Modelling foreign direct investment in Romania

Mihaela Simionescu
Institute for Economic Forecasting of the Romanian Academy
Bucharest Romania
mihaela_mb1@yahoo.com

Abstract— **The main aim of this research is to propose some econometric models to describe the evolution of the foreign domestic investment (FDI) in Romania. A moving average model of order 1 and a vector-autoregression of order 2 were used to explain the evolution of FDI during 1990-2013. According to variance decomposition from VAR model, the variance of logarithm of FDI is due exclusively to the changes in this variable. In the second period, 16.94% of the variation in logarithm of FDI is due to the modifications in the real GDP rate.**

Keywords—FDI; MA model; VAR model; variance decomposition

I. INTRODUCTION

In the past few decades the foreign direct investment has been increasing very fast. The principal outward investors have been the well developed nations, because of the major recipients of inflows and the FDI stock bulk in the entire world. There are various types of econometric models used to describe the evolution of FDI.

In this study, after a short literature review, few econometric models are proposed to describe the evolution of FDI in Romania during 1990-2013.

II. LITERATURE REVIEW

Săvoiu and Taicu(2014) proposed few econometric models to explain the evolution of FDI using country risk for countries like Romania, Poland, Russia, Hungary, Czech Republic and Slovak Republic. The econometric modeling is based on the information of the main rating agencies.

In Eastern and Central Europe there are 3 types of transnational capitalism: neo-corporatist capitalism based on performances and institutions met in Slovenia, embedded neoliberal capitalism that appeared in Visegrad countries and neoliberal capitalism specific to Baltic countries. In the integration process of the post-communist countries from Central and Eastern Europe and in world economic development the FDI has an important role. Buch et al. (2003) showed that FDI had an important effect on transition process from socialist economy to capitalism and to integration process through capital flows and trade. Jasko et al.(2010) emphasized the important role of FDI in modeling the economic growth and other macroeconomic variables from all the economies.

In the context of sustainable development the FDI flows volatility has a negative impact on this process, but the literature showed that FDI determines the economic growth. The differences between the econometric models proposed for various countries from Europe are explained by particular economic potential and the regime diversity, as Bohle and Greskovits(2007) emphasized. Carsternsen and Toubal (2004) showed that Romania lag far behind compared to other countries like Hungary, Slovak Republic, Poland and Czech Republic at the beginning of the transition process. In the context of European integration, the risk ratings signals and the economic choices were very important. The economic convergence in the European Union has accelerated the efforts for a new market economy.

Even if there was a huge theoretical work on aspects related to foreign direct investment,
an agreed model to provide the framework for empirical work was not proposed yet. In the conception of Dunning (1993) the FDI is determined by three types of elements: the advantages of internalization, spatial benefits in the host country and ownership benefits for companies to work oversees. The locational benefits of the

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region was deeply analyzed for transition economies.

There are three types of theories that refers to FDI: those related to trade, theories based on traditional approach (from the FDI theory to eclectic paradigm) and theories based on factorial diversity. For modelling the FDI four types of econometric processes have been developed:

- Models based on the economic conceptualization of foreign direct investment;
- Models based on correlation to other variables, especially the economic growth (Solow model, Keynes or Harrod-Domar model);
- Traditional and structural model;
- Electic, modern and restructured processes. These electic models are grouped in more categories:
  - ❖ models for which corruption is a FDI multiplier used by Egger and Winner(2006);
  - ❖ models with factorial variables;
  - ❖ knowledge-capital models used by Wells and Wint(2000);
  - ❖ models that correlates FDI to variables of export and trade as in Greenaway and Kneller(2007);
  - ❖ models that associate FDI to various types of risks like political risk as in Kim(2010) or macroeconomic risk as in Jinjarak(2007));
  - ❖ Models that quantify FDI symmetry and trade used by Neary(2008);
  - ❖ Models that correlate the FDI with institutional development (Bénassy-Quéré, Coupet and Mayer (2007));
  - ❖ Models that associate the FDI volume with the inequality of income repartition used by Lagendijk and Hendrikx (2009);
  - ❖ Models based on taxes used by Weichenrieder, Alfons , and Mintz (2008);
  - ❖ Models that link FDI to exchange rate and inflation rate (Blonigen(1997));
  - ❖ Models that associate FDI to unemployment rate as in Billington (1999);
  - ❖ Models that take into account diplomatic links, resources, strategies (Williamson (2001);
  - ❖ Models based on different market variables (Billington (1999));
  - ❖ Models based on number of population, labour market aspects as in Federici and Giannetti(2010).

III. MODELLING FDI IN ROMANIA

The data series is represented by the foreign domestic investment inward stock as percentage of gross domestic product in Romania during 1990-2013. The data are provided by UNCTAD. Moreover, for econometric purposes we also used the data for real GDP growth in Romania provided by Eurostat for the same period.

The stationary character of the data was checked using Augmented Dickey-Fuller (ADF) test.

An autoregressive model was not valid. So, the evolution of FDI is not explained by the value in the previous period.

A vector-auto regression of order 2 was estimated for real GDP rate and logarithm of FDI.

$$LOG\_FDI = 0.3750449735*LOG\_FDI(-1) + 0.3954091156*LOG\_FDI(-2) - 0.02571779858*RGDP(-1) + 0.01982530345*RGDP(-2) + 0.9234221593$$

$$RGDP = 3.712339411*LOG\_FDI(-1) - 2.954362241*LOG\_FDI(-2) + 0.552855804*RGDP(-1) - 0.1639729167*RGDP(-2) - 0.9412386422$$

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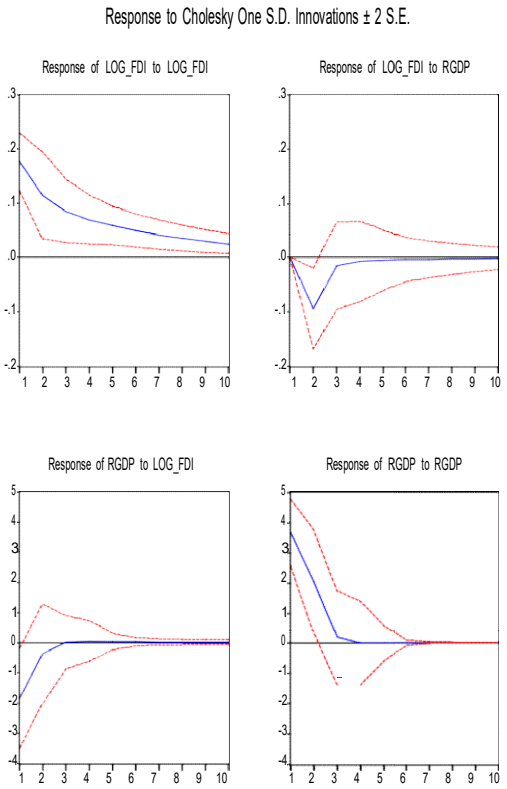

Figure 1: Impulse-response function of the VAR(2) model

In the first period, according to variance decomposition, the variance of logarithm of FDI is due exclusively to the changes in this variable. In the second period, 16.94% of the variation in logarithm of GDI is due to the modifications in the real GDP rate. This influence decreases in time, being around 12% starting with the 7th lag as in Table 1 is shown.

Table 1: The variance decomposition of logarithm of FDI

Period	S.E.	LOG_FDI	RGDP
1	0.175572	100.0000	0.000000
2	0.229315	83.05712	16.94288
3	0.244947	84.78448	15.21552
4	0.254654	85.84655	14.15345
5	0.261327	86.52718	13.47282
6	0.265990	86.96832	13.03168
7	0.269260	87.26339	12.73661
8	0.271561	87.46451	12.53549
9	0.273184	87.60340	12.39660
10	0.274332	87.70014	12.29986

Source: author's computations

According to the results of ADF test, the data in first difference is stationary. The ARMA model will be constructed using this stationary data. A moving average model of order 1 was estimated using least squares method.

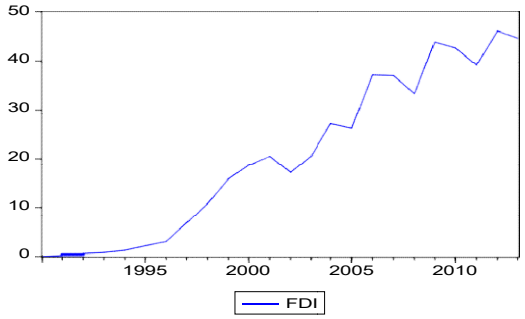

Figure 2: The evolution of FDI inflow in Romania (1990-2013)

During 1990-2013 the FDI have increased in average by 2,027 times. In 2009 the FDI has increased with 31.8% compared to the value in 2008, but the in the context of economic crisis in 2010 the variable decreased with almost 2.3%.

Table 2: The movering average model of order 1 for FDI in Romania (1990-2013)

Dependent Variable: D_FDI				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.358028	0.109452	21.54389	0.0000
MA(1)	-0.953868	0.028360	-33.63429	0.0000
R-squared	0.334959	Mean dependent var		1.939316
Adjusted R-squared	0.303290	S.D. dependent var		4.054953
S.E. of regression	3.384634	Akaike info criterion		5.359310
Sum squared resid	240.5707	Schwarz criterion		5.458049
Log likelihood	-59.63207	F-statistic		10.57700
Durbin-Watson stat	1.573453	Prob(F-statistic)		0.003812
Inverted MA Roots	.95			

Source: authors' computations

After the study of the residuals' correlogram we can conclude that the errors are independent up to lag 12. Indeed, the probabilities associated to Q-stat are higher than 0.05 for all the lags.

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Table 3: The residuals' correlogram for MA(1) model

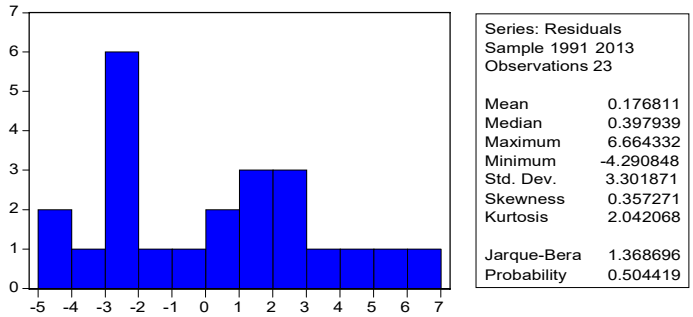
Q-statistic probabilities adjusted for 1 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |* . |	. |* . |	1	0.146	0.146	0.5564	
. | . |	. *| . |	2	-0.040	-0.063	0.6009	0.438
. |* . |	. |* . |	3	0.076	0.094	0.7681	0.681
****| . |	****| . |	4	-0.510	-0.558	8.6287	0.035
. *| . |	. | . |	5	-0.179	0.042	9.1525	0.047
. |* . |	. | . |	6	0.073	0.010	9.8320	0.080
. *| . |	. | . |	7	-0.085	0.022	10.090	0.121
. |* . |	. *| . |	8	0.190	-0.062	11.744	0.131
. |* . |	. | . |	9	0.104	-0.055	11.922	0.155
. *| . |	. | . |	10	-0.097	-0.038	12.336	0.195
.**| . |	***| . |	11	-0.207	-0.362	14.379	0.156
.**| . |	. *| . |	12	-0.211	-0.080	16.714	0.117

Source: authors' computations

According to the histogram of the errors and to the Jarque-Bera test, we do not have enough evidence to reject the assumption of normal distribution for the errors.

Figure 1: The errors' histogram



So, the validity of the MA(1) model was checked. This process will be used to construct static and dynamic forecasts. The evolution of FDI in Romania is explained by the evolution of the errors in the previous period.

IV. CONCLUSIONS

In this study the foreign direct investment in Romania is modeled using several econometric models. During 1990-2013 the FDI have increased in average by 2,027 times. In 2009 the FDI has increased with 31.8% compared to the value in 2008, but the in the context of economic crisis in 2010 the variable decreased with almost 2.3%.

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