INVESTIGATING FDI INFLOWS IN ROMANIA THROUGH AN ARMA MODEL

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Abstract
In this paper, we study the relationship between GDP and FDI in Romania and we also assess the importance of GDP level for further attracting FDI. Using an ARMA model, we find that FDI in Romania is not explained by the value in the previous period, but is due to the evolution of the errors in the previous period. In the range 1990-2013 we obtain a valid relationship between FDI and real GDP growth. According to the variance decomposition of FDI, we can conclude that 1.06% of the variation of FDI is explained by the changes in real GDP rate in the first period. Then, the influence of GDP rate decreases in time, the variance of FDI explained by GDP rate having a value close to zero in the 10th lag.

Keywords: foreign direct investments, gross domestic product, Romania, ARMA model

JEL Classification: F23, O1, C5

Introduction
Foreign direct investments (FDI) are attractive for the host economy due to their association not only with capital inflows, but also with technology, know-how flows and managerial capacities, which generates positive impact on economic growth. Also, FDI are one of the sources for financing an economy, besides public investments and European funds. Therefore, attracting FDI should be one of the main concerns of public

decision makers. Bonciu (2009) emphasize eight economic aspects that influence the decision to invest abroad: the existence of natural resources, the geographical position of the country, the cost of labour relative to the skill level, the existence of suppliers, the corporate tax level, the infrastructure development, the institutional and legislative framework and the environmental issues. Except for the first two factors, each of the following ones relate to matters that can be regulated by public policy.

At the same time, for former transition countries, where Romania is included, Kinoshita and Campos (2003) make the difference between *traditional factors* for attracting FDI, such as the host country market size, low production costs and abundance of natural resources, *new factors*, such as the institutions' quality and *transition-specific factors*, such as the initial conditions that characterizes the countries.

For the former transition countries, the literature suggests that most TNCs entering the region aim to identify new market opportunities, quantified by the absolute level of GDP and market growth (Lankes and Venables, 1996). Lopez (2010) identifies that the market size is a significant variable for FDI both in the first period of the transition (1990-1998) and in the last one (1998-2003).

We assessed in previous studies the significant determinants for attracting FDI that can be directly influenced by public decision makers (Paul, Popovici, Calin 2014; Popovici and Calin 2012 a, 2012b, 2013a, 2013 b, 2014 a, 2014b).

In this paper, we are interested in finding if GDP can be considered a determinant for FDI in Romania. Furthermore, we will model FDI in Romania in order to assess future FDI inflows and we also check to what extend GDP can be considered a determinant of FDI. The rest of the paper is divided as follows. In the first and the second part, we will analyse the literature for assessing both the impact of FDI on economic growth and that of GDP on FDI. In the second part, we will use an ARMA model for assessing the relationship between GDP and FDI and for forecasting FDI.

1. The impact of FDI on economic growth

A wider definition of FDI gives the main insights of the positive impact of foreign direct inflows on GDP. The foreign investment is seen as the transfer of an industrial package including capital, technologies, methods of industrial organization, managerial expertise, marketing knowledge, etc., that allows the investor to control the investment (Negritoiu, 1996). The same is expressed in Dunning and Lundan (2008), who assume that the foreign investment represent a transfer of both capital and intangible assets such as organizational practices, managerial skills, technological progress, which stimulate and generate economic growth.

Therefore, FDI positively impacts economic growth due to its contribution to capital formation, the technology transfer and the new technologies, as confirmed by Borensztein et al. (1995), Blomstrom et al. (1996), Borensztein and Kokko (1998) and Dunning (1993). Technology transfer is a main instrument for positive externalities for the economy of the host country. Multinational companies are responsible for important research-development activities, producing superior technologies that generate technological spillovers (Liu, 2002; Kohpaiboon, 2006).

There are also several other modalities that made from FDI an important tool for stimulating economic development. The literature point also to the increase of the knowledge of human resources, following the acquisition of new skills and training (de Mello, 1996, 1999) provided by multinational companies in the host country. Also, there are substantial changes in the management and corporate governance. In general, multinational companies impose their policies, internal reporting systems and organizational principles, usually of higher quality than those in the host country. In this way, corporate efficiency will be increased.

Studies that concern Romania generally also point to a strong impact of FDI on economic. Ulian et al. (2014) find a strong and direct impact of FDI on the economic growth rate in Romania and the Republic of Moldova during 2006-2012 by using a simple linear regression. Nistor (2012) analyzes Romanian regions and shows that there is a direct correlation between FDI stocks distribution and GDP per capita, namely the lowest FDI stock in North East region is also characterized by a low GDP per capita. Although using different methods, Roman and Padureanu (2011) also find a positive impact of FDI on Romanian economic growth. In this respect, the authors use a neoclassical model with Cobb-Douglas production functions. Pelinescu and Radulescu (2009) rather find a weak direct influence of FDI on economic growth during the first quarter of 2000 until the first quarter of 2009. Still, the authors signal that there are indirect effects of FDI on GDP, such as the increase in the labour productivity and its impact on economic growth.

Still, studies show that the impact of FDI on economic growth can be narrowed to the conditions in the host countries.

Ozturk (2007) signals that there are several barriers that can interfere in the direct relation between FDI and GDP. One of these barriers is the level of economic development. Practically, countries must have a certain level of development of the banking and financial system, of the physical infrastructure, in order to attract FDI with a positive influence on GDP. This is why is difficult to establish a straightforward result as regards the impact of FDI on economic growth for developing countries. The same is available for de Mello (1996) and OECD (2002).

2. GDP as a determinant for FDI

GDP can be considered a traditional determinant of FDI, among low production costs and natural resources abundance (Johnson, 2006, p.17). FDI in transition countries is largely due to the dimension of the market or to its potential growth (Lankes and Venables, 1996; Lopez, 2010).

Still, the economic growth also encompasses the growth in terms of competitiveness, due to its method of calculation, based on added value.

In this respect, economic growth, economic potential and market dimension – all of them being expressed in relation to GDP – can be seen as determinants for market-seeking FDI, but also for efficiency-seeking FDI.

The GDP level is mainly expressing the dimension of the destination market. When looking at the GDP level, investors are assessing the country's potential for selling their products or for realising scale economies. For Kinoshita and Campos (2006), the impact of the GDP on FDI is inconclusive, as the authors cannot clearly distinguish between the motivations of FDI inflows realised in the 90s.

The GDP/capita is expressing not only the purchasing power of the local consumers and the dimension of the market (Mehic, 2009, p.157), but can be also assigned as expressing the labour force productivity (Benassy-Quere et al., 2007), the quality of the market demand (Mateev and Tsekov, 2012; Johnson, 2006) and so on, which assigns it an ambiguous character in relation to FDI. In this respect, GDP/capita can be seen as an indicator for efficiency-seeking FDI. Based on robustness tests, Chakrabarti (2001) finds that host market size, expressed as GDP/capita, is the most important determinant for FDI, followed by economic openness.

The GDP growth rate is a measure for the market potential. The status of transition for the countries in the Central and East Europe made from this variable one of the main indicators for foreign investors, as shown in Garibaldi et al. (2001), Tondel (2001), Addison and Heshmati (2003), Busse and Hefeker (2007), Dang (2009), Bockem and Tuschke (2010).

There is a scarce empirical evidence of economic growth impact on FDI in Romania; analyses take into account Romania when studying the attractiveness of transition countries for FDI. GDP is found as a significant factor for attracting FDI in Bevan and Estrin (2000), Garibaldi et al. (2002), Globerman and Shapiro (2002), Bevan et al. (2004), Bellak et al. (2007), Bénassy-Quéré et al. (2007), Hansson and Olofsdotter (2010).

As regards studies focused on Romania, Ludosean (2012) uses VAR model estimations and finds that FDI is not a cause for stimulating growth. Still, an important result points that economic growth is an important factor for attracting FDI in Romania. The same result as regards the relationship between GDP and FDI is mentioned in Carp and Popa (2013). Using a VAR

model with data over the period 1990 – 2011, the authors find that GDP is a significant variable for the FDI inflows in Romania and Bulgaria.

3. 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.

Table 1: ADF test for FDI data in Romania (1990-2013)

Type of data	Include in the equation	Computed statistic	Critical values (5% level of significance)	Conclusion
Data in level	Intercept	-0.039087	-3.0038	Non-Stationary data series
	Trend and intercept	-3.128839	-3.6330	Non-Stationary data series
	none	1.949035	-1.9574	Non-Stationary data series
Data in first difference	Intercept	-5.316282	-3.0114	Stationary data series
	Trend and intercept	-5.195802	-3.6454	Stationary data series
	none	-3.071851	-1.9583	Stationary data series

Source: authors' 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 1: The evolution of FDI inflows in Romania (1990-2013)
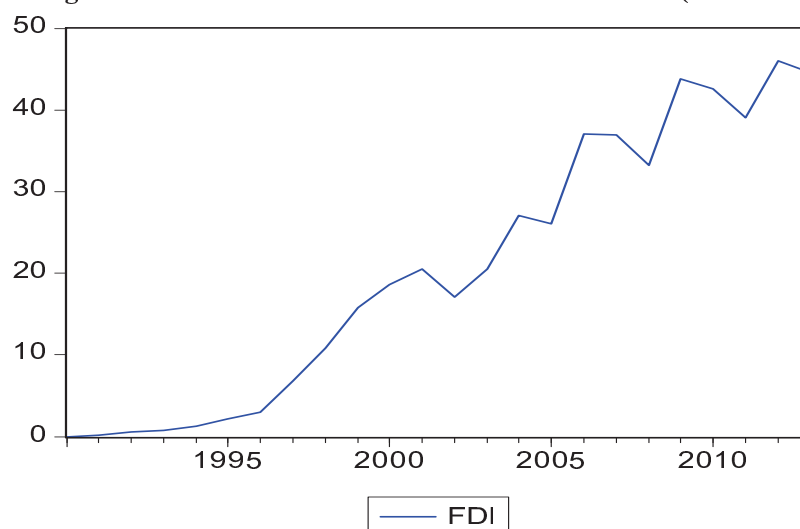
During 1990-2013, FDI have increased in average by 2,027 times. In 2009 FDI has increased with 31.8% compared to the value in 2008, but the in the context of economic crisis in 2010 the variable decreased with almost 2.3%.

Table 2: The moving 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.

**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	9.6525	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	11.480	0.119
. |* . |	. | . |	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 2: The errors' histogram
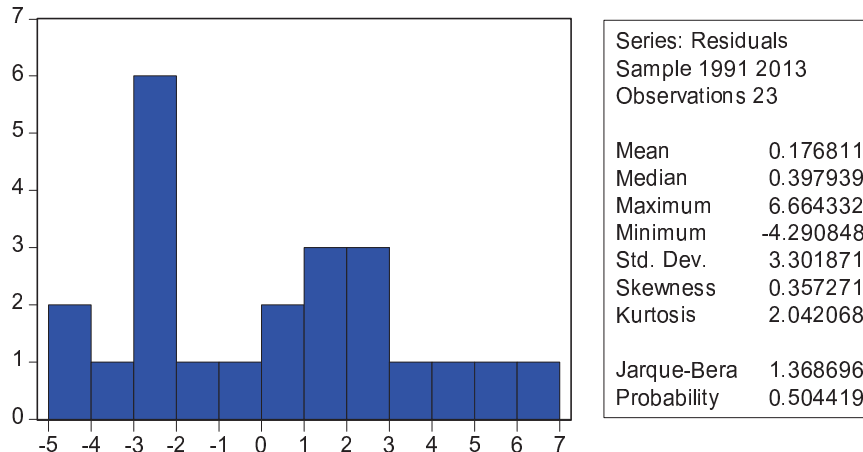
So, the validity of the MA (1) model was checked. This process will be used to construct static and dynamic forecasts. The evolution of FDI in Romania is explained by the evolution of the errors in the previous period. The static predictions suppose that we take into account only the registered values of FDI in constructing the forecasts.

Figure 2: Dynamic forecasts of FDI in Romania
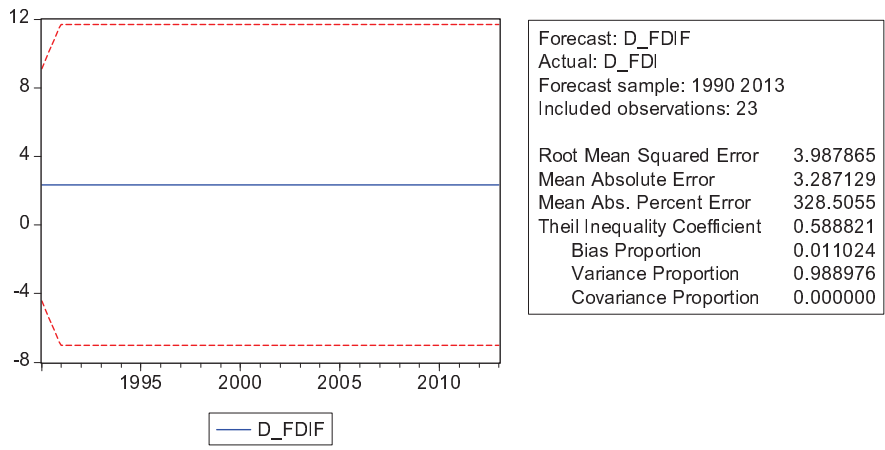
For dynamic forecasts of FDI a null covariance proportion was registered, the Theil's coefficient suggesting a low degree of accuracy. The dynamic predictions do not have oscillations, suggesting an improbable evolution for this indicator.

Figure 3: Static forecasts of FDI in Romania
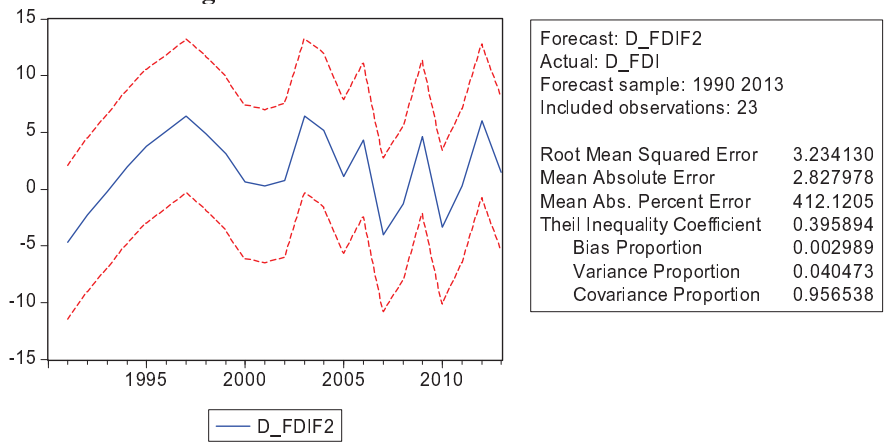
The static forecasts have a higher degree of accuracy (the Theil inequality coefficient is lower than in the case of dynamic forecasts). The biasness is small, but the covariance proportion is close to 1. For static forecasts we have consistent oscillations compared to the simplistic and constant evolution of dynamic predictions.

The real GDP rate data series is stationary, according to the results of ADF test. A vector-autoregressive model was estimated for real GDP growth and FDI.

Table 4: ADF test for real GDP growth data in Romania (1990-2013)

Type of data	Include in the equation	Computed statistic	Critical values (5% level of significance)	Conclusion
Data in level	Intercept	-3.965990	-3.0038	Stationary ata series
	Trend and intercept	-3.542685	-3.2535	Stationary data series
	none	-3.469095	-1.9574	Stationary data series

Source: authors' computations

A VAR model of order 1 was estimated and the results of estimations are displayed in Appendix 1. The errors are independent and homoskedastic, following a normal distribution.

Table 5: Variance decomposition of D_FDI

Period	Response of D_FDI to GDP rate	Response of D_FDI to D_FDI
1	1.061218	3.864367
	(0.83928)	(0.58258)
2	0.692825	-1.411985
	(0.67751)	(0.85664)
3	0.133532	0.575955
	(0.27115)	(0.63489)
4	0.112920	-0.205598
	(0.17018)	(0.36411)
5	0.014724	0.086233
	(0.07514)	(0.18609)
6	0.018973	-0.029746
	(0.03881)	(0.08925)
7	0.001097	0.012995
	(0.01707)	(0.04115)
8	0.003299	-0.004262
	(0.00818)	(0.01843)
9	7.06E-05	0.001976
	(0.00361)	(0.00810)
10	0.000595	-0.000601
	(0.00168)	(0.00350)

Source: authors' computations

There is a valid relationship between FDI and real GDP growth. According to variance decomposition of FDI, we can conclude that 1.06% of the variation of D_FDI is explained by the changes in real GDP rate in the first period. Then, the influence of GDP rate decreases in time, the variance of FDI explained by GDP rate having a value close to zero in the 10th lag.

4. Conclusions

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%.

FDI in Romania is not explained by the value in the previous period. The FDI in Romania is due to the evolution of the errors in the previous period. For static forecasts we have consistent oscillations compared to the simplistic and constant evolution of dynamic predictions during 1990-2013. The static predictions suppose that we take into account only the registered values of FDI in constructing the forecasts.

There is a valid relationship between FDI and real GDP growth. According to variance decomposition of FDI, we can conclude that 1.06% of the variation of D_FDI is explained by the changes in real GDP rate in the first period. Then, the influence of GDP rate decreases in time, the variance of FDI explained by GDP rate having a value close to zero in the 10th lag.

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Appendices
Appendix 1
The estimation of the VAR (1) model for differentiated FDI and real GDP rate
Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-126.2965	NA	398.4932	11.66332	11.76250	11.68668
1	-119.2593	12.15521*	303.3456*	11.38721*	11.68476*	11.45730*

Appendix 2
Vector Autoregression Estimates
Standard errors in ( ) & t-statistics in [ ]

	RGDP	D_FDI
RGDP(-1)	0.446137	0.076918
	(0.14162)	(0.14309)
	[3.15030]	[0.53755]
D_FDI(-1)	0.201979	-0.365386
	(0.21251)	(0.21472)
	[0.95043]	[-1.70166]
C	1.258137	2.676696
	(0.98217)	(0.99239)
	[1.28097]	[2.69723]
R-squared	0.355671	0.148554
Adj. R-squared	0.287847	0.058928
Sum sq. resids	298.8822	305.1308
S.E. equation	3.966187	4.007433
F-statistic	5.244025	1.657494
Log likelihood	-59.91572	-60.14333
Akaike AIC	5.719611	5.740302
Schwarz SC	5.868390	5.889081
Mean dependent	2.313636	2.020929
S.D. dependent	4.699878	4.130997
Determinant Residual Covariance		234.9109
Log Likelihood (d.f. adjusted)		-122.4846
Akaike Information Criteria		11.68041
Schwarz Criteria		11.97797

Appendix 3
Roots of Characteristic Polynomial
Endogenous variables: RGDP D_FDI
Exogenous variables: C
Lag specification: 1 1

Root	Modulus
0.464849	0.464849
-0.384098	0.384098

No root lies outside the unit circle.
VAR satisfies the stability condition.

Appendix 4
VAR Residual Portmanteau Tests for Autocorrelations
H0: no residual autocorrelations up to lag h

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	1.707974	NA*	1.789307	NA*	NA*
2	3.714947	0.4460	3.996976	0.4064	4
3	8.331757	0.4018	9.342757	0.3142	8
4	14.04348	0.2979	16.32375	0.1769	12
5	14.82670	0.5374	17.33733	0.3641	16
6	19.11616	0.5143	23.23534	0.2774	20
7	26.00937	0.3527	33.34538	0.0970	24
8	26.29892	0.5566	33.80038	0.2075	28
9	27.84060	0.6772	36.40939	0.2708	32
10	29.01671	0.7891	38.56559	0.3543	36
11	32.10664	0.8085	44.74545	0.2793	40
12	33.45243	0.8763	47.70618	0.3245	44

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Joint test:

Chi-sq	df	Prob.
9.504413	12	0.6593

Appendix 5
VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal

Component	Jarque-Bera	df	Prob.
1	2.908215	2	0.2336
2	0.624499	2	0.7318
Joint	3.532714	4	0.4729