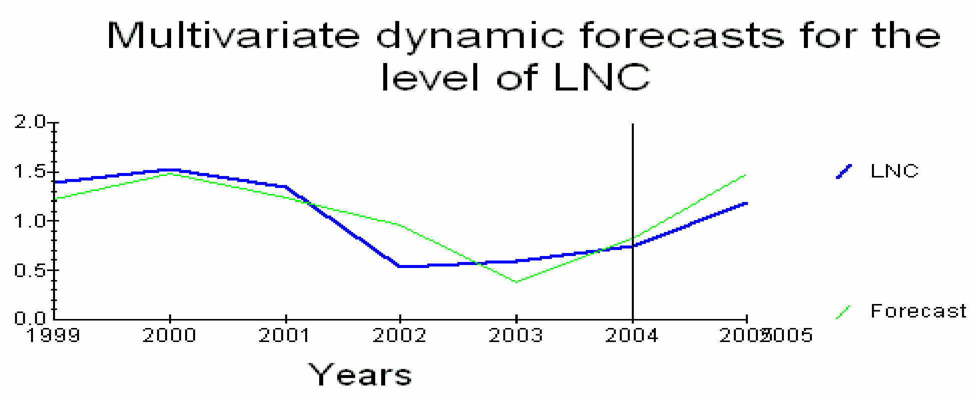
5.3.2

Still better approximation was made while incorporating ln values in crude prices and net wages.

LN Inflation C = .88868*LN Inflation C(-1) -1.0841*LN NETTO WAGE(-1) + 1.6162*LN OIL PRICE

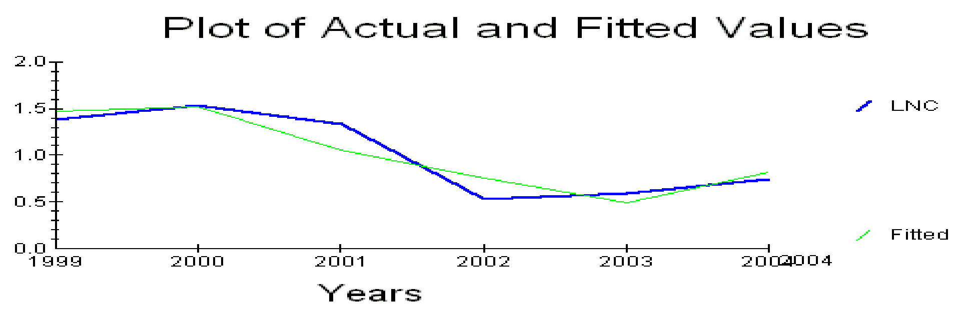


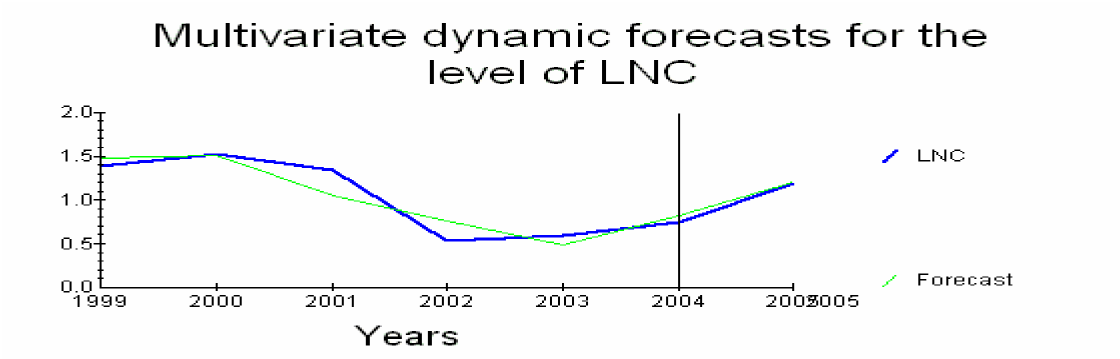
Incorporating oil prices into regression latest price increase is captured and tendency for further rise in inflation recognized.



5.3.3

This model even better simulates the relation between the inflation, import and exchange rate reducing forecast error to minimum level so far at -0,0087.

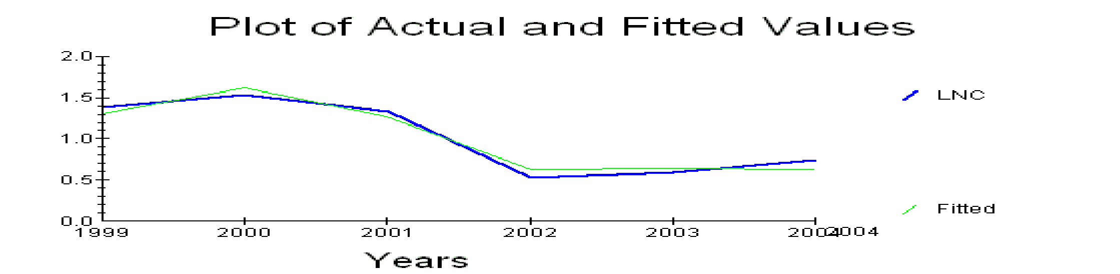


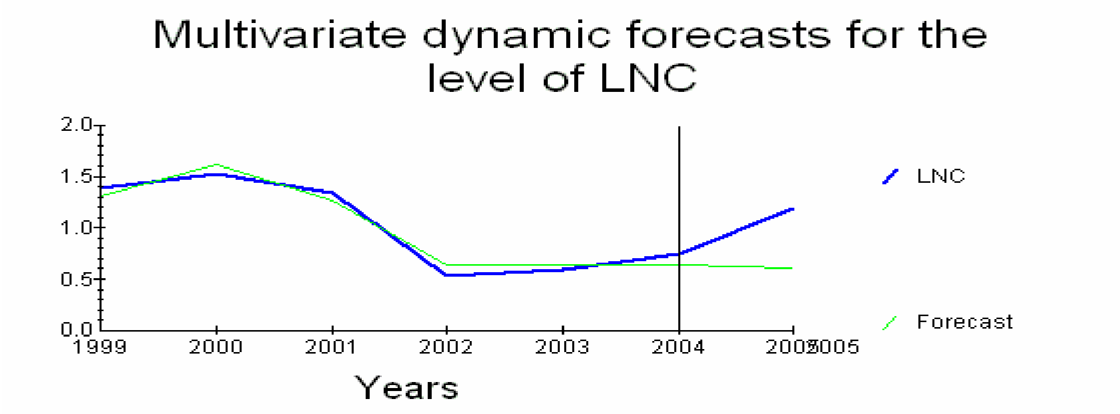


5.3.4

Further research brings us to equation with oil prices, export and wages but although excellent fit it is deficient to model before while having much larger forecasting errors 0,58.

```
LN Inflation  =    .32821*LN Inflation (-1) +   .53771*LN OIL price +
4.2657*LN Export  -3.4961*LN Net wage
```

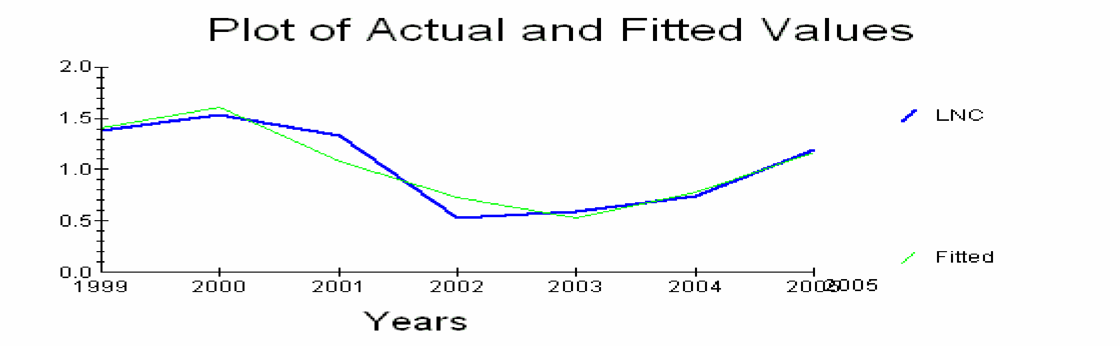


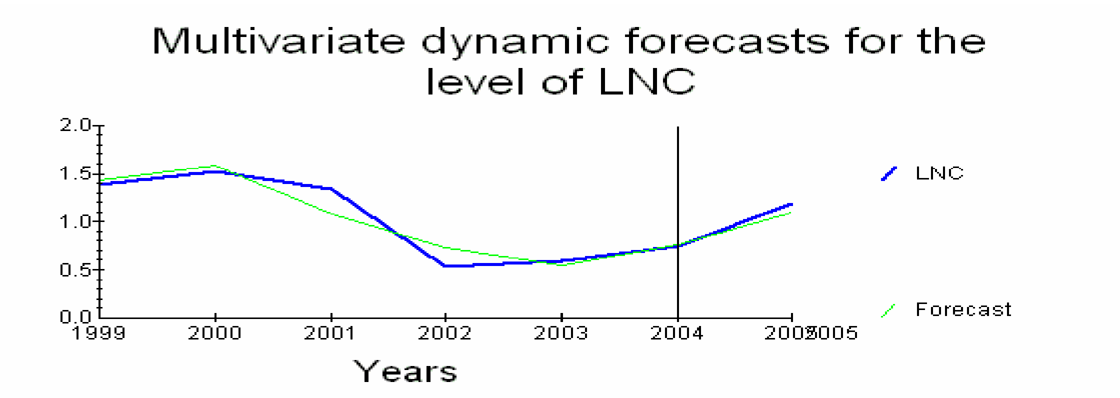


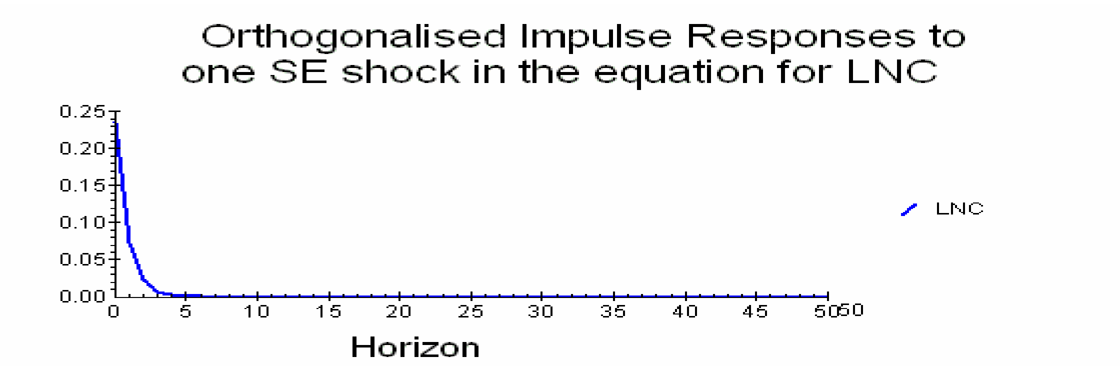
5.3.5

Due to small number of observation it is not possible to implement higher than 1 VAR model.The last in this group model reduce predictive error to 0,08.

LN Inflation = .34702*LN Inflation (-1) -2.2821*LN Net wage -1) + 1.4219*LNOIL price +3.5568*LN exchange EUR







Test criteria suggest picking the SBC criteria of order 0.

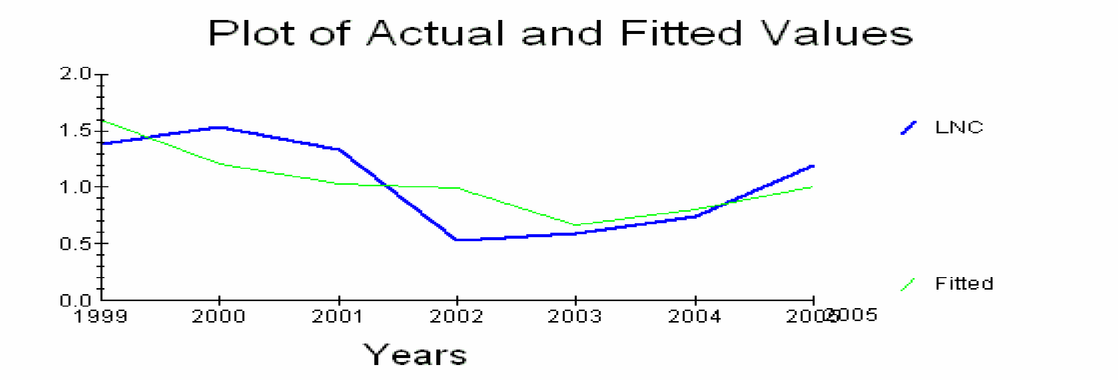
5.4. PHILIP'S CURVE

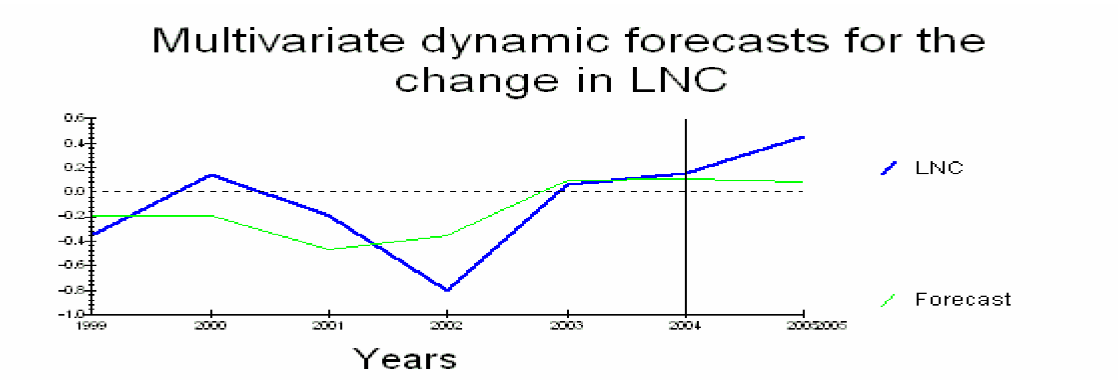
Macroeconomic theory teaches us about relation between inflation and unemployment in reverse relation under Phillips curve title.
In order to investigate this relation on the Croatia case two models are taken into consideration.

5.4.1.

The first model takes *ln* values of logged inflation together with time, intercept and unemployment. Graph depicts reverse relation with a little less predictive power having 0,36 forecast error.

```
LN Inflation  =    .59253*LN Inflation (-1)   -1.7620*LN unemployment(-1) +
.042350*TIME +4.8523*CON
```

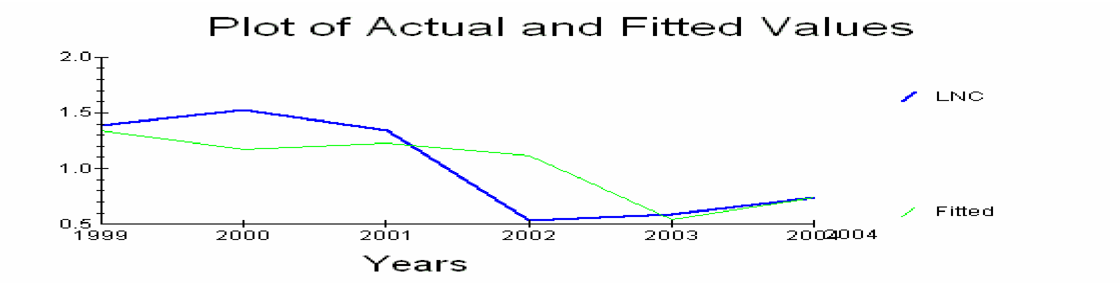


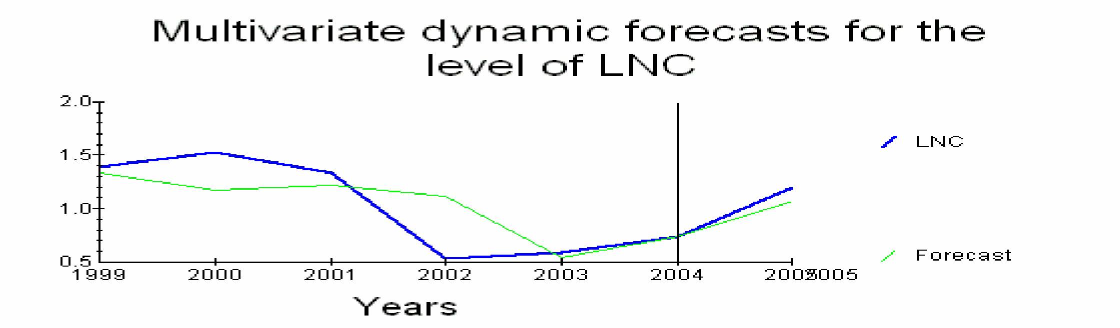


5.4.2.

The second model considers inflation in regression with unemployment and ln oil prices. The reverse relation is again vividly presented on the graphs below although forecasting performance show a less error reaching only 0,12.

LN Inflation =.81924*LN Inflation (-1)-.54647*LN unemployment + .46343*LNOIL price





6. CONCLUSION

The aim of this paper is to model and forecast measures of inflation for Croatian economy. The main leading idea is to try step by step approach using different classes of models to reach an optimal model and forecast.

Before trying to reach the best model some pre research about Croatia and its macroeconomic position in relation to its neighborhood is made. It is established that country is approaching to agreeable levels of inflation although still above EU requirements but below world average. On the other hand country is fighting with considerate level of unemployment in comparison to EU average, huge current account deficit and larger % of import to GDP in relation to export. Gray economy and unsuccessful privatization in large number of cases which further bring working force in unfavorable position, as well as the lack of strong strategic industry developments plans are further obstacles Croatia need to overcome.

With these facts considered different models show comparative performance and results of many considered are valuable to be applied. Since small observation period is taken into account this paper doesn't develope more than 1 lagged value and have limited forecast horizon ability. Non linear models are penalized by a short sample periods and forecast evaluation is based on the few observations. If the larger amount was considered some better results would be obtained and this is the further step to be taken in considering Croatia inflation.

Multivariate models that incorporate crude prices, export import and wage level best explain the inflation variation, while Phillips curve exhibits short run inflation forecast capability.

This paper provides different methodologies in forecasting one of the most important variables in the macro economy of each country.

Table 1: Croatia macroeconomic data 1998-2005

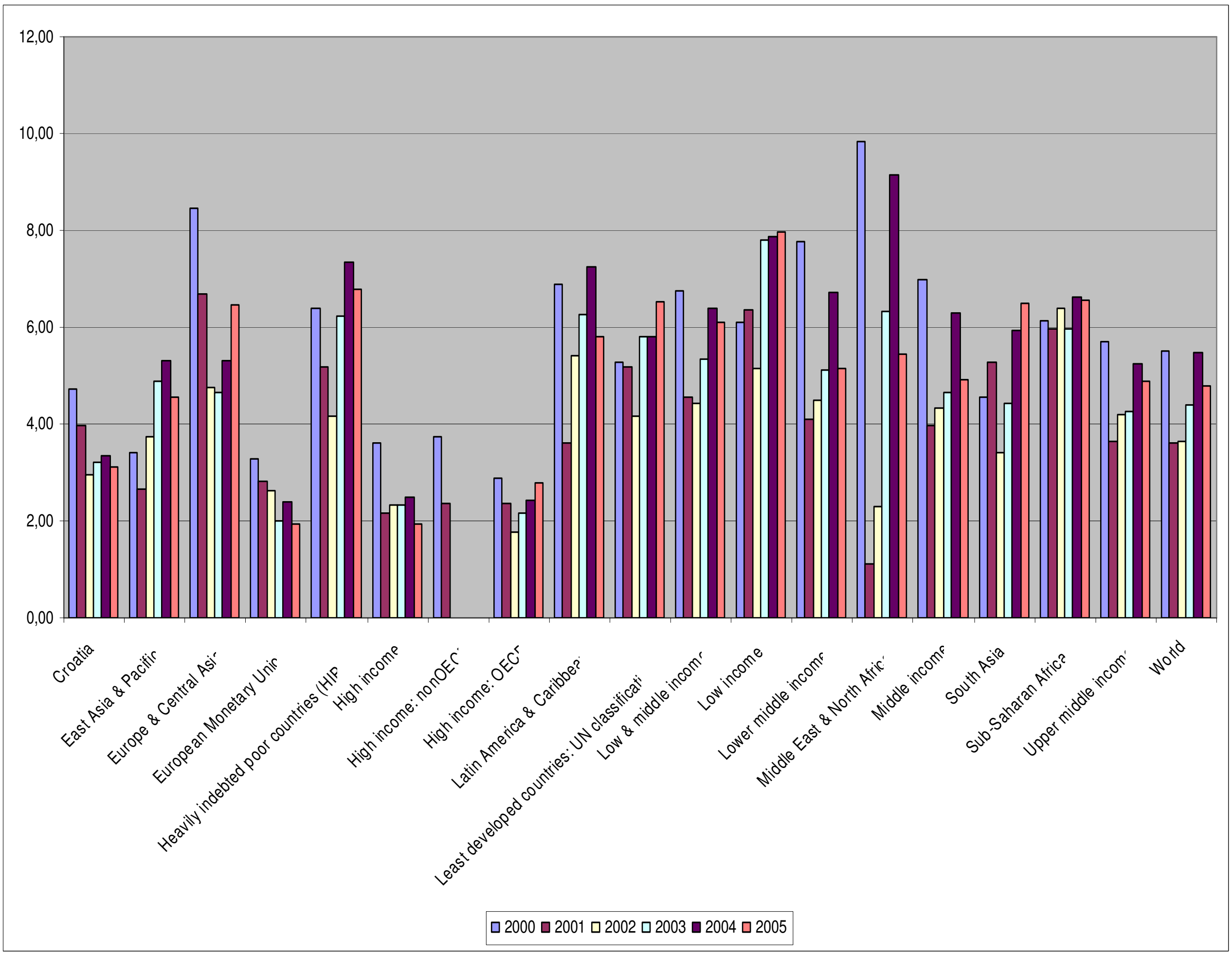
year	gdp per capita(eur)	gdp growth	inflation rate	ICP	IPP	Inndex neto wages	Index gross wages	Current account	Current account (% of GDP)	Export(%of GDP)	import (% of GDP)	Average exchange (HRK : 1 EUR)	Average exchange (HRK : 1 USD)	Rate of unemploy ment
1998.	4.282,00	2,50	5,70	88,60	102,30	100,00	100,00	- 1.305,00	- 6,80	39,80	49,10	7,14	6,36	11,40
1999.	4.100,00	- 0,90	4,00	92,10	101,10	116,90	113,10	- 1.312,00	- 7,00	40,90	49,30	7,58	7,12	13,60
2000.	4.560,00	2,90	4,60	96,40	103,70	131,90	127,40	- 478,00	- 2,40	47,10	52,30	7,63	8,29	16,10
2001.	4.997,00	4,40	3,80	99,00	113,80	150,30	140,30	- 818,00	- 3,70	48,70	54,60	7,47	8,34	15,80
2002.	5.507,00	5,60	1,70	101,70	117,90	163,60	150,10	- 2.095,00	- 8,60	45,50	56,40	7,41	7,87	14,80
2003.	5.905,00	5,30	1,80	103,50	117,40	174,20	156,10	- 1.866,00	- 7,10	50,10	57,90	7,56	6,70	14,30
2004.	6.396,00	3,80	2,10	105,60	119,60	183,00	165,50	- 1.404,00	- 4,90	50,10	57,00	7,50	6,03	13,80
2005.	6.968,00	4,30	3,30	109,10	123,80	193,80	173,40	- 1.994,00	- 6,40	49,30	56,50	7,40	5,95	12,70

Source: www.HNB.hr, 2007

Table 2: Forecast errors from models implied

	Error	SD Error	Mean Prediction Error	Absolute	Mean Sum Squares	Root Mean Sum Squares	Sum Square Prediction Error
Linear							
1	2.6816	1.4079	2.6816		2.6816	2.6816	7.191
2	0.65442	0.55238	0.65442		0.65442	0.65442	0.42826
3	0.73206	0.47170	0.73206		0.73206	0.73206	0.53590
4	0.51959	0.47191	0.51959		0.51959	0.51954	0.26997
5	0.62272	0.45171	0.62272		0.62272	0.62272	0.38778
6	0.58848	0.50925	0.58848		0.58848	0.58848	0.34631
7	0.79232	0.35988	0.79232		0.79232	0.79232	0.62777
8							
9	0.49279	0.41998	0.49276		0.49276	0.49276	0.24281
ARDL							
1	0.44890			0.2405	1.0079	0.31747	
2	1.2652			0.088448	0.009	0.095	
3							
4	0.3723		-0.00	0.1712	0.049	0.22173	
5	0.54306		-0.036858	0.12451	0.019799	0.14071	
VAR							
1	0.090674		0.7795e-3	0.21543	0.072287	0.26886	
2	-0.28061		0.0028013	0.17031	0.045037	0.21222	
3	-0.008793		-0.1350e-3	0.12915	0.025091	0.15840	
4	0.58614		0.721e-4	0.082549	0.007241	0.085031	
5	0.089544		-0.1478e-4	0.10214	0.018478	0.13593	
Philip's							
1	0.36467		-0.00	0.21625	0.069142	0.26293	
2	0.12196		-0.0019284	0.19228	0.080625	0.28395	

Picture 10: Rate of inflation 2000-2006 comparison Croatia/other EU countries



Source: World bank,2007

Literature:

-Atkeson: 2001 Are Phillips curves useful for forecasting

-Canova :Inflation forecasting

-Granger: Forecasting Economic Time Series

-Stock: Forecasting Inflation 1999

-www hnb.hr

-www hgk.hr

-www.oecd.org

-worldbank.org