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PREDICTING GDP GROWTH IN THE EURO AREA

CLÁUDIA CRISTINA MARINHO CAMPOS 418

A project carried out on the Corporate Finance Major, under the supervision of:
Paulo M. M. Rodrigues

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Abstract

Predicting GDP growth is a concern of several economic agents. The right way to model such variable is far from consensual. This paper's goal is to compare different models for GDP growth forecasting in the euro area. For comparative purposes, an autoregressive model (which is used as benchmark) and two Autoregressive Distributed Models (ADL), which contain financial and non-financial variables, chosen based on the literature, are used. The main conclusion is that the ADL(2,1,1) considered has superior forecast performance in- and out-of-sample, although in this last case depending on the evaluation metric.

Keywords: Forecasting, Linear models, GDP growth, Euro Area

1 Introduction

A vast literature in finance and macroeconomics is dedicated to the forecasting ability of financial variables for real economic activity. Since GDP growth is one of the most important macroeconomic indicators and, consequently, the main subject of interest for both society and policymakers, forecasting GDP is probably one of the most discussed topics in the literature. However, empirical evidence is mixed and results are not robust with respect to model specification, sample choice and forecast horizon, as well as, to the variables that should be used.

GDP measures economic output, representing business activity and supporting the country's level of productivity. On the one hand, economists rely on GDP data to determine whether we are in expansion or contraction, while on the other hand, monetary policymakers use GDP when measuring the state of the economy and inflation. This economic indicator gains therefore an enormous relevance for several agents' interest in the economy's wealth and future direction (expansion or recession). Finding a way to model such a variable is far from consensual and it has been intensively studied in the past. Hence, it is of interest to find a good model to predict GDP.

Empirical studies often choose financial variables that are considered as leading indicators of economic activity, such as stock returns, interest rates, interest rates spreads, monetary aggregates, and others. Banerjee *et al.* (2003) using an extensive list of leading indicators for output growth found that measures of short and long-term interest rates, as well as interest rate spreads are the best performing single indicators for GDP growth. Furthermore, Moneta (2005) found that the yield spread is a powerful variable for predicting recessions in the euro area, a result that was also confirmed by *e.g* Duarte *et al.* (2005), who used aggregated data for the euro area and observed the ability of the spread to predict output growth and recessions. However, there are studies that consider that the separate use of the long-term and the short-term interest rate is more powerful than the yield curve. Moreover, there is empirical evidence that the forecasting ability of the term spread has decreased over the past decade. For instance, Haubrich and Dombrosky (1996) and Dotsey (1998) confirmed, using US data and linear models, that from 1985 there is a sharp decrease in the predictability power of the term spread. In addition to these studies, we can further identify other works suggesting that the term structure and monetary aggregates are associated with future economic activity, *e.g.* Harvey (1988, 1997); Estrella and Hardouvelis (1991); Plosser and Rouwenhorst (1994) and Hamilton and Kim (2002).

The capability of the spread to predict recessions or economic activity can be explained using an example. Image a country that is currently enjoying a strong economic growth and where investors share the opinion that the country will be subject to a slowdown or a recession in the future. Consumers will, therefore, hedge against this scenario by purchasing financial instruments, such as long-term bonds that will give them the desirable payoffs in the slowdown, which will consequently increase the price of these bonds and decrease the correspondent yields. However, in order to do so, consumers may need to sell their shorter instruments, hence the price will decrease and consequently the yield increase. The overall result is that prior to an expected recession the long term rates decrease and the short term rates increase, originating a flat or inverted term structure.

According to Stock and Watson (2001), non-financial variables may also help predict future GDP growth. Several non-financial indicators for the euro area can be suggested such as *e.g.* industrial production (IP), new car registration, retail sales indicator, confidence surveys and composite leading indicators (CLI). However, the predictive horizon of these indicators tends to be short, declining within a year, see *e.g.* Koenig and Emery (1991) and Estrella and Mishkin (1996).

In the literature on this subject IP appears to be one of the best economic indicators to help track GDP. Runstler and Sédillot (2003) found, in an univariate forecasting framework, that monthly indicators provide useful information for predicting GDP growth over the current and the next quarter, where IP excluding construction, is the most significant and with superior performance monthly indicator. Moreover Baffigi *et al.* (2002) using disaggregated data found that GDP and IP share a strong link. Banerjee *et al.* (2003) using 46 euro area variables conclude that the best indicators were short-term interest rate, public expenditure, IP, world GDP and demand growth. More evidence supporting the use of IP can be found in Trehan (1992). Note that IP accounts for around ¼ of the euro area GDP, therefore tracking IP becomes very relevant when forecasting GDP.

This paper's goal is to analyze the predictability of GDP growth in the euro area using first an autoregressive (AR) model, since there is evidence of limited gains by substituting for more sophisticated specifications (see *e.g.* Marcellino, 2007 and Banerjee and Marcellino, 2005). Furthermore, I will also add the term structure to the AR model, and finally consider a third model which consists of adding the non-financial variable IP to the previous model. The comparison between these models will be conducted in-sample and out-of-sample.

After introducing the subject and presenting the literature review, the paper is organized as follows. Section 2 presents the models as well as the econometric methodology, Section 3 describes the data, Section 4 presents the empirical results and Section 5 summarizes the main conclusions.

2 Methodology

This section briefly reviews the econometric concepts used in the empirical analysis. It will start by the description of the models and then the key tools used to evaluate the out-of-sample results.

This paper will exploit the following forecasting model form:

$$y_{t+h}^{h} = \alpha + \beta(L)y_t + \delta(L)TSt + \varphi(L)NFVt \qquad (1)$$

where $\beta(L)$, $\delta(L)$ and $\varphi(L)$ are lag polynomials, y_t represents GDP growth, TS_t term spread and NFV_t the non-financial variable. The empirical study will consider 3 models where the first one comprehends only the autoregressive component, meaning therefore that it only accounts for the first part of the equation (*i.e.* TS and NFV are dropped from the above forecasting form). The second model will be an Autoregressive Distributed Lag model of orders p and q (ADL(p,q)), so the model will have a pth order autoregressive component plus a qth order component of the term spread. Finally, the third model will add the NFV variable to the second model, originating an ADL(p,q,m).

As can be seen, all variables have lag operators and thus the decision on the lag order to be used will be based on some information criteria (AIC or BIC) with a maximum number of 6 lags, as suggested by *e.g.* Marcellino (2007). Such criteria have the following mathematical expression:

$$\text{Akaike's Information Criterion} = \ln(\hat{\sigma}^2) + \frac{2k}{T} \qquad (2)$$

$$\text{Bayesian Information Criterion} = \ln(\hat{\sigma}^2) + \frac{k}{T}\ln(T) \qquad (3)$$

where $\hat{\sigma}^2$ is the residual variance, $k = p + q + 1$ is the total number of parameters estimated and T is the sample size.

Models with lower AIC or BIC are usually preferred. However, the two information criteria may provide different model orders, since BIC is consistent yet inefficient while AIC is inconsistent and will choose models with more parameters.

2.1 Forecast Performance Measures

The forecasting methodology used will be the static method, which calculates a sequence of one-step-ahead forecasts, rolling the sample forward one observation after each forecast, using actual rather than forecasted values of the lagged dependent variables. In order to assess the accuracy of the forecasts and perform the out-of-sample comparison the following procedures will be considered:

2.1.1 The Mean Absolute Error (MAE)

The MAE is a metric used to measure how close forecasts are to the eventual outcomes, it measures the average magnitude of the errors in a set of forecasts without considering their direction. The MAE is computed as,

$$MAE = \frac{1}{N}\sum_{t=1}^{N}\left|y_{t+s} - f_{t,s}\right| \tag{4}$$

2.1.2 The Root Mean Squared Error (RMSE)

The RMSE is similar to the MAE. Both measures depend on the scale of the dependent variable and should therefore be used as relative measures to compare forecasts for the same series across different models. The RMSE is computed as,

$$RMSE = \sqrt{\frac{1}{N}\sum_{t=1}^{N}\left(y_{t+s} - f_{t,s}\right)^2} \tag{5}$$

The measures mentioned above evaluate the forecast error, which implies that the lower their values, the lower the forecasting errors and, therefore, the better the forecasts produced.

2.1.3 Theil's inequality coefficient

Theil's inequality coefficient has the advantage of varying between 0 and 1. Note that 0 is the indication of a perfect forecast. This coefficient is given as,

$$\text{Theil} - \text{U} = \frac{\text{RMSE}}{\sqrt{\frac{1}{N}\sum_{t=1}^{N}(y_{t+s})^2} + \sqrt{\frac{1}{N}\sum_{t=1}^{N}(f_{t+s})^2}}. \tag{6}$$

Furthermore, this coefficient can be decomposed into bias, variance and covariance proportions, *i.e.*,

$$\text{Bias Proportion} = \frac{\left(\left(\frac{\sum_{t=1}^{N}\hat{y}_t}{N}\right)-\bar{y}\right)^2}{\frac{\sum_{t=1}^{N}(\hat{y}_t-y_t)^2}{N}}; \tag{7}$$

$$\text{Variance Proportion} = \frac{\left(s_{\hat{y}}-s_y\right)^2}{\frac{\sum_{t=1}^{N}(\hat{y}_t-y_t)^2}{N}}; \tag{8}$$

$$\text{Covariance Proportion} = \frac{2(1-r)s_{\hat{y}}s_y}{\frac{\sum_{t=1}^{N}(\hat{y}_t-y_t)^2}{N}}; \tag{9}$$

The bias proportion in (7) is a measure of the systematic error (a measure of the distance between the forecasts and the mean of the series), the variance proportion in (8) measures the ability of the model to replicate the variability present in the data. Finally, the covariance proportion in (9) measures the remaining unsystematic forecasting errors. The sum of these components equals one. The closer the bias and variance proportions are to 0 and the covariance proportion is to 1, the better the forecasting capacity of the model.

3 Data

Euro area data is only available since 1999. Since, for the present study GDP is the variable of interest, it is necessary to construct quarterly euro area data. This construction is surrounded by several problems such as *e.g.* the choice of the aggregation method (fixed versus time-varying weights, choice of proper weighting variables, etc), seasonal and working day adjustment methods and the presence of missing observations. This section will therefore explain from where the data was extracted and how it was transformed.

In order to focus on the topic of the paper, I have decided to use an already existing database, which was constructed by Fagan, Henry and Mestre (2001) for the ECB euro

Area Wide Model (AWM). This model was developed in order to assess the economic conditions in the area, to perform macroeconomic forecasts, allow policy analysis and to deepen the knowledge of the functioning of the euro area economy. It is based on 5 key features: it treats the euro area as a single economy; it is a medium sized model; it is designed to have a long-run equilibrium consistent with classical economic theory, while its short run dynamics are demand driven; it is mostly backward looking, meaning that expectations are reflected using the inclusion of lagged variables and finally, it uses quarterly data, allowing for a richer handling of the dynamics and it is mostly estimated on the basis of historical data. The database contains data from the 1st quarter of 1970 to the 4th quarter of 2009 and comprehends several macroeconomic variables, such as long-term interest rates (10y), short-term interest rates (3m), GDP, household consumption, exports and imports, which are the variables in which I am interested in.

The AWM database[1] was constructed following the so-called "Index Method", where, *e.g.* the logarithm of the euro area GDP is the weighted sum of the logarithms of the country specific GDPs, with constant weights based on the 1995 real GDP share. This real-time database is provided by the Euro Area Business Cycle Network[2].

From this database, GDP was transformed into growth rates and, as Fagan, Henry and Mestre (2001) point out, the short-term interest rate and long-term interest rate are in nominal values and therefore it is necessary to transform them to real using the Fisher equation. Due to the fact that I am interested in the spread variable, there is no need to adjust for inflation because it will be canceled out when calculating the spread.

Finally, the non-financial variable was extracted from the OECD database[3]. The data is already aggregated for the euro area and seasonally and working day adjusted.

[1] For more detailed information about the construction of this database see Annex 2 of the ECB Working Paper no.42 – An Area-Wide Model for the Euro Area (2001).

[2] http://www.eabcn.org/area-wide-model

[3] http://stats.oecd.org/mei

The real-time IP Index covers mining, manufacturing, electricity, gas and water sectors and also the IP growth rates were considered.

4 Empirical Results

In this section, the in- and out-of-sample results will be presented. The variables examined are real GDP growth, real spread (which is the difference between the 10 years and the 3 month interest rates) and real IP. The in-sample period will range from the 4th quarter of 1975 (1975q4) to the 4th quarter of 2001 (2001q4), which will be called the 1st sub-period and from the 4th quarter of 1975 (1975q4) to the 4th quarter of 2005 (2005q4), defined as the 2nd sub-period. In terms of out-of-sample, a full period from the 1st quarter of 2002 (2002q1) to the 4th quarter of 2009 (2009q4) will be considered and two sub-periods ranging from the 1st quarter of 2002 (2002q1) to the 1st quarter of 2006 (2006q1) and from the 1st quarter of 2006 (2006q1) to the 4th quarter of 2009 (2009q4).

4.1 Data Management and Characteristics

Before performing the econometric exercise, it is important to visually analyze the relationship between real GDP and the two variables considered. From Figure 1 it can be observed that IP and the spread provide leading information for real economic activity in the euro area, suggesting that both variables may help predict GDP growth.

Moreover it is important to test for nonstationary of each variable, because if they are nonstationary then standard assumptions for asymptotic analysis will not be valid. Resorting again to the same figure we see that none of the variables has a time trend, as a consequence the ADF test with constant and no trend was performed. The results summarized in Table 1 show that we reject the null hypothesis for the presence of a unit root in GDP growth and IP, which means that both variables are stationary [I(0) variables]. Concerning the spread we do not reject the null hypothesis at the 1% level of significance, but still because it is very close to the rejection area and we are in the context of the 1% level of significance, the variable will be assumed to be I(0).

4.2 The autoregressive model (AR)

The first model we consider is an AR model of order q, which is normally used as a benchmark in the literature for forecasting comparisons. The decision about the order was made using the AIC and BIC criterion. As summarized in Table 2, the AIC criterion prefers an AR(2) while the BIC criterion prefers an AR(1). Since they give different model choices, I decided to go forward with the AIC as also recommended by Burnham and Anderson (2004).

The intuition behind the AR(2) is that GDP growth can be explained by its past values. From Table 3 and regarding the 1^{st} sub-period we observe that GDP_growth_{t-1} is statistically significant at the 10% significance level and that GDP_growth_{t-2} is not significant at any level of significance. Moreover, the constant is statistically significant for all significance levels (p-value is 0). Regarding the 2^{nd} sub-period, GDP_growth_{t-1} becomes significant at the 5% level and GDP_growth_{t-2} remains statistically insignificant. Furthermore in the 1^{st} sub-period the R^2 is 6,54% and the adjusted R^2 is 4,67% and in the 2^{nd} sub-period the R^2 is 7,78% and the adjusted R^2 is 6,19%.

In order to validate such conclusions we need to test for autocorrelation and heteroscedasticity. Regarding autocorrelation, using robust Breusch-Godfrey tests, we conclude for the 1^{st} sub-period that there is no autocorrelation in the residuals, both F-statistic (p-value of 39,29%) and Chi-Square (p-value of 37,18%) do not reject the null hypothesis of no autocorrelation (see Table 4). Concerning heteroscedasticity, using White's test we see that in the 1^{st} sub-period we reject the null hypothesis at a 5% significance level when using the F-statistic (4,9%) and at a 10% significance level using the Chi-Square (5,05%)(see Table 5), meaning that we have heteroscedasticity in the model and that it is necessary to correct it, otherwise the standard errors, test of significance and inferences may no longer be appropriate. Moreover, when looking at the 2nd sub-period, the model also does not show evidence of autocorrelation (F-statistic is 34,08% and Chi-Square is 32,39%), but there is evidence of heteroscedasticity (F-statistic is 1,72% and Chi-Square is 1,88%), meaning that we need to correct the AR model also in the 2nd period.

After correcting for the presence of heteroscedasticity, what is most relevant to mention is that in both sub-periods GDP_growth_{t-2} becomes relevant at a 10% level of significance, as can be seen from Table 6 .

In order to evaluate the out-of-sample results, the static (one step-ahead) forecast method was used. The results for the full period (see Table 9), show that the RMSE is 0,006717, suggesting good forecast accuracy. Moreover, the MAE is 0,003820, confirming the conclusion of the RMSE. Finally, Theil's Inequality Coefficient, which is scale invariant, is 52,75%, which is quite large and therefore suggesting that the model does not offer a reliable forecast for the data. Besides that, the variance proportion (58,56%) is higher than the covariance proportion (30,34%), indicating that the model is indeed not good in terms of forecasting.

From the beginning of 2008 to 2009 there is a sharp decline that may be affecting the results. Therefore, I decided to analyze the forecasting performance of the model in 2 sub-periods: from 2002q1 to 2006q1 and from 2006q1 to 2009q4. Looking at Table 10, we see that in the 1st sub-period the RMSE decreases to 0,002252, which indicates a better performance, while, if we look at Table 11, in the 2nd sub-period the RMSE increases to 0,009077, indicating a worst performance. Regarding the MAE, the same happens, *i.e.* in the 1st sub-period it is 0,001844, while in the 2nd sub-period it increases to 0,005843. Moreover, Theil's Inequality Coefficient decreases in the 1st sub-period

(23,1%), however the variance proportion remains the highest (53,73%), while in the 2nd sub-period, the value increases (60,67%), having also the variance proportion the highest value (55,15%).

4.3 The Autoregressive Distributed Lag (2,1) Model [ADL]

The second model is an extension of the previous one, where we maintain the AR(2) structure and add lags of the spread variable. Resorting once again to the AIC/ BIC criterion, both point to the inclusion of only one lag of the spread.

From Table 3 we can see that in the 1st sub-period both GDP_growth_{t-1} and GDP_growth_{t-2} are statistically insignificant at all significant levels while the $Spread_{t-1}$ is significant at a 10% significance level. Moreover, the constant is significant at a 5% significance level. Regarding, the 2nd sub-period, despite different values, the main difference is that GDP_growth_{t-1} becomes significant at a 10% level of significance. Due to the insignificance of GDP, I decided to conduct a redundancy test, where in the 1st sub-period the redundant variables are both GDP_growth variables and in the 2nd sub-period it is just GDP_growth_{t-2}. The results summarized in Table 7 show that in the 1st sub-period, the variables are indeed redundant (the F-statistic is 11,42% and the log likelihood ratio is 10,46%), despite this result, I decided to maintain the GDP variables in this sub-period because Estrella and Hardouvelis (1991) found evidence that the spread with additional variables perform better than the spread alone as a forecasting tool. Concerning the 2nd sub-period, the variable is also redundant (F-statistic is 17,8% and Chi-Square is 16,97%), however in this case the variable was dropped (see Table 6), because the model will continue to have an additional variable besides the spread, becoming an ADL(1,1). Finally, in the 1st sub-period the R^2 of the model is 9,85% and the adjusted R^2 is 7,12% and in the 2nd sub-period the R^2 is 10,93% and the adjusted R^2 is 9,41% (already taking in account, the variable dropped).

In order to validate these conclusions it is necessary to perform as previously. Hence, using robust Breusch-Godfrey tests we test for autocorrelation. From Table 4 we observe that we do not reject the null hypothesis neither in the 1st sub-period (F-statistic is 18,56% and Chi-Square is 16,93%) nor in the 2nd sub-period (F-statistic is 10,26% and the Chi-square is 9,71%, being this last value in the rejection area nevertheless very close to 10%), which means that there is no autocorrelation in the residuals. Moreover, White's test for heteroscedasticity (see Table 5), also does not reject the null hypothesis neither in the 1st sub-period (F-statistic is 17,14% and the Chi-Square is 16,92%) nor in the 2nd sub-period (F-statistic is 25,67% and the Chi-Square is 25,12%). We can state, therefore, that this model is autocorrelation and heteroscedasticity free, meaning that previous conclusions can be drawn here as well.

Once again, using the same method (static) and the same forecasting period, the out-of-sample evaluation was conducted. Looking at Table 9, the RMSE is 0,006478, and the MAE is 0,003791. Moreover, Theil's Inequality coefficient (51,74%) is large, suggesting a bad performance of the model. If we decompose this coefficient, we still have a variance proportion (66,92%) higher than the covariance proportion (22,82%), confirming the previous statement.

Furthermore, looking at Table 10, it is possible to see that in the 1st sub-period, the model accomplishes a better performance according to RMSE (0,002412) and MAE (0,001977). While, as summarized in Table 11, in the 2nd sub-period, there is a deterioration of the forecasting performance (RMSE=0,00884 and MAE=0,005565). Moreover, Theil's Inequality Coefficient in the 1st sub-period decreases to 24,11%, accomplished by a decrease of the variance proportion (49,11%) and an increase of both the bias proportion (23,51%) and the covariance proportion (27,38%), while in the 2nd sub-period it increases to 62,13%, where the covariance proportion (14,26%) decreases and the variance proportion (75,33%) increases, when compared to the full-period, which shows the worse performance of the model in this period.

4.4 The Autoregressive Distributed Lag (2,1,1) Model

The third model is an extension of the previous one, where we maintain the ADL(2,1) structure and add the non-financial variable IP. In this model, both AIC and BIC criterion consider that the best model choice is to include only one lag of IP.

From Table 3, we can see that in both sub-periods only IP_{t-1} and the constant term are statistically significant at all levels (both variables have p-values close to 0%). All other variables are statistically insignificant. As previously indicated the redundancy test, summarized in Table 7, was conducted in both sub-periods where the GDP_growth_{t-1}, GDP_growth_{t-2} and $Spread_{t-1}$ were considered as the redundant variables. The test allowed to conclude that indeed we do not reject the null hypothesis neither in the 1st sub-period (F-statistic is 41,28% and log likelihood test 39,22%) nor in the 2nd sub-period (F-statistic is 42,34% and the Chi-Square is 40,56%). Despite this conclusion, the variables were not dropped from the model, because non-financial variables should not be used as single predictors but as complementary variables that help improve the prediction exercise (Runstler and Sédillot,2003). Finally, in the 1st sub-period the model presents an R^2 of 18,80% and an adjusted R^2 of 15,49% and in the 2nd sub-period and R^2 of 18,213% and an adjusted R^2 of 15,34%.

When performing the autocorrelation test (see Table 4), we do not reject the null hypothesis for the 1st sub-period (F-statistic is 12,32% and Chi-Square is 10,87%) but we reject it for the 2nd sub-period nevertheless very close to the 10% significance level (F-statistic is 9,97% and Chi-Square is 8,93%). Moreover, regarding heteroscedasticity, we also do not reject the null hypothesis neither for the 1st sub-period (F-statistic is

56,81% and the Chi-Square is 54,87%) nor for the 2nd sub-period (F-statistic is 21,06% and Chi-Square is 20,78%); see Table 5.

Regarding the out-of-sample results, maintaining the static method and the forecasting sample, we can see from Table 9 that the RMSE is 0,006434 and the MAE is 0,004386. Furthermore, the model presents a Theil Inequality coefficient of 45,47%, which, although high, corresponds to the best forecasting model. If we decompose this coefficient, we see that the covariance proportion (68,21%) is the largest and both the bias proportion (13,07%) and the variance proportion (18,72%) are small.

In terms of the sub-periods it follows that in the 1st sub-period (see Table 10) the RMSE (0,002747) and the MAE (0,002234) decrease, showing a better performance of this model in this period, whereas is the 2nd sub-period (see Table 11) both the RMSE (0,008174) and the MAE (0,005973) present a worse performance. Moreover, Theil's Inequality Coefficient decreases in the 1st sub-period to (26,17%), however this is due to an increase in the bias proportion (30,63%) and a smaller covariance proportion (59,53%) and variance proportion (9,84%), remaining nevertheless a good forecasting model (the covariance proportion is the highest). Regarding the 2nd sub-period, Theil's Inequality Coefficient increases (50,55%), though there is an increase in the covariance proportion (61,26%) signaling also, that the model is indeed a good forecasting model.

4.4.1 Error Correction Model

The ADL(2,1,1) model by adding IP variable becomes an extension of the ADL(2,1). As a consequence of adding this variable, in terms of in-sample results, the ADL(2,1,1) presents both GDP and spread variables which are statistically insignificant. In order to solve this problem I decided to consider an error correction model.

The variables chosen for the error correction model are variables taken from the macroeconomic identity, which are net exports and household consumption. Looking at

Table 1, we see that net exports is I(1) and that household consumption requires one differentiation in order to become I(1).

After performing the necessary intermediate stages (*e.g.* create the residuals and tests it in order to determine whether cointegration exists) we can conclude that adding the error correction term improves the ADL(2,1,1). In terms of in-sample (see Table 8), the major difference, besides having a statistically significant error correction model, is that the spread becomes statistically significant at a 10% level of significance in both periods and also the adjusted R^2 increases in both periods (in the 1st sub-period to 20,83% and in the 2nd sub-period to 19,72%). Moreover, in terms of out-of-sample results, in the full period (see Table 9), there is a decrease of all metrics regarding the ADL(2,1,1) model, which signals a better performance. On the other hand, looking at Tables 10 and 11, it deteriorates its forecasting performance in the 1st sub-period but it improves in the 2nd sub-period.

4.5 Model Comparison

After modeling and forecasting GDP growth through the use of different linear model, a question that can be asked relates to which model performed better in the in-sample and out-of-sample period. Previously, the choice of the models was explained, their problems identified and the necessary corrections performed and their forecasts computed. This section will indentify the model that performed better in-sample and out-of-sample.

Regarding the in-sample analysis, looking at the adjusted R^2, we see that the ADL(2,1,1) model presented the best result. This model yielded the highest adjusted R^2 in the 1st and 2nd sub-periods (15,49% and 15,34%, respectively). The second best performance is provided by the ADL(2,1) model in the 1st sub-period with an adjusted R^2 of 7,12% and the ADL(1,1) with 8,34% in the 2nd sub-period. Finally, the AR seems to be the worse model with an adjusted R^2 of 4,67% in the 1st sub-period and 6,19% in the 2nd sub-period.

Concerning the out-of-sample results the metrics used give mixed information. Evaluating first the full sample forecast, the RMSE indicates that the ADL(2,1,1) is the best forecasting model. If we look at the MAE, the ADL(2,1) is considered to be the best. Notice, however, that in terms of Theil's Inequality Coefficient the ADL(2,1,1) model is not only the best (it has the lowest value of 44,89%) but also the only one that respects the rule that a good forecasting model contains the higher proportion in the covariance.

After splitting the full period into sub-periods, we see that in the 1st sub-period the autoregressive model clearly performs better in all metrics, nevertheless, the ADL(2,1,1) is the only one that respects the rule of having the covariance proportion higher than the other proportions. Regarding the 2nd sub-period, the autoregressive model becomes the worst model, whereas if we use the MAE, the best model is the ADL(1,1) (disregarding ADL(2,1,1) with the error term, otherwise it would be this one), while if we use the RMSE and the Theil Inequality Coefficient the best is ADL(2,1,1).

5 Conclusion

The goal of this paper was to model GDP growth in the euro area through the use of 3 types of models: an AR model, an ADL(2,1) model (comprehending the autoregressive component and the term spread) and an ADL(2,1,1) (a three variables model with GDP, term spread and IP). The analyses of each model was conducted both in-sample and out-of-sample.

The overall conclusion is that in the in-sample context, the ADL(2,1,1) yields the best result. In terms of out-sample forecast, it depends not only on the metrics used but also on the period under evaluation. Despite the mixed information, the ADL(2,1,1) is the only model that respects the rule of having a covariance proportion in Theil's Inequality Coefficient higher than the other proportion in every period evaluated. Moreover, the AR model outperforms the others if we reduce the forecasting period to 2002q1 to 2006q1. In the period of 2006q1 to 2009q4 the best model can be either the ADL(2,1,1) or the ADL(2,1), depending on the metrics used.

The main limitation of this analysis arises from the data issue of aggregate versus disaggregated data. This study focuses on aggregated data for the euro area. Despite the potential benefits of disaggregated data approaches based on the aggregation of individual countries, the evidence about this subject is still quite mixed. For example, Marcellino *et al* (2003) concluded that forecasts from disaggregated data, in general, outperform those from aggregate data, nevertheless as argued by Baffigi *et al* (2002), these gains depend on the properties of the single country specifications and may vary over the forecast horizon.

Another caveat is the linear framework developed throughout the paper. Indeed, the results obtained are taken from a setting of linear models and therefore the analysis should be interpreted in that context. It is possible that financial variables have a nonlinear impact on macroeconomic variables and consequently that impact should be modeled by a nonlinear regression. Nevertheless, as stated by Marcellino (2007: abstract): "Our main conclusion is that in general linear time series models can be hardly beaten if they are carefully specified".

An interesting future research would be using the best model [ADL(2,1,1)] to forecast from 2009 onwards, in order to see if this same model would be able to predict when the euro area would recover from the recession we face nowadays. It is clear that this future research would need a longitudinal study, since the predictions made by the model would have to be compared with the data releases over the years.

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7 Appendices

Figure 1: Growth rates of GDP, Spread and Industrial Production

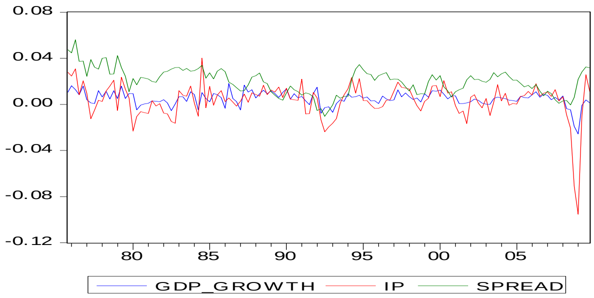


Table 1: ADF test

	Levels	1st differences	2nd differences
GDP Growth	-4,361525	-	-
Spread	**-3,404397**	-	-
IP	-5,202727	-	-
Net Exports	**-2,326037**	-4,818303	-
Consumption	**-1,985519**	**-2,590046**	-7,489474
ln(GDP)	**-1,963295**	-4,273176	-
ECM	-4,771341	-	-

Table 2: Models Order Choice

Autoregressive			**ADL(2,q)**			**ADL(2,1,m)**		
	AIC	BIC		AIC	BIC		AIC	BIC
AR(1)	**-7,648332**	**-7,597478**	**Spread(-1)**	**-7,679110**	**-7,576170**	**IP(-1)**	**-7,783005**	**-7,654330**
AR(2)	**-7,670988**	-7,594249	**Spread(-2)**	-7,660037	-7,530575	**IP(-2)**	-7,773657	-7,618303
AR(3)	**-7,659188**	-7,556248	**Spread(-3)**	-7,648480	-7,492170	**IP(-3)**	-7,763301	-7,580939
AR(4)	**-7,644446**	-7,514984	**Spread(-4)**	-7,632755	-7,449262	**IP(-4)**	-7,750993	-7,541286
AR(5)	**-7,662062**	-7,505752	**Spread(-5)**	-7,629421	-7,418403	**IP(-5)**	-7,741629	-7,504234
AR(6)	**-7,640189**	-7,456696	**Spread(-6)**	-7,605833	-7,366943	**IP(-6)**	-7,734653	-7,469219

Table 3: In-sample results

	Ar(2)		ADL(2,1)		ADL(2,1,1)	
1st Period	**R^2**	**Adjusted R^2**	**R^2**	**Adjusted R^2**	**R^2**	**Adjusted R^2**
	6,5431%	4,6740%	9,8515%	7,1197%	18,80%	15,49%
	t-statistic	**p-values**	**t-statistic**	**p-value**	**t-statistic**	**p-value**
Constant	4,353843	0,00%	2,163101	3,29%	3,3760	0,11%
AR(1)	1,856685	6,63%	1,529027	12,94%	-0,8404	40,27%
AR(2)	1,430119	15,58%	1,135285	25,90%	0,4532	65,14%
Spread(-1)	-	-	1,906090	5,95%	1,3627	17,61%
IP(-1)	-	-	-	-	3,2867	0,14%
2nd Period	**R^2**	**Adjusted R^2**	**R^2**	**Adjusted R^2**	**R^2**	**Adjusted R^2**
	7,7797%	6,1897%	10,6711%	8,3408%	18,213%	15,343%
	t-statistic	**p-values**	**t-statistic**	**p-value**	**t-statistic**	**p-value**
Constant	4,697229	0,00%	2,10961	3,71%	3,269656	0,14%
AR(1)	2,192995	3,03%	1,88971	6,13%	-0,498351	61,92%
AR(2)	1,610006	11,01%	1,35523	17,80%	0,703629	48,31%
Spread(-1)	-	-	1,92936	5,62%	1,385798	16,85%
IP(-1)	-	-	-	-	3,242185	0,16%

Table 4: Results of Autocorrelation test

	F-statistic		Chi-Square	
1st Period	Statistic	P-value	Statistic	P-value
AR(2) of order 4	1,035760	39,29%	4,261237	37,18%
ADL(2,1) of order 4	1,581077	18,56%	6,4289	16,93%
ADL (2,1,1) of order 4	1,864026	12,32%	7,569566	10,87%
2nd Period				
AR(2) of order 4	1,141397	34,08%	4,660937	32,39%
ADL(1,1) of order 4	1,978329	10,26%	7,853543	9,71%
ADL(2,1,1) of order 4	1,998697	9,97%	8,062898	8,93%

Table 5: Results of Heteroscedasticity test

	F-statistic		Chi-Square	
1st Period	Statistic	P-value	Statistic	P-value
AR(2)	2,478242	4,90%	9,461661	5,05%
ADL(2,1)	1,546446	17,14%	9,077844	16,92%
ADL(2,1,1)	0,842168	56,81%	6,888667	54,87%
2nd Period				
AR(2)	3,142360	1,72%	1,181773	1,88%
ADL(1,1)	1,347293	25,67%	5,371749	25,12%
ADL(2,1,1)	1,385604	21,06%	1,089397	20,78%

Table 6: Corrected output

		1st Period		2nd Period	
		t-statistic	**p-values**	**t-statistic**	**p-values**
AR Model	**Constant**	3,815884	0,02%	4,217350	0,00%
	AR(1)	1,834028	6,96%	2,133458	3,50%
	AR(2)	1,727804	8,71%	1,865716	6,46%
ADL (1,1) Model	**Constant**	-	-	2,334231	2,13%
	AR(1)	-	-	2,298947	2,33%
	Spread (-1)	-	-	2,470853	1,49%
		R^2	**Adjusted R^2**	**R^2**	**Adjusted R^2**
		-	-	10,93%	9,41%

Table 7: Results of Redundant Test

	F-statistic		Log Likelihood ratio	
1st Period	Statistic	P-value	Statistic	P-value
ADL(2,1) Model	2,217886	11,42%	4,514594	10,46%
ADL(2,1,1) Model	0,964336	41,28%	2,996594	39,22%
2nd Period				
ADL(2,1) Model	1,836648	17,80%	1,885515	16,97%
ADL(2,1,1) Model	0,941004	42,34%	2,910934	40,56%

Table 8: In-sample Results for the ADL(1,1,2) with Error Correction Model

		1st Period		2nd Period	
ADL (2,1,1) +ECM		R^2	Adjusted R^2	R^2	Adjusted R^2
		24,71%	20,83%	23,12%	19,72%
		t-statistic	p-values	t-statistic	p-value
	Constant	2,42417	1,72%	2,212960	
	AR(1)	-0,78310	43,55%	-0,374805	70,85%
	AR(2)	1,28390	20,22%	1,549925	12,40%
	Spread(-1)	1,70387	9,16%	1,690239	9,37%
	IP(-1)	3,80609	0,02%	3,695161	0,03%
	ECM(-1)	-2,75921	0,69%	-2,686384	0,83%

Table 9: Out-of-sample results for the full period

	AR(2)	ADL(2,1)	ADL(2,1,1)	ADL(2,1,1)+ECM
RMSE	0,006717	0,006539	**0,006183**	**0,00541**
MAE	0,00382	**0,003772**	0,004135	**0,00394**
Theil Inequality C.	52,755%	52,172%	**44,885%**	**38,233%**
Bias Proportion	11,095%	10,830%	12,571%	3,781%
Variance Proportion	58,564%	69,393%	26,617%	10,365%
Covariance Proportion	30,341%	19,777%	60,812%	85,854%

Table 10: Out-of-sample results for the 1st sub-period

	AR(2)	ADL(2,1)	ADL(2,1,1)	ADL(2,1,1)+ECM
RMSE	**0,002252**	0,002412	0,002747	0,00304
MAE	**0,001844**	0,001977	0,002234	0,00245
Theil Inequality Coefficient	**23,099%**	24,109%	26,168%	27,755%
Bias Proportion	16,199%	23,513%	30,629%	40,508%
Variance Proportion	53,731%	49,107%	9,842%	4,336%
Covariance Proportion	30,069%	27,380%	59,527%	55,156%

Table 11: Out-of-sample results for the 2nd sub-period

	AR(2)	ADL(2,1)	ADL(2,1,1)	ADL(2,1,1)+ECM
RMSE	0,009077	0,00884	**0,008174**	0,006977
MAE	0,005843	**0,005565**	0,005973	0,005431
Theil Inequality Coefficient	60,673%	62,129%	**50,547%**	42,510%
Bias Proportion	11,714%	10,405%	8,523%	0,005%
Variance Proportion	55,151%	75,334%	30,213%	23,253%
Covariance Proportion	33,136%	14,261%	61,264%	76,701%

NOVA SCHOOL OF BUSINESS AND ECONOMICS

Appendix

Time Series' concepts and Eviews' Outputs

Cláudia Campos

07-01-2013

A project carried out on the Corporate Finance Major, under the supervision of:

Paulo M. M. Rodrigues

This appendix contains information clarifying econometric concepts and presents the Eviews' outputs that support the work project tables.

Index

1 Time Series Concepts

1.1 The Classical Linear Regression Model

The multiple linear regression model is a generalization of the simple model and has the following expression:

$$y_t = \beta_0 + \beta_1 x_{1t} + \cdots + \beta_k x_{kt} + \mu_t, t = 1, \ldots, T \quad (1)$$

In order to obtain the parameter estimates, the Residual Sum of Squares $(\sum_{t=1}^{T} \hat{\mu}_t^2)$ has to be minimized with respect to all the βs. Typically the following assumptions needed to be consider for the Multiple Linear Regression Model to be valid:

1. $E(\mu_t) = 0$
2. $Var(\mu_t) = \sigma^2 < \infty$ (Homoscedasticity)
3. $Cov(\mu_i, \mu_j) = 0$ (No autocorrelation)
4. $Cov(\mu_t, x_t) = 0$ (No relationship between error and corresponding x variate)
5. $\mu_t \sim N(0, \sigma^2)$ (this assumption is required if we want to make inferences about the population parameters from the sample parameters)

If some of the assumptions do not hold, a combination of the following problems may occur: coefficient estimates may be wrong, associated standard errors may be wrong and the distribution assumed for the test statistic inappropriate. So it becomes relevant to test these assumptions in order to validate the model.

After estimating the models the following tests are necessary to perform in order to ensure that the assumptions hold:

1.1.1 Whites' Heteroscedasticity test

The White test for heteroscedasticity requires running an auxiliary regression on the residuals of the original regression. This auxiliary regression will have as explanatory variables all of the independent variables from the initial regression and their squares.

For example, if we considered the initial regression with 3 independent variables, White's auxiliary regression would be,

$$\hat{u}^2 = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \delta_3 x_3 + \delta_4 {x_1}^2 + \delta_5 {x_2}^2 + \delta_6 {x_3}^2 + v. \qquad (2)$$

Hence, in order for the errors to be homoscedastic, the δ_i, $i = 1, \dots, 6$ have to equal 0. Therefore, the null hypothesis is $H_0: \delta_1 = \cdots = \delta_6 = 0$ and the alternative $H_A: \delta_1 \neq 0 \vee \delta_2 \neq 0 \vee \dots \vee \delta_6 \neq 0$.

The test statistic for heteroscedasticity is $LM_k = T \times R^2$, which under the hull hypothesis converges to a Chi-square distribution with k degrees of freedmon. If the test statistic is above the corresponding critical value, we reject the null hypothesis of homocedasticity. The coefficient estimates are still unbiased, but the standard errors, tests of significance and inferences may no longer be appropriate.

In order to correct for heteroscedasticity, White's robust standard errors can be used.

1.1.2 Breusch-Godfrey's Autocorrelation test

The Breusch-Godfrey test allows testing for autocorrelation of order q. Considering a linear regression model with m explanatory variables, the following auxiliary regression will have to be computed,

$$\widehat{\varepsilon_t} = \gamma_0 + \gamma_1 x_{t,1} + \cdots + \gamma_m x_{t,m} + \emptyset_1 \widehat{\varepsilon_{t-1}} + \cdots + \emptyset_k \widehat{\varepsilon_{t-k}} + u_t \qquad (3)$$

where $\widehat{\varepsilon_t}$ correspond to the regression residuals.

In order for the errors not to be autocorrelated, the $\emptyset$s have to equal 0. Therefore, the null hypothesis is $H_0: \emptyset_1 = \cdots = \emptyset_k = 0$ and the alternative $H_A: \emptyset_1 \neq 0 \vee \emptyset_2 \neq 0 \vee \dots \vee \emptyset_k \neq 0$.

The test statistic for autocorrelation of order k is $LM_k = T \times R^2$, which under the hull hypothesis converges to a Chi-square distribution with k degrees of freedom.

For small samples, the F version of the test is preferable and can be computed as

$$F_{LM_k} = \frac{R^2}{1-R^2}\frac{T-p-k-1}{k} \sim F(k, T-p-k-1). \qquad (4)$$

1.2 The Autoregressive (AR) model of order p

$$y_t = \delta + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} + u_t = \delta + \sum_{i=1}^{p} \beta_i y_{t-i} + u_t \qquad (5)$$

An AR(p) process is a process where the present values of the variable depend solely on the past values of the variable that we want to analyze plus a random error term (such as white noise). Notice that β_i measures the persistence of the past values of the dependent variable.

The above expression is normally written in terms of the lag operator, moving all lags of the dependent variables to the LHS, *i.e.*

$$(1 - \beta_1 L - \beta_2 L^2 - \cdots - \beta_p L^p) y_t = u_t \qquad (6)$$

Or equivalently:

$$\beta(L) y_t = u_t \qquad (7)$$

Where $\beta(L)$ is a polynomial in the lag operator and $\beta_{i=1,..,p}$ the coefficients. The lag operator is important because it allows simplifying the notation of the time series model. This model is important because it is used as the benchmark to compare with the other models proposed.

1.3 Autoregressive Distributed Lag Model of order (p,q,m)

$$y_t = \beta_0 + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} + \alpha_1 X_{1,t-1} + \cdots + \alpha_q X_{1,t-q}$$
$$+ \delta_1 X_{2,t-1} + \cdots + \alpha_m X_{2,t-m} + u_t \qquad (8)$$

Where y_t, $X_{1,t}$ and $X_{2,t}$ are stationary variables, u_t is white noise and p,q,m represent the number of lags of the correspondent variable.

In type of model, the concept of white noise is very important. By definition, u_t is white noise if each value in the sequence has zero mean, a constant variance and it is serially uncorrelated:

$$E(u_t) = E(u_{t-1}) = \cdots = 0 \quad (9)$$

$$E(u_t^2) = E(u_{t-1}^2) = \cdots = \sigma^2 \quad (10)$$

$$E(u_t u_{t-s}) = E\left(u_{t-j} u_{t-j-s}\right) = 0, \text{ for all u} \quad (11)$$

If the error term is indeed white noise process (more generally it is stationary and independent of y_t and X_t's variables), the ADL model can be estimated consistently with by ordinary least squares.

1.4 Cointegration

In most cases, if two variables that are I(1) are linearly combined, the combination will also be I(1). It can be generalize that if variables with differing orders of integration are combined, then the combination will have an order of integration equal to the largest.

In general, many financial variables contain at least one unit root. In this context, a set of variables is defined as cointegrated if a linear combination of them is stationary. Many time series are non-stationary nevertheless the variables may “move together” over time (*i.e* there is some influences on the series, which implies that the two series are bound by some relationship in the long-run). A cointegration relationship may also be seen as a long-term or equilibrium phenomenon, since it is possible that cointegrating variables may deviate from their relationship in the short-run, but their association would return in the long-run.

1.4.1 Unit root tests

Unit root tests are used to determine whether a series is stationary [I(0)] or not [superior orders of I(d)]. A formal procedure that can be used in this context is the Augmented Dickey Fuller test (ADF).

There are three versions of the ADF test:

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + u_t \qquad (12)$$

$$\Delta y_t = \propto + \rho y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + u_t. \qquad (13)$$

$$\Delta y_t = \propto + \beta t + \rho y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + u_t \qquad (14)$$

where (12) is ADF with no constant nor trend; (13) is ADF with constant and no trend and (14) is ADF with constant and trend.

This test aims to test the null hypothesis, ρ=0, of a unit root. The augmented version of the Dickey Fuller test varies from the original model by including extra lags of the dependent variable with the objective to ensure that the residuals are autocorrelation free.

1.4.2 Error Correction Model

One way to correct for the non-stationary is to take the 1st differences, however the problem with this approach is that the pure 1st differenced model have no long-run solution. For example, considering y_t and x_t both I(1):

$$\Delta y_t = \beta \Delta x_t + u_t \qquad (15)$$

This has no long-run solution. One way to correct such problem is to use the first differences and level terms, *e.g.*:

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 \left(y_{t-1} - \gamma x_{t-1}\right) + u_t \qquad (16)$$

Where $y_{t-1} - \gamma x_{t-1}$ is known as the error correction term. This error term will be I(0), even knowing that both variables are I(1).

1.4.3 The Engle Granger test

The Engle and Granger test is used to test for cointegration. In other words,

$$H_0\text{: unit root in cointegrating regression residuals (no cointegration)}$$

$$H_A\text{: residuals from cointegrating regression are stationary}$$

In order to perform this test two steps are require. First, each variable is tested using the ADF in order to make sure that they are I(1), then the cointegration regression is estimated using OLS and the residuals of such a regression saved. Then, to conclude step 1, using ADF we test the residuals saved to ensure that they are I(0). However, because this is a test on the residuals of an actual model the critical values are different.

The 2nd step consists on using the residuals of step 1 as one variable in the error correction model *e.g.*

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2(\widehat{\hat{u}_t}) + \varepsilon_t \tag{17}$$

where

$$\hat{u}_t = y_{t-1} - \hat{\gamma} x_{t-1} \tag{18}$$

1.5 T-statistics and P-values

The t-statistic is used when we want to test if the true value of the parameter is a given value (β_i).

$$\text{test statistic} = \frac{\hat{\beta}_i - \beta_i}{se(\hat{\beta}_i)} \tag{19}$$

The p-value is the maximum significance level at which we do not reject the null hypothesis.

In the case that the variables are statistically insignificant, the redundant test should be performed:

1.5.1 Redundant Test

This test is used to determine whether a variable is irrelevant or not for a given model. In this test we compare the original model with the model without the statistically insignificant variables. For example, considering the following regression:

$$y_t = \alpha + \beta_1 x_{t,1} + \beta_2 x_{t,2} + \beta_3 x_{t,3} + u_t \tag{20}$$

and assume that $\widehat{\beta_3}$ is statistically insignificant. Hence, we run the following restricted regression:

$$y_t = \alpha + \beta_1 x_{t,1} + \beta_2 x_{t,2} + v_t \tag{21}$$

The test compares the values of R^2 for the 2 models (F-test) and the value of the log-likelihood of the 2 models (Likelihood-Ratio test). The consequence of including an irrelevant variable would be that the coefficient estimators would still be consistent and unbiased, but no longer efficient. As a consequence, the standard errors for the coefficients are likely to be inflated relative to the values which they would have taken in the case of not including the irrelevant variable.

1.6 F-test

The F-test is used when we want to perform a test on more than one coefficient simultaneously. In order to perform the F-test, two regressions are required: the unrestricted estimated regression and the restricted regression, where the restrictions are imposed on the equation.

1.7 Goodness of Fit Statistic

The classical goodness of fit statistics is,

$$R^2 = \frac{\sum_{t=1}^{T}(y_t - \bar{y})^2}{\sum_{t=1}^{T}(\hat{y}_t - \bar{y})^2} = \frac{\text{Error Sum of Squares}}{\text{Total Sum of Squares}}. \qquad (22)$$

This statistic indicates the percentage of the behavior of the dependent variable explained by the regression and therefore can be seen as an in-sample comparison measure. However, if we increase the number of regressors in the model, the R^2 will also increase, although the fit may not improve in a practical sense. Therefore, the comparison between models has to be made using the adjusted $R^2(\overline{R^2})$, which penalizes the goodness of fit when extra variables are added, taking into account the loss of degrees of freedom. Meaning that in order for $\overline{R^2}$ to increase, R^2 has to increase sufficiently to compensate for the added variables, *i.e.*,

$$\overline{R^2} = 1 - \frac{T-1}{T-k}(1 - R^2) \qquad (23)$$

2 Eviews' Outputs

2.1 ADF test in levels

2.1.1 GDP growth variable

ADF Test Statistic	-4.361525	1% Critical Value*	-3.4807
		5% Critical Value	-2.8833
		10% Critical Value	-2.5783

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP_GROWTH)
Method: Least Squares
Date: 11/09/12 Time: 10:46
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GROWTH(-1)	-0.566045	0.129781	-4.361525	0.0000
D(GDP_GROWTH(-1))	-0.086642	0.132104	-0.655860	0.5131
D(GDP_GROWTH(-2))	0.012233	0.128395	0.095280	0.9242
D(GDP_GROWTH(-3))	0.059071	0.126967	0.465248	0.6426
D(GDP_GROWTH(-4))	0.143041	0.101380	1.410945	0.1607
C	0.002724	0.000835	3.262831	0.0014

R-squared	0.331237	Mean dependent var	-0.000111
Adjusted R-squared	0.304699	S.D. dependent var	0.006540
S.E. of regression	0.005453	Akaike info criterion	-7.540780
Sum squared resid	0.003747	Schwarz criterion	-7.409743
Log likelihood	503.6915	F-statistic	12.48152
Durbin-Watson stat	1.957095	Prob(F-statistic)	0.000000

2.1.2 Spread variable

ADF Test Statistic	-3.404397	1% Critical Value*	-3.4807
		5% Critical Value	-2.8833
		10% Critical Value	-2.5783

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SPREAD)
Method: Least Squares
Date: 11/09/12 Time: 11:00
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SPREAD(-1)	-0.168396	0.049464	-3.404397	0.0009
D(SPREAD(-1))	0.091932	0.088721	1.036199	0.3021
D(SPREAD(-2))	0.095557	0.081796	1.168239	0.2449
D(SPREAD(-3))	-0.121777	0.082379	-1.478249	0.1418
D(SPREAD(-4))	0.171877	0.084781	2.027312	0.0447
C	0.003227	0.001065	3.031262	0.0030

R-squared	0.145310	Mean dependent var	-4.51E-05
Adjusted R-squared	0.111394	S.D. dependent var	0.005649
S.E. of regression	0.005325	Akaike info criterion	-7.588372
Sum squared resid	0.003573	Schwarz criterion	-7.457336
Log likelihood	506.8326	F-statistic	4.284377
Durbin-Watson stat	1.931279	Prob(F-statistic)	0.001241

2.1.3 IP growth variable

ADF Test Statistic	-5.202727	1% Critical Value*	-3.4807
		5% Critical Value	-2.8833
		10% Critical Value	-2.5783

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IP)
Method: Least Squares
Date: 11/09/12 Time: 11:05
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IP(-1)	-0.704825	0.135472	-5.202727	0.0000
D(IP(-1))	0.243853	0.126486	1.927905	0.0561
D(IP(-2))	0.192193	0.124767	1.540414	0.1260
D(IP(-3))	0.191162	0.139481	1.370519	0.1730
D(IP(-4))	0.148943	0.116986	1.273174	0.2053
C	0.002223	0.001267	1.755074	0.0817

R-squared	0.268286	Mean dependent var	-7.16E-05
Adjusted R-squared	0.239250	S.D. dependent var	0.015035
S.E. of regression	0.013114	Akaike info criterion	-5.785925
Sum squared resid	0.021668	Schwarz criterion	-5.654888
Log likelihood	387.8710	F-statistic	9.239682
Durbin-Watson stat	2.007234	Prob(F-statistic)	0.000000

2.1.4 Net Exports variable

2.1.4.1 Level

ADF Test Statistic	-2.326037	1% Critical Value*	-3.4807
		5% Critical Value	-2.8833
		10% Critical Value	-2.5783

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNETEX)
Method: Least Squares
Date: 01/04/13 Time: 12:02
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNETEX(-1)	-0.110873	0.047666	-2.326037	0.0216
D(LNETEX(-1))	-0.341667	0.090552	-3.773157	0.0002
D(LNETEX(-2))	0.046680	0.094984	0.491450	0.6240
D(LNETEX(-3))	0.031727	0.094741	0.334882	0.7383
D(LNETEX(-4))	-0.095407	0.087322	-1.092586	0.2767
C	1.104406	0.464995	2.375094	0.0191

R-squared	0.213417	Mean dependent var	0.017411
Adjusted R-squared	0.182203	S.D. dependent var	0.581818
S.E. of regression	0.526150	Akaike info criterion	1.597928
Sum squared resid	34.88105	Schwarz criterion	1.728964
Log likelihood	-99.46325	F-statistic	6.837305
Durbin-Watson stat	1.949720	Prob(F-statistic)	0.000011

2.1.4.2 1st Diferences

ADF Test Statistic	-4.818303	1% Critical Value*	-3.4811
		5% Critical Value	-2.8835
		10% Critical Value	-2.5783

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNETEX.2)
Method: Least Squares
Date: 01/04/13 Time: 12:03
Sample(adjusted): 1977:2 2009:4
Included observations: 131 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNETEX(-1))	-1.243558	0.258091	-4.818303	0.0000
D(LNETEX(-1).2)	-0.145318	0.225970	-0.643088	0.5213
D(LNETEX(-2).2)	-0.151509	0.190984	-0.793309	0.4291
D(LNETEX(-3).2)	-0.172721	0.149181	-1.157793	0.2492
D(LNETEX(-4).2)	-0.213399	0.087075	-2.450752	0.0156
C	0.014701	0.045929	0.320085	0.7494

R-squared	0.726869	Mean dependent var	-0.004071
Adjusted R-squared	0.715943	S.D. dependent var	0.979888
S.E. of regression	0.522250	Akaike info criterion	1.583380
Sum squared resid	34.09318	Schwarz criterion	1.715069
Log likelihood	-97.71140	F-statistic	66.53104
Durbin-Watson stat	1.926689	Prob(F-statistic)	0.000000

2.1.5 Household Consumption variable

2.1.5.1 Level

ADF Test Statistic	-1.985519	1% Critical Value*	-4.0298
		5% Critical Value	-3.4442
		10% Critical Value	-3.1467

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LCONS)
Method: Least Squares
Date: 01/04/13 Time: 12:04
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCONS(-1)	-0.044485	0.022405	-1.985519	0.0493
D(LCONS(-1))	0.007061	0.086599	0.081538	0.9351
D(LCONS(-2))	0.183147	0.085358	2.145648	0.0338
D(LCONS(-3))	0.246705	0.086681	2.846128	0.0052
D(LCONS(-4))	0.268007	0.088732	3.020406	0.0031
C	0.587376	0.294394	1.995202	0.0482
@TREND(1975:4)	0.000224	0.000120	1.870095	0.0638

R-squared	0.199025	Mean dependent var	0.004825
Adjusted R-squared	0.160579	S.D. dependent var	0.005287
S.E. of regression	0.004844	Akaike info criterion	-7.770495
Sum squared resid	0.002933	Schwarz criterion	-7.617619
Log likelihood	519.8527	F-statistic	5.176648
Durbin-Watson stat	2.049663	Prob(F-statistic)	0.000087

2.1.5.2 1st Diferences

ADF Test Statistic	-2.590046	1% Critical Value*	-4.0303
		5% Critical Value	-3.4445
		10% Critical Value	-3.1468

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LCONS,2)
Method: Least Squares
Date: 01/04/13 Time: 12:10
Sample(adjusted): 1977:2 2009:4
Included observations: 131 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCONS(-1))	-0.372929	0.143986	-2.590046	0.0107
D(LCONS(-1),2)	-0.662058	0.148587	-4.455693	0.0000
D(LCONS(-2),2)	-0.531801	0.146030	-3.641736	0.0004
D(LCONS(-3),2)	-0.342239	0.129070	-2.651578	0.0091
D(LCONS(-4),2)	-0.100141	0.090695	-1.104148	0.2717
C	0.002629	0.001339	1.963904	0.0518
@TREND(1975:4)	-1.36E-05	1.19E-05	-1.144949	0.2544

R-squared	0.530623	Mean dependent var	-9.92E-07
Adjusted R-squared	0.507911	S.D. dependent var	0.006966
S.E. of regression	0.004886	Akaike info criterion	-7.752798
Sum squared resid	0.002961	Schwarz criterion	-7.599162
Log likelihood	514.8083	F-statistic	23.36335
Durbin-Watson stat	1.962027	Prob(F-statistic)	0.000000

2.1.5.3 2nd Diferences

ADF Test Statistic	-7.489474	1% Critical Value*	-4.0309
		5% Critical Value	-3.4447
		10% Critical Value	-3.1469

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LCONS,3)
Method: Least Squares
Date: 01/04/13 Time: 12:10
Sample(adjusted): 1977:3 2009:4
Included observations: 130 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCONS(-1),2)	-3.484549	0.465260	-7.489474	0.0000
D(LCONS(-1),3)	1.512888	0.410295	3.687315	0.0003
D(LCONS(-2),3)	0.735974	0.314416	2.340763	0.0209
D(LCONS(-3),3)	0.222503	0.200181	1.111508	0.2685
D(LCONS(-4),3)	0.029400	0.090114	0.326248	0.7448
C	-4.94E-05	0.000948	-0.052081	0.9585
@TREND(1975:4)	-2.84E-06	1.18E-05	-0.240932	0.8100

R-squared	0.840736	Mean dependent var	-5.03E-05
Adjusted R-squared	0.832967	S.D. dependent var	0.012288
S.E. of regression	0.005022	Akaike info criterion	-7.697613
Sum squared resid	0.003102	Schwarz criterion	-7.543207
Log likelihood	507.3449	F-statistic	108.2168
Durbin-Watson stat	1.985867	Prob(F-statistic)	0.000000

2.1.6 GDP variable

2.1.6.1 Level

ADF Test Statistic	-1.963295	1% Critical Value*	-4.0298
		5% Critical Value	-3.4442
		10% Critical Value	-3.1467

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 01/04/13 Time: 12:19
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.058216	0.029652	-1.963295	0.0518
D(LGDP(-1))	0.359297	0.088419	4.063573	0.0001
D(LGDP(-2))	0.128858	0.094963	1.356923	0.1773
D(LGDP(-3))	0.074193	0.096564	0.768329	0.4437
D(LGDP(-4))	0.098513	0.100072	0.984420	0.3268
C	0.799899	0.405743	1.971440	0.0509
@TREND(1975:4)	0.000307	0.000163	1.878276	0.0627

R-squared	0.206028	Mean dependent var	0.004810
Adjusted R-squared	0.167917	S.D. dependent var	0.005935
S.E. of regression	0.005414	Akaike info criterion	-7.548209
Sum squared resid	0.003663	Schwarz criterion	-7.395333
Log likelihood	505.1818	F-statistic	5.406043
Durbin-Watson stat	1.942966	Prob(F-statistic)	0.000054

2.1.6.2 1st Diferences

ADF Test Statistic	-4.273176	1% Critical Value*	-4.0303
		5% Critical Value	-3.4445
		10% Critical Value	-3.1468

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 01/04/13 Time: 12:20
Sample(adjusted): 1977:2 2009:4
Included observations: 131 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.579296	0.135566	-4.273176	0.0000
D(LGDP(-1),2)	-0.070282	0.134587	-0.522202	0.6025
D(LGDP(-2),2)	0.014170	0.130455	0.108621	0.9137
D(LGDP(-3),2)	0.055032	0.127983	0.429994	0.6679
D(LGDP(-4),2)	0.146418	0.101325	1.445030	0.1510
C	0.003925	0.001370	2.865034	0.0049
@TREND(1975:4)	-1.54E-05	1.30E-05	-1.186878	0.2375

R-squared	0.327722	Mean dependent var	-2.17E-05
Adjusted R-squared	0.295192	S.D. dependent var	0.006483
S.E. of regression	0.005443	Akaike info criterion	-7.536990
Sum squared resid	0.003674	Schwarz criterion	-7.383354
Log likelihood	500.6729	F-statistic	10.07458
Durbin-Watson stat	2.001013	Prob(F-statistic)	0.000000

2.1.7 ECM

2.1.7.1 Level

ADF Test Statistic	-4.771341	1% Critical Value*	-2.5812
		5% Critical Value	-1.9423
		10% Critical Value	-1.6170

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ECM)
Method: Least Squares
Date: 01/04/13 Time: 15:27
Sample(adjusted): 1977:1 2009:4
Included observations: 132 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.314930	0.066004	-4.771341	0.0000
D(ECM(-1))	0.161301	0.089639	1.799458	0.0743
D(ECM(-2))	0.176010	0.086719	2.029652	0.0445
D(ECM(-3))	0.001541	0.087904	0.017527	0.9860
D(ECM(-4))	0.229397	0.092498	2.480030	0.0144

R-squared	0.183481	Mean dependent var	-0.000183
Adjusted R-squared	0.157764	S.D. dependent var	0.004724
S.E. of regression	0.004335	Akaike info criterion	-8.007044
Sum squared resid	0.002387	Schwarz criterion	-7.897846
Log likelihood	533.4649	Durbin-Watson stat	2.027271

2.2 Order Selection

2.2.1 AR

2.2.1.1 AR(1)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:14
Sample(adjusted): 1976:1 2001:4
Included observations: 104 after adjusting endpoints
Convergence achieved after 2 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005859	0.000723	8.100563	0.0000
GDP_GROWTH(-1)	0.226559	0.118518	1.911601	0.0587

R-squared	0.051326	Mean dependent var	0.005885
Adjusted R-squared	0.042025	S.D. dependent var	0.005347
S.E. of regression	0.005234	Akaike info criterion	-7.648332
Sum squared resid	0.002794	Schwarz criterion	-7.597478
Log likelihood	399.7132	F-statistic	5.518511
Durbin-Watson stat	2.057179	Prob(F-statistic)	0.020743
Inverted AR Roots	.23		

2.2.1.2 AR(2)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:15
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005697	0.000756	7.539993	0.0000
GDP_GROWTH(-1)	0.181269	0.098837	1.834028	0.0696
GDP_GROWTH(-2)	0.139790	0.080906	1.727804	0.0871

R-squared	0.065431	Mean dependent var	0.005784
Adjusted R-squared	0.046740	S.D. dependent var	0.005275
S.E. of regression	0.005150	Akaike info criterion	-7.670988
Sum squared resid	0.002652	Schwarz criterion	-7.594249
Log likelihood	398.0559	F-statistic	3.500620
Durbin-Watson stat	2.049033	Prob(F-statistic)	0.033928
Inverted AR Roots	.48	-.29	

2.2.1.3 AR(3)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:15
Sample(adjusted): 1976:3 2001:4
Included observations: 102 after adjusting endpoints
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005583	0.000839	6.651994	0.0000
GDP_GROWTH(-1)	0.151805	0.100190	1.515167	0.1329
GDP_GROWTH(-2)	0.117845	0.083681	1.408263	0.1622
GDP_GROWTH(-3)	0.098667	0.099018	0.996452	0.3215

R-squared	0.065970	Mean dependent var	0.005716
Adjusted R-squared	0.037377	S.D. dependent var	0.005254
S.E. of regression	0.005155	Akaike info criterion	-7.659188
Sum squared resid	0.002604	Schwarz criterion	-7.556248
Log likelihood	394.6186	F-statistic	2.307221
Durbin-Watson stat	2.021045	Prob(F-statistic)	0.081309

Inverted AR Roots	.61	-.23 -.33i	-.23+.33i

2.2.1.4 AR(4)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:28
Sample(adjusted): 1976:4 2001:4
Included observations: 101 after adjusting endpoints
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005508	0.000944	5.832153	0.0000
GDP_GROWTH(-1)	0.138894	0.107117	1.296661	0.1979
GDP_GROWTH(-2)	0.102355	0.086189	1.187559	0.2379
GDP_GROWTH(-3)	0.077157	0.111407	0.692563	0.4903
GDP_GROWTH(-4)	0.123261	0.144561	0.852659	0.3960

R-squared	0.078134	Mean dependent var	0.005689
Adjusted R-squared	0.039723	S.D. dependent var	0.005274
S.E. of regression	0.005168	Akaike info criterion	-7.644446
Sum squared resid	0.002564	Schwarz criterion	-7.514984
Log likelihood	391.0445	F-statistic	2.034160
Durbin-Watson stat	1.934328	Prob(F-statistic)	0.095672

Inverted AR Roots	.73	-.02+.55i	-.02 -.55i	-.55

2.2.1.5 AR(5)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:29
Sample(adjusted): 1977:1 2001:4
Included observations: 100 after adjusting endpoints
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005495	0.000774	7.100482	0.0000
GDP_GROWTH(-1)	0.157842	0.101210	1.559552	0.1222
GDP_GROWTH(-2)	0.101109	0.087333	1.157749	0.2499
GDP_GROWTH(-3)	0.068641	0.111638	0.614853	0.5401
GDP_GROWTH(-4)	0.141836	0.141381	1.003222	0.3183
GDP_GROWTH(-5)	-0.146734	0.071380	-2.055678	0.0426

R-squared	0.087032	Mean dependent var	0.005587
Adjusted R-squared	0.038470	S.D. dependent var	0.005198
S.E. of regression	0.005097	Akaike info criterion	-7.662062
Sum squared resid	0.002442	Schwarz criterion	-7.505752
Log likelihood	389.1031	F-statistic	1.792185
Durbin-Watson stat	1.952609	Prob(F-statistic)	0.121916

Inverted AR Roots	.59 -.23i	.59+.23i	-.15+.69i	-.15 -.69i
	-.73			

2.2.1.6 AR(6)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 17:29
Sample(adjusted): 1977:2 2001:4
Included observations: 99 after adjusting endpoints
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005545	0.000815	6.803048	0.0000
GDP_GROWTH(-1)	0.174843	0.105386	1.659082	0.1005
GDP_GROWTH(-2)	0.097441	0.089515	1.088545	0.2792
GDP_GROWTH(-3)	0.074717	0.106820	0.699465	0.4860
GDP_GROWTH(-4)	0.154645	0.144842	1.067676	0.2885
GDP_GROWTH(-5)	-0.147706	0.069289	-2.131749	0.0357
GDP_GROWTH(-6)	0.010797	0.087261	0.123737	0.9018

R-squared	0.095006	Mean dependent var	0.005602
Adjusted R-squared	0.035984	S.D. dependent var	0.005223
S.E. of regression	0.005128	Akaike info criterion	-7.640189
Sum squared resid	0.002419	Schwarz criterion	-7.456696
Log likelihood	385.1894	F-statistic	1.609684
Durbin-Watson stat	2.005682	Prob(F-statistic)	0.153276

Inverted AR Roots	.57 -.19i	.57+.19i	.08	-.15+.69i
	-.15 -.69i	-.74		

2.2.2 ADL(2,q)

2.2.2.1 Spread(-1)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:20
Sample(adjusted): 1976:3 2001:4
Included observations: 102 after adjusting endpoints
Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003666	0.001311	2.797000	0.0062
SPREAD(-1)	0.098655	0.055688	1.771549	0.0796
GDP_GROWTH(-1)	0.136785	0.100332	1.363320	0.1759
GDP_GROWTH(-2)	0.116276	0.099559	1.167904	0.2457

R-squared	0.084394	Mean dependent var	0.005716
Adjusted R-squared	0.056365	S.D. dependent var	0.005254
S.E. of regression	0.005104	Akaike info criterion	-7.679110
Sum squared resid	0.002553	Schwarz criterion	-7.576170
Log likelihood	395.6346	F-statistic	3.010970
Durbin-Watson stat	2.013949	Prob(F-statistic)	0.033799

Inverted AR Roots	.42	-.28

2.2.2.2 Spread(-2)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:22
Sample(adjusted): 1976:4 2001:4
Included observations: 101 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003127	0.001439	2.173296	0.0322
SPREAD(-1)	0.047319	0.089571	0.528284	0.5985
SPREAD(-2)	0.078313	0.084674	0.924877	0.3573
GDP_GROWTH(-1)	0.139279	0.101781	1.368419	0.1744
GDP_GROWTH(-2)	0.132146	0.101499	1.301935	0.1961

R-squared	0.092395	Mean dependent var	0.005689
Adjusted R-squared	0.054578	S.D. dependent var	0.005274
S.E. of regression	0.005128	Akaike info criterion	-7.660037
Sum squared resid	0.002524	Schwarz criterion	-7.530575
Log likelihood	391.8318	F-statistic	2.443231
Durbin-Watson stat	2.000047	Prob(F-statistic)	0.051789
Inverted AR Roots	.44	-.30	

2.2.2.3 Spread(-3)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:22
Sample(adjusted): 1977:1 2001:4
Included observations: 100 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003532	0.001474	2.396175	0.0185
SPREAD(-1)	0.074783	0.091867	0.814033	0.4177
SPREAD(-2)	0.045335	0.108809	0.416650	0.6779
SPREAD(-3)	-0.018408	0.085130	-0.216235	0.8293
GDP_GROWTH(-1)	0.143103	0.102087	1.401784	0.1643
GDP_GROWTH(-2)	0.111636	0.102176	1.092585	0.2774

R-squared	0.074548	Mean dependent var	0.005587
Adjusted R-squared	0.025321	S.D. dependent var	0.005198
S.E. of regression	0.005132	Akaike info criterion	-7.648480
Sum squared resid	0.002476	Schwarz criterion	-7.492170
Log likelihood	388.4240	F-statistic	1.514389
Durbin-Watson stat	1.987579	Prob(F-statistic)	0.192738
Inverted AR Roots	.41	-.27	

2.2.2.4 Spread(-4)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:23
Sample(adjusted): 1977:2 2001:4
Included observations: 99 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003642	0.001569	2.321358	0.0225
SPREAD(-1)	0.075836	0.092126	0.823177	0.4125
SPREAD(-2)	0.036984	0.111681	0.331161	0.7413
SPREAD(-3)	0.062046	0.109171	0.568343	0.5712
SPREAD(-4)	-0.074356	0.085418	-0.870496	0.3863
GDP_GROWTH(-1)	0.145383	0.103626	1.402960	0.1640
GDP_GROWTH(-2)	0.123003	0.102649	1.198286	0.2339

R-squared	0.088253	Mean dependent var	0.005602
Adjusted R-squared	0.028791	S.D. dependent var	0.005223
S.E. of regression	0.005147	Akaike info criterion	-7.632755
Sum squared resid	0.002437	Schwarz criterion	-7.449262
Log likelihood	384.8214	F-statistic	1.484194
Durbin-Watson stat	2.033758	Prob(F-statistic)	0.192258

Inverted AR Roots	.43	-.29

2.2.2.5 Spread(-5)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:23
Sample(adjusted): 1977:3 2001:4
Included observations: 98 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003909	0.001644	2.377471	0.0195
SPREAD(-1)	0.095202	0.096203	0.989596	0.3250
SPREAD(-2)	0.026020	0.114637	0.226977	0.8210
SPREAD(-3)	0.055699	0.111510	0.499494	0.6187
SPREAD(-4)	0.036119	0.109661	0.329368	0.7426
SPREAD(-5)	-0.119430	0.088416	-1.350772	0.1802
GDP_GROWTH(-1)	0.144818	0.105161	1.377113	0.1719
GDP_GROWTH(-2)	0.142022	0.105244	1.349458	0.1806

R-squared	0.107916	Mean dependent var	0.005645
Adjusted R-squared	0.038532	S.D. dependent var	0.005232
S.E. of regression	0.005130	Akaike info criterion	-7.629421
Sum squared resid	0.002368	Schwarz criterion	-7.418403
Log likelihood	381.8416	F-statistic	1.555337
Durbin-Watson stat	2.036847	Prob(F-statistic)	0.159094

Inverted AR Roots	.46	-.31

2.2.2.6 Spread(-6)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:23
Sample(adjusted): 1977:4 2001:4
Included observations: 97 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003509	0.001702	2.061873	0.0422
SPREAD(-1)	0.117805	0.100443	1.172855	0.2440
SPREAD(-2)	-0.014093	0.124641	-0.113066	0.9102
SPREAD(-3)	0.075961	0.114937	0.660890	0.5104
SPREAD(-4)	0.019536	0.112609	0.173481	0.8627
SPREAD(-5)	-0.137191	0.114164	-1.201705	0.2327
SPREAD(-6)	0.052428	0.090025	0.582372	0.5618
GDP_GROWTH(-1)	0.137236	0.106235	1.291815	0.1998
GDP_GROWTH(-2)	0.139464	0.106414	1.310578	0.1934

R-squared	0.107864	Mean dependent var	0.005695
Adjusted R-squared	0.026761	S.D. dependent var	0.005235
S.E. of regression	0.005164	Akaike info criterion	-7.605833
Sum squared resid	0.002347	Schwarz criterion	-7.366943
Log likelihood	377.8829	F-statistic	1.329962
Durbin-Watson stat	1.997074	Prob(F-statistic)	0.239357
Inverted AR Roots	.45	-.31	

2.2.3 ADL(2,1,m)

2.2.3.1 IP(-1)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:51
Sample(adjusted): 1976:3 2001:4
Included observations: 102 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003915	0.000784	4.994441	0.0000
SPREAD(-1)	0.039330	0.036125	1.088730	0.2790
IP(-1)	0.225206	0.045356	4.965266	0.0000
GDP_GROWTH(-1)	-0.217822	0.115211	-1.890642	0.0617
GDP_GROWTH(-2)	-0.065001	0.106861	-0.608275	0.5444

R-squared	0.190770	Mean dependent var	0.005716
Adjusted R-squared	0.157399	S.D. dependent var	0.005254
S.E. of regression	0.004823	Akaike info criterion	-7.783005
Sum squared resid	0.002256	Schwarz criterion	-7.654330
Log likelihood	401.9333	F-statistic	5.716744
Durbin-Watson stat	1.979001	Prob(F-statistic)	0.000357
Inverted AR Roots	-.11+.23i	-.11 -.23i	

2.2.3.2 IP(-2)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:52
Sample(adjusted): 1976:4 2001:4
Included observations: 101 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003711	0.000820	4.525210	0.0000
SPREAD(-1)	0.044809	0.038104	1.175981	0.2425
IP(-1)	0.192885	0.057309	3.365699	0.0011
IP(-2)	0.056846	0.052686	1.078964	0.2833
GDP_GROWTH(-1)	-0.173000	0.123056	-1.405866	0.1630
GDP_GROWTH(-2)	-0.085551	0.110607	-0.773471	0.4412

R-squared	0.205759	Mean dependent var	0.005689
Adjusted R-squared	0.163957	S.D. dependent var	0.005274
S.E. of regression	0.004822	Akaike info criterion	-7.773657
Sum squared resid	0.002209	Schwarz criterion	-7.618303
Log likelihood	398.5697	F-statistic	4.922220
Durbin-Watson stat	1.949494	Prob(F-statistic)	0.000475
Inverted AR Roots	-.09 -.28i	-.09+.28i	

2.2.3.3 IP(-3)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:52
Sample(adjusted): 1977:1 2001:4
Included observations: 100 after adjusting endpoints
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003850	0.000845	4.555382	0.0000
SPREAD(-1)	0.037467	0.039051	0.959425	0.3398
IP(-1)	0.195574	0.058552	3.340191	0.0012
IP(-2)	0.039018	0.062839	0.620919	0.5362
IP(-3)	0.004763	0.051028	0.093344	0.9258
GDP_GROWTH(-1)	-0.162164	0.124500	-1.302519	0.1960
GDP_GROWTH(-2)	-0.070797	0.124086	-0.570546	0.5697

R-squared	0.191272	Mean dependent var	0.005587
Adjusted R-squared	0.139096	S.D. dependent var	0.005198
S.E. of regression	0.004823	Akaike info criterion	-7.763301
Sum squared resid	0.002164	Schwarz criterion	-7.580939
Log likelihood	395.1650	F-statistic	3.665911
Durbin-Watson stat	1.956317	Prob(F-statistic)	0.002596

Inverted AR Roots	-.08+.25i	-.08 -.25i

2.2.3.4 IP(-4)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:52
Sample(adjusted): 1977:2 2001:4
Included observations: 99 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003808	0.000883	4.315298	0.0000
SPREAD(-1)	0.044399	0.040601	1.093531	0.2770
IP(-1)	0.188504	0.058940	3.198247	0.0019
IP(-2)	0.041833	0.063534	0.658434	0.5119
IP(-3)	0.037428	0.056323	0.664519	0.5080
IP(-4)	-0.038866	0.046839	-0.829795	0.4088
GDP_GROWTH(-1)	-0.141176	0.126196	-1.118706	0.2662
GDP_GROWTH(-2)	-0.059813	0.123999	-0.482370	0.6307

R-squared	0.206127	Mean dependent var	0.005602
Adjusted R-squared	0.145060	S.D. dependent var	0.005223
S.E. of regression	0.004829	Akaike info criterion	-7.750993
Sum squared resid	0.002122	Schwarz criterion	-7.541286
Log likelihood	391.6741	F-statistic	3.375421
Durbin-Watson stat	2.011807	Prob(F-statistic)	0.003016
Inverted AR Roots	-.07 -.23i	-.07+.23i	

2.2.3.5 IP(-5)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:53
Sample(adjusted): 1977:3 2001:4
Included observations: 98 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003827	0.000932	4.105283	0.0001
SPREAD(-1)	0.048955	0.042362	1.155646	0.2509
IP(-1)	0.181608	0.059137	3.070958	0.0028
IP(-2)	0.032307	0.063029	0.512575	0.6095
IP(-3)	0.049989	0.056945	0.877846	0.3824
IP(-4)	-0.009705	0.052415	-0.185165	0.8535
IP(-5)	-0.037276	0.047540	-0.784089	0.4351
GDP_GROWTH(-1)	-0.136231	0.126738	-1.074906	0.2853
GDP_GROWTH(-2)	-0.003470	0.124703	-0.027823	0.9779

R-squared	0.218711	Mean dependent var	0.005645
Adjusted R-squared	0.148483	S.D. dependent var	0.005232
S.E. of regression	0.004828	Akaike info criterion	-7.741629
Sum squared resid	0.002074	Schwarz criterion	-7.504234
Log likelihood	388.3398	F-statistic	3.114294
Durbin-Watson stat	2.013415	Prob(F-statistic)	0.003794

Inverted AR Roots	-.03	-.10

2.2.3.6 IP(-6)

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 19:53
Sample(adjusted): 1977:4 2001:4
Included observations: 97 after adjusting endpoints
Convergence achieved after 9 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003603	0.000847	4.253026	0.0001
SPREAD(-1)	0.047146	0.038757	1.216461	0.2271
IP(-1)	0.210394	0.062271	3.378672	0.0011
IP(-2)	0.042772	0.066615	0.642076	0.5225
IP(-3)	0.039482	0.061014	0.647099	0.5193
IP(-4)	-0.031793	0.055568	-0.572153	0.5687
IP(-5)	-0.049305	0.054630	-0.902526	0.3693
IP(-6)	0.068950	0.048439	1.423441	0.1582
GDP_GROWTH(-1)	-0.224801	0.129678	-1.733526	0.0865
GDP_GROWTH(-2)	-0.066947	0.128374	-0.521496	0.6033

R-squared	0.231700	Mean dependent var	0.005695
Adjusted R-squared	0.152221	S.D. dependent var	0.005235
S.E. of regression	0.004820	Akaike info criterion	-7.734653
Sum squared resid	0.002021	Schwarz criterion	-7.469219
Log likelihood	385.1307	F-statistic	2.915223
Durbin-Watson stat	1.958084	Prob(F-statistic)	0.004589
Inverted AR Roots	-.11 -.23i	-.11+.23i	

2.3 Model tests

2.3.1 AR(2) 1st sub-period

2.3.1.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:09
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003868	0.000888	4.353843	0.0000
GDP_GROWTH(-1)	0.181269	0.097630	1.856685	0.0663
GDP_GROWTH(-2)	0.139790	0.097747	1.430119	0.1558

R-squared	0.065431	Mean dependent var	0.005784
Adjusted R-squared	0.046740	S.D. dependent var	0.005275
S.E. of regression	0.005150	Akaike info criterion	-7.670988
Sum squared resid	0.002652	Schwarz criterion	-7.594249
Log likelihood	398.0559	F-statistic	3.500620
Durbin-Watson stat	2.049033	Prob(F-statistic)	0.033928

2.3.1.2 Heterescedasticity test

White Heteroskedasticity Test:

F-statistic	2.478242	Probability	0.048969
Obs*R-squared	9.461661	Probability	0.050541

2.3.1.3 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.035760	Probability	0.392903
Obs*R-squared	4.261237	Probability	0.371804

2.3.1.4 Corrected output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:14
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003868	0.001014	3.815884	0.0002
GDP_GROWTH(-1)	0.181269	0.098837	1.834028	0.0696
GDP_GROWTH(-2)	0.139790	0.080906	1.727804	0.0871

R-squared	0.065431	Mean dependent var	0.005784
Adjusted R-squared	0.046740	S.D. dependent var	0.005275
S.E. of regression	0.005150	Akaike info criterion	-7.670988
Sum squared resid	0.002652	Schwarz criterion	-7.594249
Log likelihood	398.0559	F-statistic	3.500620
Durbin-Watson stat	2.049033	Prob(F-statistic)	0.033928

2.3.2 AR(2) 2nd sub-period

2.3.2.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 12/18/12 Time: 17:31
Sample(adjusted): 1976:2 2005:4
Included observations: 119 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003593	0.000765	4.697229	0.0000
GDP_GROWTH(-1)	0.198233	0.090394	2.192995	0.0303
GDP_GROWTH(-2)	0.144976	0.090047	1.610006	0.1101

R-squared	0.077797	Mean dependent var	0.005525
Adjusted R-squared	0.061897	S.D. dependent var	0.005007
S.E. of regression	0.004850	Akaike info criterion	-7.794912
Sum squared resid	0.002728	Schwarz criterion	-7.724850
Log likelihood	466.7972	F-statistic	4.892854
Durbin-Watson stat	2.052634	Prob(F-statistic)	0.009119

2.3.2.2 Heterescedasticity test

White Heteroskedasticity Test:

F-statistic	3.142360	Probability	0.017153
Obs*R-squared	11.81773	Probability	0.018759

2.3.2.3 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.141397	Probability	0.340816
Obs*R-squared	4.660937	Probability	0.323889

2.3.2.4 Corrected output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 12/18/12 Time: 17:32
Sample(adjusted): 1976:2 2005:4
Included observations: 119 after adjusting endpoints
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003593	0.000852	4.217350	0.0000
GDP_GROWTH(-1)	0.198233	0.092916	2.133458	0.0350
GDP_GROWTH(-2)	0.144976	0.077705	1.865716	0.0646

R-squared	0.077797	Mean dependent var	0.005525
Adjusted R-squared	0.061897	S.D. dependent var	0.005007
S.E. of regression	0.004850	Akaike info criterion	-7.794912
Sum squared resid	0.002728	Schwarz criterion	-7.724850
Log likelihood	466.7972	F-statistic	4.892854
Durbin-Watson stat	2.052634	Prob(F-statistic)	0.009119

2.3.3 ADL(2,1) 1st sub-period

2.3.3.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 18:48
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002471	0.001143	2.163101	0.0329
GDP_GROWTH(-1)	0.149535	0.097797	1.529027	0.1294
GDP_GROWTH(-2)	0.110883	0.097669	1.135285	0.2590
SPREAD(-1)	0.085604	0.044911	1.906090	0.0595

R-squared	0.098515	Mean dependent var	0.005784
Adjusted R-squared	0.071197	S.D. dependent var	0.005275
S.E. of regression	0.005083	Akaike info criterion	-7.687612
Sum squared resid	0.002558	Schwarz criterion	-7.585293
Log likelihood	399.9120	F-statistic	3.606258
Durbin-Watson stat	2.042070	Prob(F-statistic)	0.016043

2.3.3.2 Redundant test

Redundant Variables: GDP_GROWTH(-1) GDP_GROWTH(-2)

F-statistic	2.217886	Probability	0.114219
Log likelihood ratio	4.514594	Probability	0.104633

2.3.3.3 Heterescedasticity test

White Heteroskedasticity Test:

F-statistic	1.546446	Probability	0.171393
Obs*R-squared	9.077844	Probability	0.169247

2.3.3.4 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.581077	Probability	0.185649
Obs*R-squared	6.428900	Probability	0.169326

2.3.4 ADL(1,1) 2nd sub-period

2.3.4.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 12/18/12 Time: 17:34
Sample(adjusted): 1976:2 2005:4
Included observations: 119 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002203	0.001044	2.109608	0.0371
GDP_GROWTH(-1)	0.170950	0.090463	1.889709	0.0613
GDP_GROWTH(-2)	0.121727	0.089820	1.355230	0.1780
SPREAD(-1)	0.080603	0.041777	1.929358	0.0562

R-squared	0.106711	Mean dependent var	0.005525
Adjusted R-squared	0.083408	S.D. dependent var	0.005007
S.E. of regression	0.004794	Akaike info criterion	-7.809961
Sum squared resid	0.002643	Schwarz criterion	-7.716545
Log likelihood	468.6927	F-statistic	4.579264
Durbin-Watson stat	2.045077	Prob(F-statistic)	0.004566

2.3.4.2 Redundant test

.Redundant Variables: GDP_GROWTH(-2)

F-statistic	1.836648	Probability	0.178000
Log likelihood ratio	1.885515	Probability	0.169709

2.3.4.3 Corrected Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 12/19/12 Time: 12:33
Sample(adjusted): 1976:1 2005:4
Included observations: 120 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002340	0.001002	2.334231	0.0213
GDP_GROWTH(-1)	0.204235	0.088838	2.298947	0.0233
SPREAD(-1)	0.100944	0.040854	2.470853	0.0149

R-squared	0.109282	Mean dependent var	0.005614
Adjusted R-squared	0.094056	S.D. dependent var	0.005080
S.E. of regression	0.004835	Akaike info criterion	-7.800985
Sum squared resid	0.002736	Schwarz criterion	-7.731297
Log likelihood	471.0591	F-statistic	7.177328
Durbin-Watson stat	2.056046	Prob(F-statistic)	0.001148

2.3.4.4 Heterescedasticity test

White Heteroskedasticity Test:

F-statistic	1.347293	Probability	0.256743
Obs*R-squared	5.371749	Probability	0.251235

2.3.4.5 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.978329	Probability	0.102572
Obs*R-squared	7.853543	Probability	0.097093

2.3.5 ADL(2,1,1) 1st sub-period

2.3.5.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 11/29/12 Time: 20:02
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004001	0.001185	3.375977	0.0011
GDP_GROWTH(-1)	-0.101286	0.120527	-0.840365	0.4027
GDP_GROWTH(-2)	0.043244	0.095412	0.453236	0.6514
SPREAD(-1)	0.059382	0.043577	1.362691	0.1761
IP(-1)	0.192700	0.058631	3.286660	0.0014

R-squared	0.188016	Mean dependent var	0.005784
Adjusted R-squared	0.154874	S.D. dependent var	0.005275
S.E. of regression	0.004849	Akaike info criterion	-7.772758
Sum squared resid	0.002304	Schwarz criterion	-7.644859
Log likelihood	405.2971	F-statistic	5.673023
Durbin-Watson stat	2.119457	Prob(F-statistic)	0.000378

2.3.5.2 Redundant test

Redundant Variables: GDP_GROWTH(-1) GDP_GROWTH(-2) SPREAD(-1)

F-statistic	0.964336	Probability	0.412818
Log likelihood ratio	2.996594	Probability	0.392151

2.3.5.3 Heteroscedasticity test

White Heteroskedasticity Test:

F-statistic	0.842168	Probability	0.568052
Obs*R-squared	6.888667	Probability	0.548691

2.3.5.4 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.864026	Probability	0.123223
Obs*R-squared	7.569566	Probability	0.108681

2.3.6 ADL(2,1,1) 2nd sub-period

2.3.6.1 Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 12/18/12 Time: 17:39
Sample(adjusted): 1976:2 2005:4
Included observations: 119 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003552	0.001086	3.269656	0.0014
GDP_GROWTH(-1)	-0.055584	0.111536	-0.498351	0.6192
GDP_GROWTH(-2)	0.062101	0.088259	0.703629	0.4831
SPREAD(-1)	0.056579	0.040828	1.385798	0.1685
IP(-1)	0.173288	0.053448	3.242185	0.0016

R-squared	0.182126	Mean dependent var	0.005525
Adjusted R-squared	0.153429	S.D. dependent var	0.005007
S.E. of regression	0.004607	Akaike info criterion	-7.881356
Sum squared resid	0.002420	Schwarz criterion	-7.764586
Log likelihood	473.9407	F-statistic	6.346456
Durbin-Watson stat	2.104527	Prob(F-statistic)	0.000120

2.3.6.2 Redundant Test

Redundant Variables: GDP_GROWTH(-1) GDP_GROWTH(-2) SPREAD(-1)

F-statistic	0.941004	Probability	0.423370
Log likelihood ratio	2.910934	Probability	0.405562

2.3.6.3 Heteroscedasticity test

White Heteroskedasticity Test:

F-statistic	1.385604	Probability	0.210648
Obs*R-squared	10.89397	Probability	0.207779

2.3.6.4 Autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.998697	Probability	0.099698
Obs*R-squared	8.062898	Probability	0.089301

2.3.7 ADL(2,1,1) plus the Error Correction Model

2.3.7.1 ECM Output

Dependent Variable: LGDP
Method: Least Squares
Date: 01/04/13 Time: 15:28
Sample: 1975:4 2009:4
Included observations: 137

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.197725	0.043393	4.556646	0.0000
DLCONS	1.024449	0.003384	302.7260	0.0000
LNETEX	0.002846	0.000653	4.355066	0.0000

R-squared	0.998829	Mean dependent var	14.07660
Adjusted R-squared	0.998811	S.D. dependent var	0.215509
S.E. of regression	0.007430	Akaike info criterion	-6.945015
Sum squared resid	0.007397	Schwarz criterion	-6.881074
Log likelihood	478.7335	F-statistic	57146.89
Durbin-Watson stat	0.401340	Prob(F-statistic)	0.000000

2.3.7.2 1st sub-period Ouput

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 01/04/13 Time: 15:02
Sample(adjusted): 1976:2 2001:4
Included observations: 103 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002934	0.001210	2.424168	0.0172
GDP_GROWTH(-1)	-0.091395	0.116710	-0.783097	0.4355
GDP_GROWTH(-2)	0.124438	0.096922	1.283902	0.2022
SPREAD(-1)	0.072306	0.042436	1.703868	0.0916
IP(-1)	0.219015	0.057543	3.806087	0.0002
ECM(-1)	-0.232104	0.084120	-2.759209	0.0069

R-squared	0.247109	Mean dependent var	0.005784
Adjusted R-squared	0.208300	S.D. dependent var	0.005275
S.E. of regression	0.004693	Akaike info criterion	-7.828900
Sum squared resid	0.002137	Schwarz criterion	-7.675421
Log likelihood	409.1883	F-statistic	6.367326
Durbin-Watson stat	2.213990	Prob(F-statistic)	0.000037

2.3.7.3 2nd sub-period Output

Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 01/04/13 Time: 15:08
Sample(adjusted): 1976:2 2005:4
Included observations: 119 after adjusting endpoints

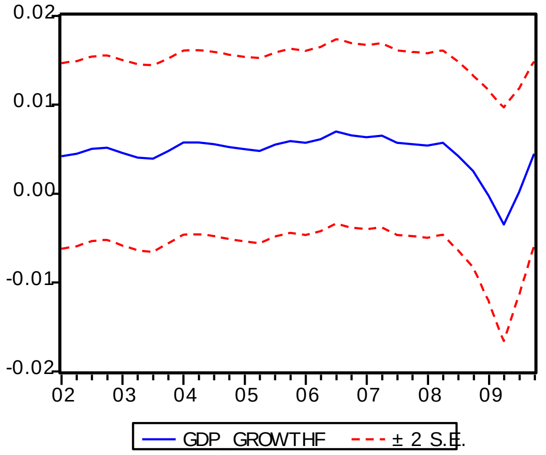
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002497	0.001128	2.212960	0.0289
GDP_GROWTH(-1)	-0.040762	0.108754	-0.374805	0.7085
GDP_GROWTH(-2)	0.140722	0.090793	1.549925	0.1240
SPREAD(-1)	0.067554	0.039967	1.690239	0.0937
IP(-1)	0.194531	0.052645	3.695161	0.0003
ECM(-1)	-0.211241	0.078634	-2.686384	0.0083

R-squared	0.231224	Mean dependent var	0.005525
Adjusted R-squared	0.197207	S.D. dependent var	0.005007
S.E. of regression	0.004486	Akaike info criterion	-7.926457
Sum squared resid	0.002274	Schwarz criterion	-7.786333
Log likelihood	477.6242	F-statistic	6.797366
Durbin-Watson stat	2.177080	Prob(F-statistic)	0.000014

2.4 Out-of-sample results

2.4.1 AR(2)

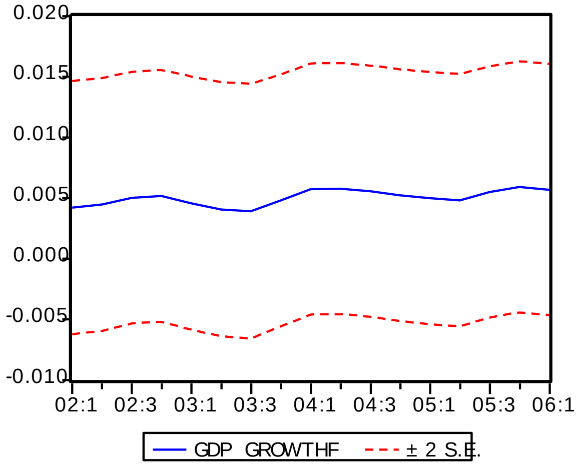
2.4.1.1 Full Period



Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2002:1 2009:4
Included observations: 32

Root Mean Squared Error	0.006717
Mean Absolute Error	0.003820
Mean Abs. Percent Error	493.3785
Theil Inequality Coefficient	0.527547
Bias Proportion	0.110952
Variance Proportion	0.585641
Covariance Proportion	0.303407

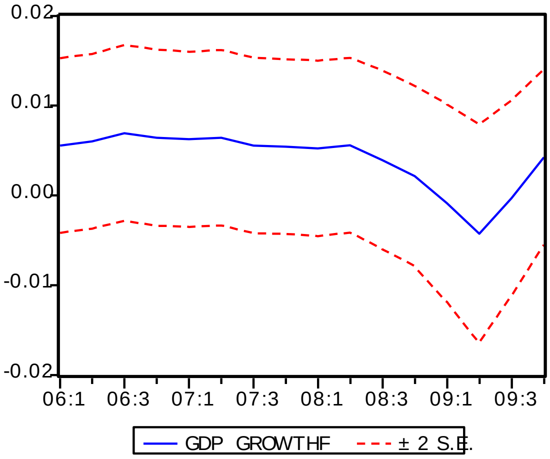
2.4.1.2 1st Sub-period



Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2002:1 2006:1
Included observations: 17

Root Mean Squared Error	0.002252
Mean Absolute Error	0.001844
Mean Abs. Percent Error	837.5214
Theil Inequality Coefficient	0.230985
Bias Proportion	0.161994
Variance Proportion	0.537313
Covariance Proportion	0.300693

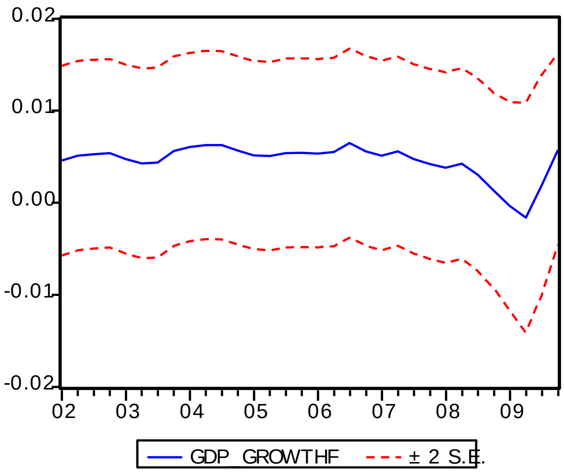
2.4.1.3 2nd Sub-period



Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2006:1 2009:4	
Included observations: 16	
Root Mean Squared Error	0.009077
Mean Absolute Error	0.005843
Mean Abs. Percent Error	103.6373
Theil Inequality Coefficient	0.606731
Bias Proportion	0.117136
Variance Proportion	0.551506
Covariance Proportion	0.331358

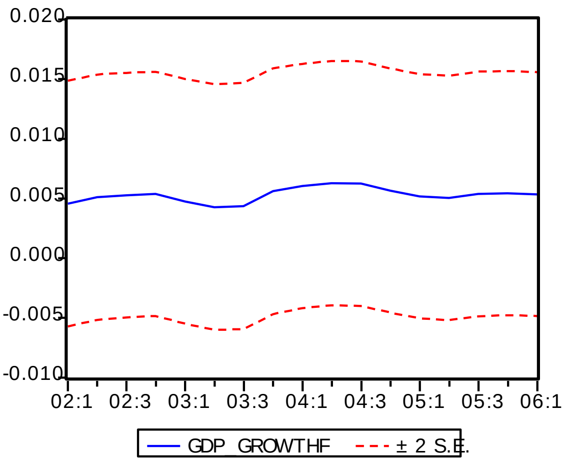
2.4.2 ADL(2,1)

2.4.2.1 Full Period



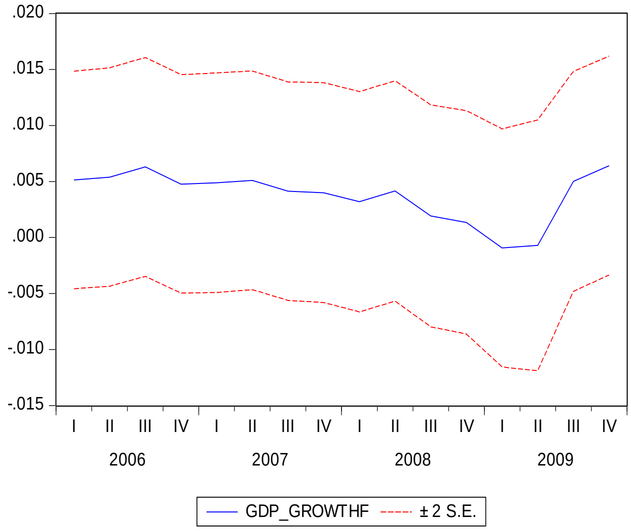
Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2002:1 2009:4	
Included observations: 32	
Root Mean Squared Error	0.006539
Mean Absolute Error	0.003772
Mean Abs. Percent Error	509.6468
Theil Inequality Coefficient	0.521721
Bias Proportion	0.108302
Variance Proportion	0.693927
Covariance Proportion	0.197771

2.4.2.2 1st Sub-period



Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2002:1 2006:1	
Included observations: 17	
Root Mean Squared Error	0.002412
Mean Absolute Error	0.001977
Mean Abs. Percent Error	881.6363
Theil Inequality Coefficient	0.241089
Bias Proportion	0.235133
Variance Proportion	0.491065
Covariance Proportion	0.273802

2.4.2.3 2nd Sub-period [ADL(1,1)]

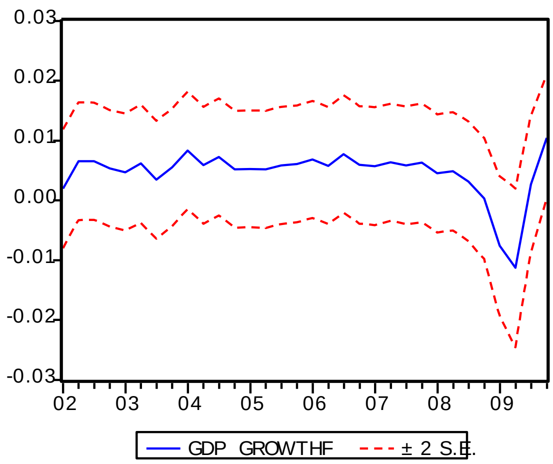


Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2006Q1 2009Q4
Included observations: 16

Root Mean Squared Error	0.008840
Mean Absolute Error	0.005565
Mean Abs. Percent Error	81.20311
Theil Inequality Coefficient	0.621297
Bias Proportion	0.104049
Variance Proportion	0.753340
Covariance Proportion	0.142611

2.4.3 ADL(2,1,1)

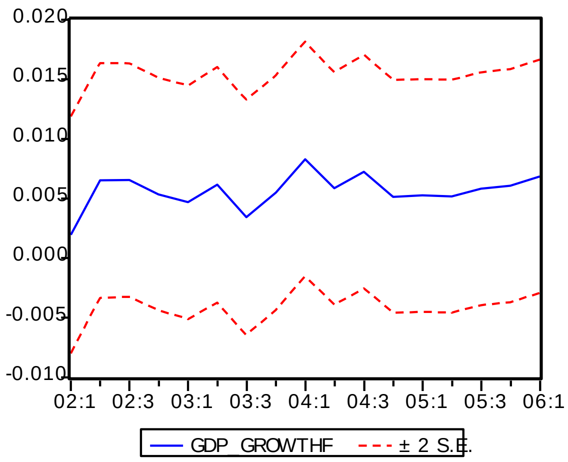
2.4.3.1 Full Period



Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2002:1 2009:4
Included observations: 32

Root Mean Squared Error	0.006183
Mean Absolute Error	0.004135
Mean Abs. Percent Error	722.0572
Theil Inequality Coefficient	0.448852
Bias Proportion	0.125706
Variance Proportion	0.266172
Covariance Proportion	0.608122

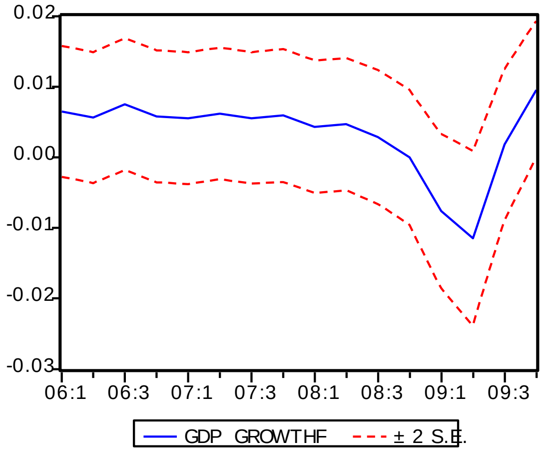
2.4.3.2 1st Sub-period



Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2002:1 2006:1
Included observations: 17

Root Mean Squared Error	0.002747
Mean Absolute Error	0.002234
Mean Abs. Percent Error	1192.274
Theil Inequality Coefficient	0.261681
Bias Proportion	0.306289
Variance Proportion	0.098442
Covariance Proportion	0.595269

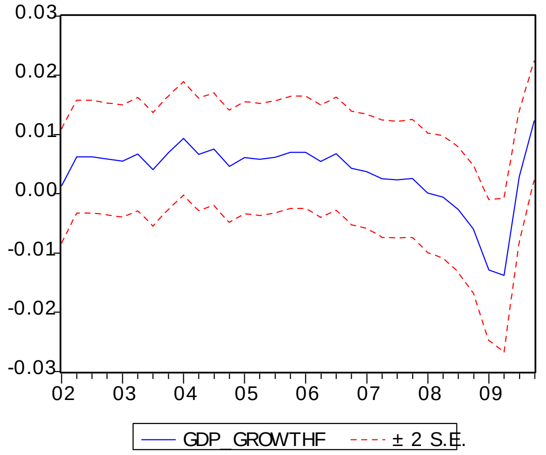
2.4.3.3 2nd Sub-period



Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2006:1 2009:4	
Included observations: 16	
Root Mean Squared Error	0.008174
Mean Absolute Error	0.005973
Mean Abs. Percent Error	175.9818
Theil Inequality Coefficient	0.505474
Bias Proportion	0.085225
Variance Proportion	0.302132
Covariance Proportion	0.612643

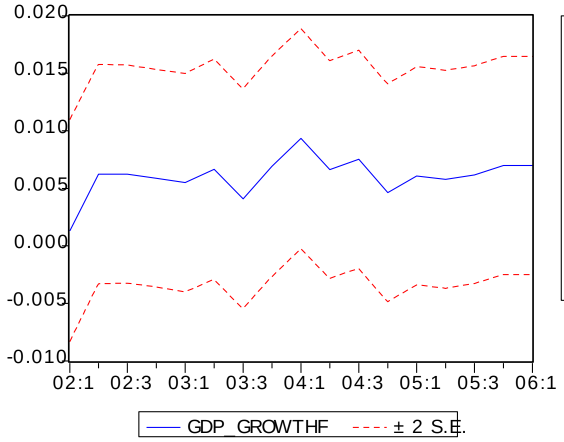
2.4.4 ADL(2,1,1) plus the Error Correction Model

2.4.4.1 Full Period



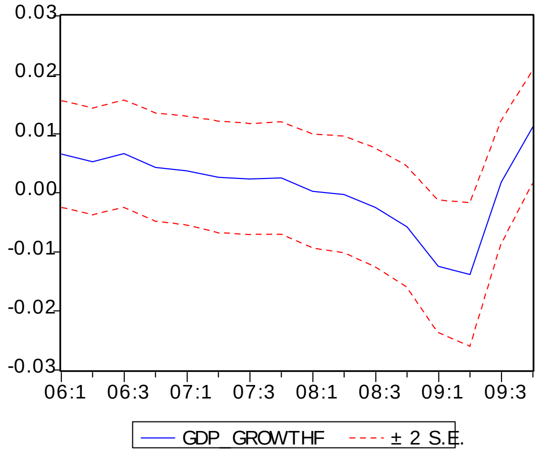
Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2002:1 2009:4	
Included observations: 32	
Root Mean Squared Error	0.005411
Mean Absolute Error	0.003942
Mean Abs. Percent Error	789.3728
Theil Inequality Coefficient	0.382334
Bias Proportion	0.037807
Variance Proportion	0.103649
Covariance Proportion	0.858544

2.4.4.2 1st Sub-period



Forecast: GDP_GROWTHF	
Actual: GDP_GROWTH	
Forecast sample: 2002:1 2006:1	
Included observations: 17	
Root Mean Squared Error	0.003041
Mean Absolute Error	0.002451
Mean Abs. Percent Error	1306.814
Theil Inequality Coefficient	0.277550
Bias Proportion	0.405076
Variance Proportion	0.043362
Covariance Proportion	0.551562

2.4.4.3 2nd Sub-period



Forecast: GDP_GROWTHF
Actual: GDP_GROWTH
Forecast sample: 2006:1 2009:4
Included observations: 16

Root Mean Squared Error	0.006977
Mean Absolute Error	0.005431
Mean Abs. Percent Error	188.2778
Theil Inequality Coefficient	0.425095
Bias Proportion	0.000456
Variance Proportion	0.232532
Covariance Proportion	0.767012