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MODELLING THE EVOLUTION OF THE ROMANIAN GDP BETWEEN 2005-2013

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Abstract *This paper pinpoints the econometric modelling of the time series for macroeconomic variable GDP in our economy. Since this is a non-stationary time series, there are used statistical surveys, namely Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), to turn it into a stationary time series. Thus, we aim at presenting the stationarity of the time series starting with the quarterly values of GDP.*

Key words:

Time series, analysis, gross domestic product, statistical survey, variable

1. Introduction

The methods of forecasting economic phenomena based on chronological series can either be stationary (random) and non-stationary (developmental). As for the non-stationary series, a value of the series at time $t_i(y_{ti})$ does not depend on the previous value(y_{ti-k}), which causes independence between time and the variable considered. Statistical parameters of a stationary series (average, variation, moments of superior order) remain constant over time. Non-stationary series are characterised by changing over time of its parameter statistics. In this situation there can be identified more or less intense link between the variable considered and the time, due to the values of the temporal self-correlation of the series values.

The time series analysis aims at identifying and describing the process that generates the evolution of the variable considered when forecasting its further development. The analysis of the time series is grounded on the graphs where time is marked on the abscissa and, on the ordinate, the variable taken into account, which, in our case, is the gross domestic product (GDP). Simple visual observation of such a graph may allow recognition of each type of series. In the case where the graph is not very relevant, in order to determine whether the series is stationary or non-stationary, it is appropriate to apply a self-correlation test. To analyse the stationarity of the time series between 2005-2013, we also need to take into account the 1st order difference (PIB_t – PIB_{t-1}) Thus, using the econometric soft EViews, the following command is written:

genrdpib=d(pib) (1)

and it generates a 1st order new data series of the values of the chronological series. The graphs of the two chronological series (gdp) and the one corresponding to the 1st order difference (dgdp) are detailed below in figures 1 and 2.

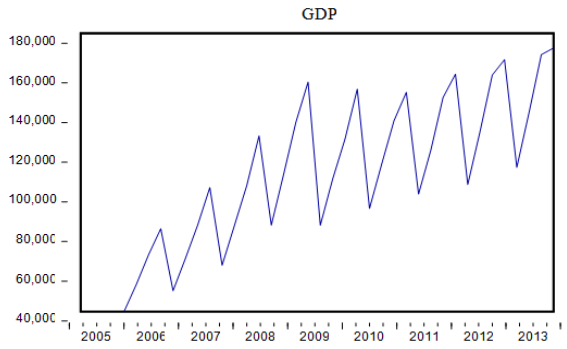

Figure 1.

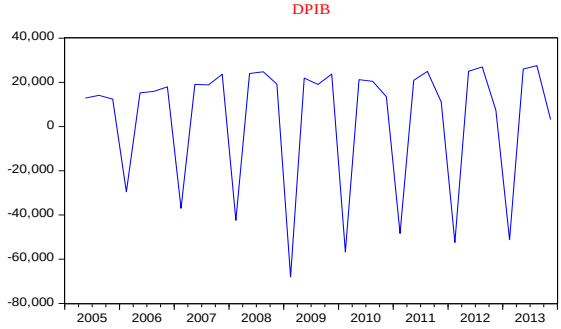

Figure 2.

But we have to check the stationarity by the means of the stationarity test. We use both Augmented Dickey-Fuller Test (ADF) and Phillips-Perron Test (PP). To achieve this goal, in EViews, we select View-Unit Root Test within the time series.

Table 1. ADF Test (Augmented Dickey-Fuller)

Null Hypothesis: PIB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		**-2.302615**	0.4203
Test critical values:	1% level	*-4.284580*	
	5% level	*-3.562882*	
	10% level	*-3.215267*	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PIB)
Method: Least Squares
Date: 02/08/14 Time: 20:35
Sample (adjusted): 2006Q2 2013Q4
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIB(-1)	-0.369719	0.160565	**-2.302615**	0.0303
D(PIB(-1))	-0.060011	0.187803	-0.319544	0.7521
D(PIB(-2))	-0.163289	0.166622	-0.979999	0.3369
D(PIB(-3))	-0.224480	0.152874	-1.468395	0.1550
D(PIB(-4))	0.689005	0.143747	4.793174	0.0001
C	33614.84	12257.41	2.742409	0.0113
@TREND(2005Q1)	735.8998	412.4003	1.784431	0.0870

R-squared	0.968882	Mean dependant var	3720.871
Adjusted R-squared	0.961102	S.D. dependant var	30781.56
S.E. of regression	6070.902	Akaike info criterion	20.45608
Sum squared resid	8.85E+08	Schwarz criterion	20.77989
Log likelihood	-310.0693	Hannan-Quinn criter.	20.56163
F-statistic	124.5419	Durbin-Watson stat	1.932608
Prob(F-statistic)	0.000000		

The first part of the test stands for the information regarding to the type of test (AFD), introduced exogenous variables-the constant, trend) and comprises the result of the test, the critical values for each level of relevance (1.5 and 10%), and probability, p, associated with the result of the test.
As for our case, ADF records the value – 2,302615 and its value p is0.4203. If the value is bigger than the critical one- the null hypothesis is not rejected- the series has a unitary root (is non-stationary). In this case, the null hypothesis is accepted- the series is non-stationary.
Using p, the null hypothesis is accepted – the series is non-stationary – for a certain level of relevance, anytime probability p is bigger than that relevance level. The second part of the test presents the estimated equation on which basis ADF test has been calculated.
We must formulate the two hypotheses regarding the stationarity of GDP 2005-2013, as follows:

H_0: GDP series has unitary root (series is non-stationary);
H_1: GDP series is stationary;
In our case, since: $t_{test\ ADF}$ = **-2.302615 >$t_{critical}$**(1%, 5%, 10%)and Prob = 42,03% > level of relevance (1%, 5%, 10%) $H_0$is not rejected and GDP series are non-stationary.

Table 2. PPTest (Phillips-Perron)

EViews generates the following output for GDP series between 2005-2013.

Null Hypothesis: PIB has a unit root
Exogenous: Constant
Bandwidth: 22 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perronstatistic test		**-3.204624**	0.0281
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	6.71E+08
HAC corrected variance (Bartlett kernel)	8.57E+08

Phillips-Perron Test Equation
Dependent Variable: D(PIB)
Method: Least Squares
Date: 02/08/14 Time: 20:56
Sample (adjusted): 2005Q2 2013Q4
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIB(-1)	-0.404187	0.135495	-2.983041	0.0053
C	51798.93	16781.75	3.086622	0.0041

R-squared	0.212383	Mean dependent var	3578.069
Adjusted R-squared	0.188516	S.D. dependent var	29604.39
S.E. of regression	26668.35	Akaike info criterion	23.27579
Sum squared resid	2.35E+10	Schwarz criterion	23.36466
Log likelihood	-405.3263	Hannan-Quinn criter.	23.30647
F-statistic	8.898535	Durbin-Watson stat	2.145388
Prob(F-statistic)	0.005334		

According to PP Test, $ast_{test\ PP}$ =**-3.204624<t_{critic}**(1%, 5%, 10%) and Prob = 2,81% <Level of relevance (1%, 5%, 10%) H_0 is rejected and consequently the GDP series is stationary.
Next step is to check the stationarity of GDP series the 1st order difference (dgdp) through the two tests (ADF and PP), as follows:

Table 3. ADF Test for dgdp series

Null Hypothesis: DPIB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.290936	0.4262
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DPIB)
Method: Least Squares
Date: 02/08/14 Time: 21:34
Sample (adjusted): 2006Q2 2013Q4
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPIB(-1)	-1.381871	0.603191	-2.290936	0.0307
D(DPIB(-1))	0.028098	0.457804	0.061375	0.9515
D(DPIB(-2))	-0.338581	0.308500	-1.097509	0.2829
D(DPIB(-3))	-0.673931	0.155463	-4.334990	0.0002
C	6706.482	4004.494	1.674739	0.1065
@TREND(2005Q1)	-162.2394	144.9815	-1.119035	0.2738

R-squared	0.985509	Mean dependent var	1056.035
Adjusted R-squared	0.982610	S.D. dependent var	49840.83
S.E. of regression	6572.523	Akaike info criterion	20.59117
Sum squared resid	1.08E+09	Schwarz criterion	20.86871
Log likelihood	-313.1631	Hannan-Quinn criter.	20.68164
F-statistic	340.0305	Durbin-Watson stat	1.723190
Prob(F-statistic)	0.000000		

In our case, since: $t_{test\ ADF}$ = -2.290936**>t_{critic}**(1%, 5%, 10%)and Prob = 42,62% >level of relevance (1%, 5%, 10%) it means that $H_0$is not rejected and dgdp series is non- stationary.

Table 4. PP Test for dgdpseries

Null Hypothesis: DPIB has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		**-12.08503**	**0.0000**
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	8.04E+08
HAC corrected variance (Bartlett kernel)	1.56E+08

Phillips-Perron Test Equation
Dependent Variable: D(DPIB)
Method: Least Squares
Date: 02/08/14 Time: 21:36
Sample (adjusted): 2005Q3 2013Q4
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPIB(-1)	-1.282122	0.169321	-7.572118	0.0000
C	4317.460	5049.350	0.855053	0.3989

R-squared	0.641806	Mean dependent var	-284.3235
Adjusted R-squared	0.630612	S.D. dependent var	48091.13
S.E. of regression	29228.49	Akaike info criterion	23.46070
Sum squared resid	2.73E+10	Schwarz criterion	23.55048
Log likelihood	-396.8319	Hannan-Quinn criter.	23.49132
F-statistic	57.33697	Durbin-Watson stat	2.293605
Prob(F-statistic)	0.000000		

According to PP Test, since$t_{test\ PP}$ = **-12.08503<t_{critic}**(1%, 5%, 10%)and Prob = 0 % <Level of relevance (1%, 5%, 10%) $H_0$is rejected and dgdp series is stationary.
We have to characterize the time series by the means of the statistical indicators (such as average, dispersion, median, smoothness coefficient). To get these data, EViews offers us the option View-Descriptive Statistics and Test- Stats Table. The generated output for dgdp is:

Sample: 2005Q1 2013Q4	
DPIB	
Mean	3578.069
Median	17950.50
Maximum	27535.90
Minimum	-68050.70
Std. Dev.	29604.39
Skewness	-1.297369
Kurtosis	3.025278
Sum	125232.4
Sum Sq. Dev.	2.98E+10
Observations	35

2. Conclusions

Consequently, the stationary time series is characterized by: average equal to 3578.069 mil. lei current prices (which actually implies that GDP evolves from one quarter to other, averagely, by3578.069 mil. lei current prices), Kurtosis smoothness coefficient reaches 3.025278 > 3, so we may note that the time series follows an almost normal distribution series, asymmetrical and oblate. For a normal distribution:

• Skewness coefficient is zero – normal distribution is symmetrical.

• Kurtosis is 3.

If this indicator has a value higher than 3, the distribution is called leptokurtosis, and if it is lower, the distribution is called platikurtosis.

In our paper, according to the statistical results, the distribution of the quarter evolution of GDP presents a positive asymmetry (which means that in during the period under examination, GDP recorded a growth trend), and the kurtosis has a value higher than 3, which means that this distribution is leptokurtosis. In a leptokurtosis distribution, the probability of an external event is superior to the probability of the appearance of that event involved in a normal distribution. As a result, the econometric models of GDP forecast may generate errors if they imply its normal distribution.

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