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Analysis Model of GDP Dependence on the Structural Variables

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Abstract. *In this paper, the authors present an analysis model designed to outline some of the Gross Domestic dependences, on the case of Romanian economy. The study is based on the VAR methodology, and the steps pursued in the article are the study of evolution for Final Consumption, direct foreign investments flow and GDP, the presentation of the estimated VAR models, the testing for the number of lags, the testing for the stationery of the first difference of the data series.*

Keywords: Gross Domestic Product, investments, economic growth, VAR, consumption.

JEL Classification: E21, E22.

1. Introduction. Literature review

The influence of the flow of direct foreign investments on the most synthetic indicator, which emphasizes the economic situation at national level, was not yet entirely made clear by the researchers. Thus, the capital accumulation, materialized by the setting up of the greenfield investments, transfer of new technologies, of know-how, as well as by advanced managerial strategies, is generating the entailing of the host economy towards a model of economic growth, which forecasts the premises of the economic tendencies from the western countries, placed in the category of the developed countries, with a high level of the production, specialized labour force for the domains of reference and well consolidated international relationship that are facilitating both the production process and the access on the external markets.

Hence, as we can state out from the interpretation of the obtained outcomes following the studies achieved by researchers, the analysed region or more specifically, the country of origin, is playing an essential role as to the influence of the direct foreign investments on the economic growth. In this context, in order to emphasize the *relationship direct foreign investments -economic growth at the level of Romania*, in the frame of this chapter we shall build up and interpret an economic model meant to explain the correlation existing between the flow of direct foreign investments and the process of economic growth. In the process of building up this econometric model we shall utilize variables such as: the flow of direct foreign investments, the final consumption and the gross domestic product.

The data bases utilized in order to establish the model of the economic growth of Romania have been processed out of the data published by UNCTAD*, being expressed in* millions of dollars. Thus, in the frame of the present chapter we achieved an analysis through the *dynamic model VAR (Vector Autoregressive)* in order to establish the existing relations between the main economic indicators at the level of our country.

The achieved economic growth is aiming to point out the existing interdependences between the economic indicators flow of DFI, final consumption and GDP, through an analysis performed at the level of Romania, during the statistical period 1990 - 2013. To this purpose we applied to a model of VAR type, as this one is considered as one of the most efficient and flexible models of analysis of the multivariate time series. The *VAR model is representing a continuation of the univariate autoregressive model for multidimensional dynamic time series. It proved to be particularly useful for pointing out the dynamic tendency of the economic and financial series and,* meantime, efficient for prognosis.

Through this model, the forecasts acquire a superior quality in comparison with the forecasts achieved through the utilisation of the univariate models of the time series.

The prognoses achieved through the *VAR model are flexible as they can be conditioned by potential futures ways of the* variables, which can be specified in the model.

Apart the analysis of the data series and prognosis, the *VAR model is used also for characterizing the structural inference as well as in the economic analyses based on functions of impulse-response.*

In the structural analysis, there are certain hypotheses being implied as regards the causal structure of the data making the subject of the study, the outcomes being based on the impact of some unforeseen shocks or of modifications of the variables specified in the model. These causal effects are usually comprised in the response to the functions of impulse.

As already mentioned by important researchers such as Chowdhury and Mavrotas (2005), through a very large number of empirical achieved studies, which aimed the role of the DFI in the host countries, it has been demonstrated that these ones are representing important sources of capital, which are supplementing the domestic investments, a phenomenon also associated with the generating new jobs, improving the utilized technologies and the level of training of the labour force, through the achieved improving trainings, all these developments stimulating the economic growth in the host countries.

On the other side, the empirical studies achieved at the level of the companies, the direct foreign investment does not guarantee these perspectives, namely that the direct foreign investments would generate economic growth.

Akbas, Senturk and Sancar (2013) present a study on the causality between several macroeconomic indicators, including the foreign direct investments and the Gross Domestic Product. The research of Albu (2006) describes the trends in the correlation between interest rate, investment and the growth of the GDP. Anghelache (2014) includes in his book a detailed analysis of Romania's macroeconomic situation, covering the evolutions of the indicators studied in this article. The studies of Anghelache and Manole (2012) and Mitruţ et al. (2014) describe correlations between the Gross Domestic Product and investments. Anghelache (2008) represents a reliable reference for economic studies, at the macroeconomic level, based on statistical methods.

2. Model *VAR of* analysis of the interdependences between investments and consumption in connection with the economic growth

Further on, we shall extend the analysis at the level of Romania in order to explain through the estimate of three VAR models, for the evolution of the Gross Domestic Product *(GDP), of the direct foreign* investments *(DFI)* and of the final consumption

(FC), the relation existing between variables, with the purpose to analyse the impact of the flows of *direct foreign* investments as well as of the final consumption on the economic growth.

Thus, by utilizing the data basis processed out of the information published by *UNCTAD*, with the help of the informatics soft Eviews 7.2, we shall build up three VAR models

In order to estimate the models, all three variables ***(GDP,*** representing the Gross Domestic Product, ***DFI*** representing flows of direct foreign investments and ***FC,*** representing the final consumption), have been considered as being dependent, getting thus three VAR models.

Before analysing the VAR model VAR, we can observe the similar tendency of the evolution of the three variables analysed over the statistical period making the subject of the analysis (Figure 1).

As noticeable from the following graphic, during the analysed period, 1991-2013, the evolution of the three variables is a sinuous one, but relatively similar. This aspect can be underlined also by the results aiming the correlation between the three macroeconomic indicators, according to the correlation matrix, represented further on (Table 1).

Figure 1. *The evolution of the Final Consumption, of the Flow of DFI and of the GDP, over the period 1991-2013 in Romania*

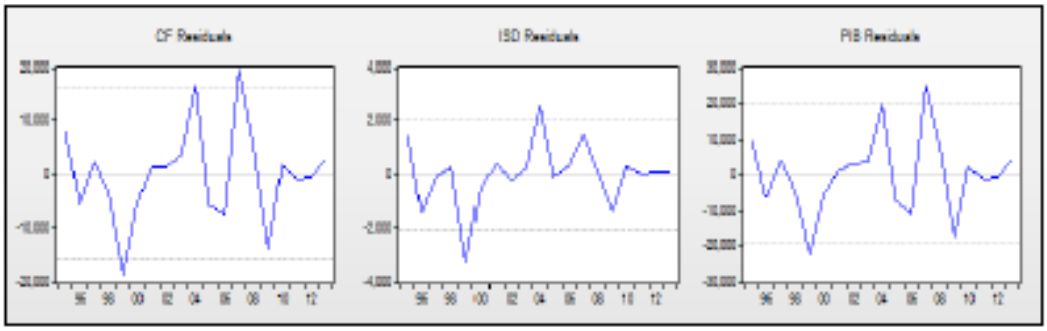


Table 1. *The correlation matrix of Final Consumption, Flow of DFI and GDP*

	CF	ISD	PIB
CF	1.000000	0.871240	0.997808
ISD	0.871240	1.000000	0.843203
PIB	0.997808	0.843203	1.000000

The estimated *VAR* model is evidencing four lags for each variable, so that, further to the processing of the model in Eviews, there will be 39 resulting coefficients, 13 coefficients for each of the three resulting models

The three VAR models can be represented by the following equations:

$$FC = C(1)*FC(-1) + C(2)*FC(-2) + C(3)*FC(-3) + C(4)*FC(-4) + C(5)*DFI(-1) + \\ + C(6)*DFI(-2) + C(7)*DFI(-3) + C(8)*DFI(-4) + C(9)*GDP(-1) + \\ + C(10)*GDP(-2) + C(11)*GDP(-3) + C(12)*GDP(-4) + C(13) \quad (1)$$

$$DFI = C(14)*FC(-1) + C(15)*FC(-2) + C(16)*FC(-3) + C(17)*FC(-4) + \\ + C(18)*DFI(-1)\ C(19)*DFI(-2) + C(20)*DFI(-3) + C(21)*DFI(-4) + \\ + C(22)*GDP(-1) + C(23)*GDP(-2)\ C(24)\ *GDP(-3) + C(25)\ *GDP(-4) + C(26) \quad (2)$$

$$GDP = C(27)*FC(-1) + C(28)*FC(-2) + C(29)*FC(-3) + C(30)*FC(-4) + \\ + C(31)*DFI(-1) + C(32)*DFI(-2) + C(33)*DFI(-3) + C(34)*DFI(-4) + \\ + C(35)*GDP(-1) + C(36)*GDP(-2) + C(37)\ *GDP(-3) + C(38)\ *GDP(-4) + C(39) \quad (3)$$

The outcomes obtained as a result of the implementation of the model VAR can be analysed by applying the model obtained through the processing of the Eviews 7.2 data basis. As it can be observed, the model is grasping three dependent variables, which compose the three models. Each dependent variable is influenced by 12 independent variables, representing the lag one, two, three and four of each dependent variable dependent within the model.

In order to get the results of the tests *t-statistics [] the coefficient of each* independent variable is divided by the standard *error ()*.

In the model achieved after processing the official data published for the statistical interval 1991 -2013, we have considered four lags and three endogenous variables, implying the estimation of 36 coefficients, each equation having 12 coefficients.

In order to finalize the VAR model tests have been made with the purpose of setting up the number of lags, taking into account the evolution of the indicators at the level of our country. In this respect, we used informatics criteria, tested with the help of the informatics soft Eviews 7.2. These are very useful when estimating a VAR model, for establishing a model, valid from the theoretic and practical point of view, as through the intermediary of these criteria that part of the endogenous variable, not represented by the model, can be quantified.

Thus, the outcomes obtained subsequent to the testing of the VAR model in Eviews 7.2 (Figure 2) is indicating the finalization of a model on four lags.

The tests performed in order to finalize the VAR model have been achieved by utilizing the official data published by *UNCTAD, hence the original data basis, without making the test* ADF *(Augmented Dickey Fuller Test)* and implicitly, the first difference. In this respect it has been assumed that the data series is stationary, following, as indicated by Harvey as well *„the traditional approach of the VAR enthusiasts consists of working in level even if some of the series are non-stationary. In this case, it is important to recognise the effect of the unitary squares on the estimators' distribution".*

Figure 2. *The testing of the number of lags for the VAR model of economic growth based on the data of the interval 1991-2013 in Romania*

VAR Lag Order Selection Criteria Endogenous variables: CFISD GDP Exogenous variables: C Date: 07/18/15 Time: 11:53 Sample: 1991 2013 Included observations: 19

Lag	LogL	LF:	FPE	AIC	SC	HO
0	-578.8570	NA	7.99e+22	61.24810	61.39723	61.27334
1	-533.9411	70.91989*	1.86e+21	57.46748	58.06397	57.56843
2	-521.1462	16.16195	1.36e+21	57.06802	58.11187	57.2—68
3	-503.3005	16.90647	6.85e+20*	56.13689	57.62811	56.38927
4	-489.8245	8.511113	7.52e+20	55.66574*	57.60433*	55.99383*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at ***5%*** level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

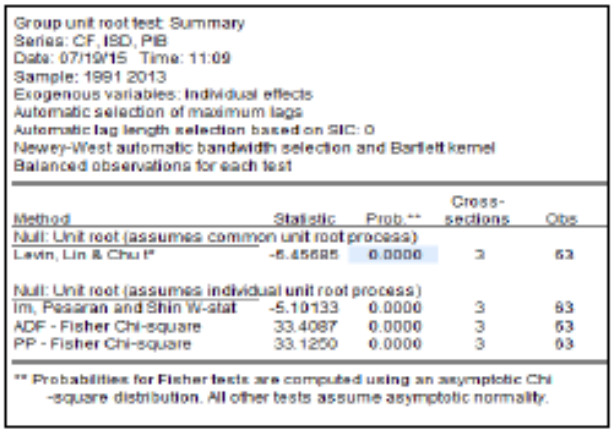
As deduced from the obtained outcomes, in the case of both the criterion Akaike or Hannan-Quinn, and the one evidenced by the tests Schwartz, the estimation of a VAR Model on four lags is indicated.

In order to interpret the models VAR it is necessary to identify whether the independent variables in the frame of the model are influencing or not the evolution of the dependent variable. In order perform this analysis it is required to test the coefficients of the independent variables of the model. To the purpose of a general testing of the coefficients, we shall achieve a system of coefficients meant to let us know the values of the probability tests. If the outcomes of this testing is indicating probability values lower than 5% for the coefficients of the VAR model, submitted below, we can allege that the independent variables have a significant impact on the evolution of the dependent variable. Contrary to the above argument, if the value of the probability of coefficient is exceeding a probability of 5%, this one would have no significant influence on the dependent variable of the analyzed model.

Taking into consideration the outcomes obtained from the achieved tests, in order to set up the coefficients which explains to the best the dependent variable, in each of the three models defined (equations (1), (2) and (3)), we notice out of the value of the probability test that these ones are not significant for explaining the dependent variable.

Further on, we shall test the stationery of the series composed by the three variables, respectively final consumption, flow of DFI and GDP, in order to verify whether the assumption initially assumed as regards the stationery is veridical.

Figure 3. *The testing of the stationery of the first difference of the data series regarding the evolution of the final consumption, flow of DFI and GDP at the level of Romania*



Group unit root test: Summary
Series: CF, ISD, PIB
Date: 07/19/15 Time: 11:09
Sample: 1991 2013
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.45685	0.0000	3	63
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.10133	0.0000	3	63
ADF - Fisher Chi-square	33.4087	0.0000	3	63
PP - Fisher Chi-square	33.1250	0.0000	3	63

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

3. Conclusions

Subsequent to the stationery tests applied to the data series, as a group, through the Eviews soft (Figure 3), we can conclude that the series is a non-stationary one. Thus, we shall keep on building up the VAR model by applying the stationery tests and afterwards achieving the estimation of the coefficients in order to establish the interdependences between them. The stationery of the group composed by the 3 series of data has been obtained through the application of the *ADF test*. In this respect we can conclude that the application of the first difference to the data series is generating their transformation into stationary series of data, allowing us to continue the verification of the correlation, between the analyzed variables, through the corelogramme and the auto-correlation tests.

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