Theoretical and Applied Economics
Volume XIX (2012), No. 10(575), pp. 115-130

A VAR analysis of the connection between FDI and economic growth in Romania

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Abstract. *The impact of FDI on economic growth is neither homogeneous, nor completely clarified. Due to the accumulation of capital in the host economy, FDI is expected to encourage the incorporation of new inputs and technologies in the process of production. However, the impact of FDIon economic growth is not so shaped up in empirical studies. Accordingly, while some studies remarked a positive impact of FDI on economic growth, others showed a negative relationship between the two variables. In this article, we carried out an analysis of vector autoregressive type (VAR), so as to identify the relationship between FDI and economic growth in Romania between1991-2009. The main conclusion of our study is that the FDI volume does not initiate growth; and that economic growth is an important factor in terms of attracting FDI in Romania.*

Keywords: foreign direct investments; economic growth; VAR model; impulse functions.

JEL Codes: F41, O49.
REL Codes: 8E, 10F.

1. Literature

One can notice, in the up-to-date literature, that special attention is paid to the FDI impact on economic growth in host countries. Theoretically, within the neo-classical model, FDI encourages economic growth by increasing investment and/or their efficiency. Endogenous model of growth shows that FDI fosters growth by diffusion of technologies from developed economies to host countries (Borensztein et al., 1998). As summarized in studies authored by Balasubramanyam et al. (1996) and De Mello (1999), FDI is a mixture of capital stocks, know-how and technology, that can enhance existing knowledge stock in the host economy through sustainable training of workers, skill acquisition and dissemination, and by introducing alternative management practices and organizational structural management (Xiaoying, Xiaming, 2005).

From an empirical point of view, Blomstrom et al. (1996) identified the positive effects of FDI on economic growth, using FDI input flows in an emerging country, as a measure of its interaction with other countries. The study carried out by Balasubramanyam et al. (1996) led to significant results that support the hypothesis that FDI is more important for economic growth in countries promoting exports, than in those that encourage imports. This implies that the impact of FDI varies, depending on the peculiarities of the country; trade policy can influence the role of FDI on economic growth. UNCTAD (1999) found that FDI can have either a positive or a negative effect, depending on the variables included in the testing equation. These variables include the initial GDP per capita, level of education, level of domestic investment, political instability, trade issues, the size of the "black" market and the financial development stage.

Borensztein et al. (1998) suggest that differences in the absorption capacity of technologies may explain the variations of the FDI effects on the economic growth among countries. In the model we suggest**,** the training of human capital determines the ability of adopting foreign technologies**.** Therefore, one may assume that a higher level of human capital skills may induce higher rates of growth at a given level of FDI (this assumption is supported by their empirical results**).** The same authors point out that the country might need a minimum level of human capital stock in order to obtain positive FDI results.

Similarly, Olofsdotter(1998) is considering the absorptive capacity of FDI recipient countries, and then comes to the conclusion that the FDI positive effects are stronger when there is a superior level of institutional capacity, and the importance of bureaucratic efficiency is higher. Bengo and Sanchez-Robles (2003) prove that FDI is positively correlated with the economic growth, but

host countries require human capital, economic stability and liberalized markets so as to benefit of FDI effects flows in the long-run. Using the data resulting from a survey carried out on 80 countries, in the period1979-1998, Durham (2004) did not identify a positive relationship between the economic growth and FDI, and suggests that the FDI effects are correlated with the absorption capacity of the host countries.

Developed countries tend to have a higher level of skilled workforce than the emerging countries; therefore one may assume that the latter will have a higher FDI flow. This assumption is confirmed by Xu (2000), who studied the USA multinationals as a channel of diffusion for international technology in 40 countries during 1966-1994. The main result is that technology transfer from USA multinationals contributed to productivity growth in the developed countries but not in the developing countries. However, there is empirical evidence according to which the FDI positive effects are not necessarily correlated with the absorptive capacity. For example, Bende-Nabende et al. (2003) revealed that direct FDI impact in the long-run on the economic growth is noteworthy; it is also positive for countries such as the Philippines and Thailand (less advanced economically), and negative in the more economically advanced countries such as Japan and Taiwan. The previous findings are consistent with the Sjoholm study (1999), at microeconomic level; according to him, the greater the distance between domestic and foreign firms, the larger the gains in productivity.

The above debate demonstrates that the FDI impact on economic growth is far from conclusive. The FDI role may be influenced by that particular country's peculiarities; it can be positive, negative, or even irrelevant, depending on economic, institutional, or technological conditions of the host country.

When analyzing the correlation between the two variables, an important issue is the probable endogeneity between them. In this respect, two approaches are implemented. The former refers to the bilateral causality testing. Using data from ten countries of East Asia, Kholdy (1995) administered Granger causality tests, but found no causality between FDI and productivity. As explained, FDI can cause "leakage" of limited effectiveness, as a vehicle for technology transfer less important than previously assumed. Zhang (1999) also studied the causality (for ten Asian economies) and concludes that FDI enhances long-term economic growth in mainland China, Hong Kong, Indonesia, Japan and Taiwan, and in the short-run intensifies it in the case of Singapore.

Chakraborty and Basu (2002) make use of the co-integration and error correction technique to examine the relation between FDI and the economic growth in India. The results obtained suggest that, in India, the GDP is not

Granger caused by FDI; its causality being rather the other way round (from GDP to FDI). Nair-Reichert and Weinhold (2001) start from mixed estimations (fixed and random) to explore the connection between FDI and economic growth in emerging countries, and then identified a causal relationship between the two variables. Using data from 80 countries between 1971-1995, Choe (2003) revealed a two-way causality between FDI and economic growth; its effects are more obvious from economic growth towards FDI.

From the above studies, one can notice that the results concerning causality are heterogenous. It proves again that the relationship between FDI and economic growth is far from being clarified. It varies depending on the country in question and the determined period of time.

The second approach regarding endogeneity between the two variables is the estimation of a system of equations, in which FDI equation includes variables such as: economic growth, human capital, exchange rate and the infrastructure. Recent examples include the studies of Bende-Nabende and Ford (1998), and Bend-Nabende et al. (2002, 2003) wich explain a system of equations where both FDI and economic growth are treated as endogenous variables.

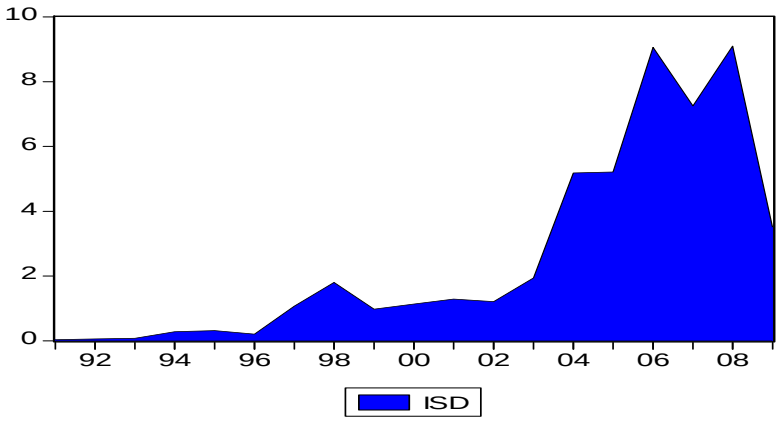
Xiaoying and Xiaming (2005) studied the FDI impact on economic growth both in developed countries (21) and in some emerging countries (63), using cross-sectional data for the period 1970-1999. The results reveal that there is no endogeneity between the two variables over the whole period, except for the period 1985-1999. The study illustrates that there is a high complementary connection between FDI and economic growth for all countries under study. Moreover, FDI not only enhances the economic growth by themselves, but also indirectly, through positive interaction effects with human capital; and also through high negative effects regarding the FDI interaction with technological gaps in emerging countries. Empirical data support new theories on FDI and economic growth, confirming that FDI flows are attracted by countries with large markets. Moreover, human capital and the absorptive capacity are very important so as FDI to have positive consequences on economic growth. Political implications of the study are obvious: since the studied variables tend to become endogenous, promoting human capital, technological skills and economic development will attract new FDI flows. This factor will further stimulate economic growth and competitiveness.

2. Description of the analyzed variables

Romania's potential in terms of *foreign direct investments*, during the period 1991-2003, was a relatively low one, and it can be explained by the absence of a functional market economy, corroborated with the inability of

politicians to create a stable business environment, and also the lack of business opportunities due to the delay in privatization. This country has become a country with a functioning market economy, a status awarded by the European Union in October 2004, and this was a positive signal for foreign investors, who appreciated that Romania can have economic stability, which may lead to the establishment of a favorable investment environment.

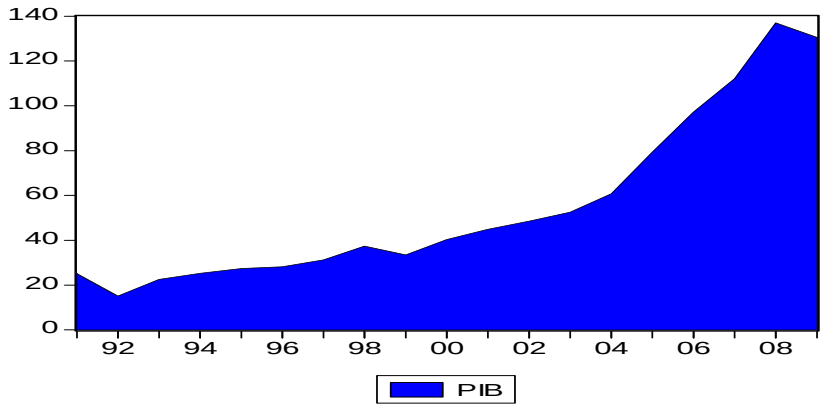
Under the circumstances, considering the statistical data analyzed, one can notice that by the end of 2004 the inflow of foreign investment in Romania has tripled in comparison with 2003, and was nearly six times higher than the average of previous years taken into observation.



Source: data processed by means of Eviews 5.0.

Figure 1. *FDI evolution in Romania, during 1991-2009*

The most eloquent indicator for estimating *the economic growth* is GDP. From the graphic representation below, one can notice the rising trend of the Romanian GDP throughout the analyzed period, with three points of inflection represented by the years 1992, 1999 and 2009. The most dramatic growth of this macroeconomic indicator was recorded between 2004 and 2008, an interval during which the FDI level has increased considerably, and one year later, in 2009, due to the financial and economic crisis, the level of both variables studied decreased significantly.



Source: data processed by means of Eviews 5.0.

Figure 2.*The GDP development in Romania during1991-2009*

In Table 1 we have included the main statistic parameters which characterize the two variables:

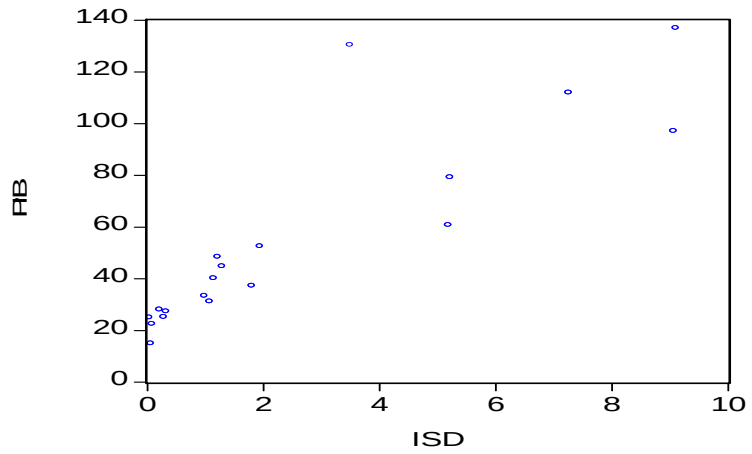
Table1

Statistic characteristics of GDP and FDI in Romania, 1991-2009

Statistic indicator	FDI	GDP
Average	2.616053	55.21579
Median	1.210000	40.30000
Maximum	9.100000	137.0000
Minimum	0.035000	15.10000
Dev.Std.	3.049177	37.77597
Skewness	1.144427	1.076860
Kurtosis	2.908080	2.821105
Jarque-Bera	4.154114	3.697489
Probability	0.125298	0.157435
Amount	49.70500	1049.100
Amount dev. std	167.3547	25686.43

Source: data processed by means of Eviews 5.0.

Statistical connection between the economic growth and FDI in Romania during the period 1991-2009, can be easily inferred from Figure 3, however it will be empirically tested in the last part of the case study.



Source: data processed by means of Eviews 5.0.

Figure 3. *"Simple scatter graph" related FDI (FDI)and GDP (GDP)*

3. Method of research and results

In order to confirm whether there is a relationship between foreign direct investment (FDI) and economic growth (GDP), we considered the following assumptions**:**

H1: FDI = f(GDP) (1)
H2: GDP = f(FDI) (2)

The demonstration will be performed by using a VAR model, which can be written as the following equation:

$$ISD_t = \alpha_1 + \sum_{j=1}^{k} \beta_j \times ISD_{t-j} + \sum_{j=1}^{k} \chi_j \times PIB_{t-j} + \varepsilon_{1t} \quad (3)$$

$$PIB_t = \alpha_2 + \sum_{j=1}^{k} \phi_j \times PIB_{t-j} + \sum_{j=1}^{k} \varphi_j \times ISD_{t-j} + \varepsilon_{2t} \quad (4)$$

where α_1, α_2 are the free terms coefficients; β, χ, ϕ, φ are endogenous variables coefficients and ε are residual errors.

The main steps of the econometric analysis are:
a) administering of stationary tests;
b) checking Granger causality between the variables considered;

c) VAR model selection and the appropriate lag;
d) checking the stability of the model;
e) identification of impulse functions.

a) Conditions to be fulfilled, so that a time series be stationary, are:

- Average time series to be stable, or in other words, remarks must fluctuate around the average.
- The series variance to be stable.

From an economic perspective, a series is stationary if shock applied on it is temporary (absorbed in time) and not constantly. If a series is not stationary, by differentiating one obtains a stationary series. The integration order of the series is the number of successive differentiations required to achieve a stationary series.

For the variables studied, we have first tested the level stationary of the series using ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests, and it showed that the time series are not stationary, or in other words, show a unit root (Tables 2 and 3). Therefore, we have proceeded to the differentiation of order1of the series, and the results indicate that these integrated series are stationary of 1 order (do not show a unit root or I (1)), as shown in Tables 4 and 5.

Table 2

Testing the level stationary of FDI series

Null Hypothesis: FDI has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-1.491770	0.5147
Test critical values:	1% level	-3.857386	
	5% level	-3.040391	
	10% level	-2.660551	

Source: data processed by means of Eviews 5.0.

Table 3

Testing the FDI stationary level of GDP series

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		1.554044	0.9987
Test critical values:	1% level	-3.857386	
	5% level	-3.040391	
	10% level	-2.660551	

Source: data processed by means of Eviews 5.0.

Table 4

Testing the FDI differentiated stationary the order 1 level

Null Hypothesis: D(FDI) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.102715	0.0009
Test critical values:	1% level	-3.886751	
	5% level	-3.052169	
	10% level	-2.666593	

Source: data processed by means of Eviews 5.0

Table 5

Testing the GDP differentiate order 1 stationary series

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.361421	0.0279
Test critical values:	1% level	-3.886751	
	5% level	-3.052169	
	10% level	-2.666593	

Source: data processed by means of Eviews 5.0.

b) The Pairwise Granger causality test checks on the proportion in which the current level of GDP is due to its previous levels**,** proving at the same time that if, by adding the previous values of the other variables (FDI), the explanation could be improved.

The Pairwise Granger causality test, shown in Table 6, suggests (for a lag equal to 4) that we can accept the null hypothesis in the first case**,** which means that *GDP does not cause FDI volume Grangerin Romania*. The null hypothesis is rejected in the later case (for a confidence level of 5% and 10%, respectively), which means that *FDI volume causes GDP level Granger***.**

Table 6

Pairwise Granger causality test

Sample: 1991 2009
Lags: 4

Null Hypothesis:	Rmk.	F-Statistic	Probabilities
GDP does not cause Granger FDI	15	0.75907	0.58783
FDI does not cause Granger GDP		4.57925	0.04897

Source: data processed by means of Eviews 5.0.

c) Next, we shall explain *the selection criterion of the lag and the VAR model construction*. Regarding the construction of the model, *we used the series on level*, even if the VAR methodology suggests that all variables should be stationary. The argument is as follows: "The traditional approach of VAR enthusiasts is to work on level, even if some of the series are non-stationary. In this case, it is important to recognize the effect of the unit root over the estimator distribution." (Harvey, 1990, p. 83).

As for lag selection**,** we considered the "VAR Lag Order Selection Criteria" test, which in Table 7 illustrates that for five theoretical lags, all the five criteria (LR, FPE, AIC, SCandHQ**)** recommend a lag equal to 5 for the VAR model" FDI-GDP".

Table 7

VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-97.44754	NA	5072.174	14.20679	14.29809	14.19834
1	-67.60385	46.89724	128.0696	10.51484	10.78872	10.48948
2	-61.32736	8.069768	97.48768	10.18962	10.64609	10.14737
3	-53.89009	7.437264	68.03725	9.698585	10.33764	9.639429
4	-49.82406	2.904312	89.48589	9.689151	10.51080	9.613093
5	-24.11146	11.01969*	7.457847*	6.587351*	7.591584*	6.494391*

Source: data processed by means of Eviews 5.0.
Note that: * indicates the order of the selected lag according to 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

Under the circumstances the model can be written as follows (see Table 8 for the VAR estimations):

$$ISD_t = \alpha_1 + \beta \times ISD_{t-5} + \chi \times PIB_{t-5} + \varepsilon_{1t} \quad (5)$$

$$PIB_t = \alpha_2 + \phi \div PIB_{t-5} + \varphi \times ISD_{t-5} + \varepsilon_{2t} \quad (6)$$

Table 8

Estimations of the "Unrestricted FDI-GDP autoregressive vector"
Period (adjusted): 1996 - 2009
Remarks included: 14 after adjustments
Standard errors in ( ) & t-statistics in [ ]

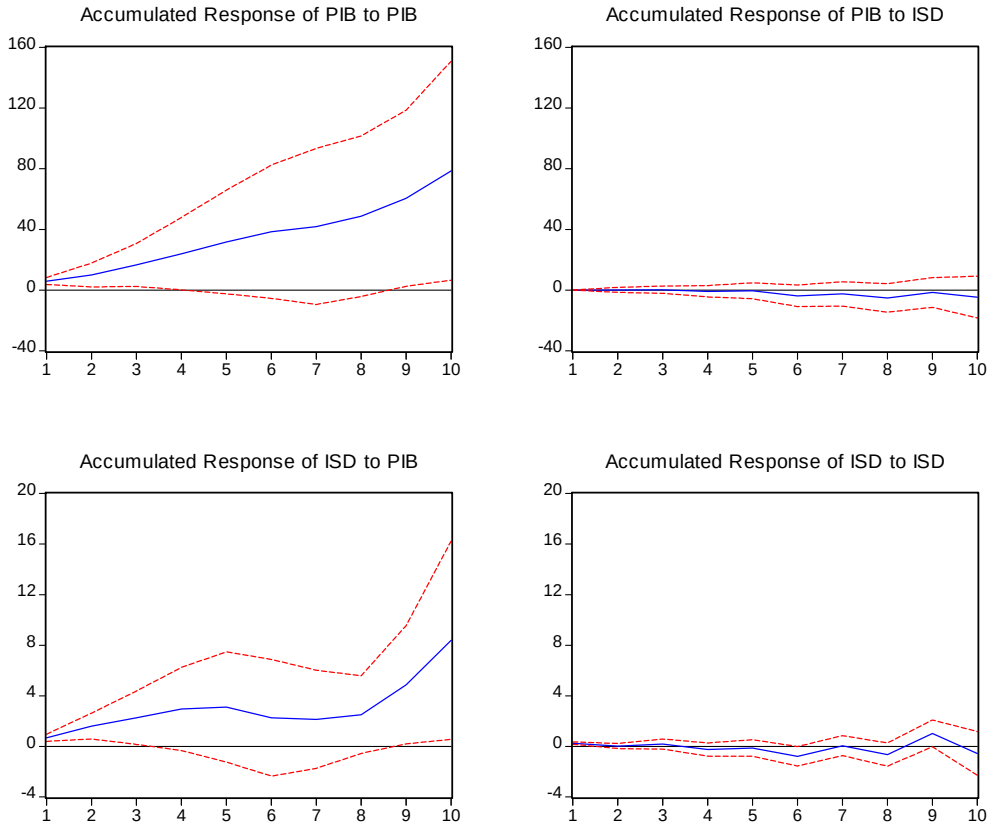
	GDP	FDI
GDP(-1)	0.591595	0.256234
	(0.75189)	(0.08995)
	[0.78681]	[2.84872]
GDP(-2)	0.552456	0.124641
	(0.74442)	(0.08905)
	[0.74213]	[1.39962]
GDP(-3)	0.555708	0.094202
	(0.75649)	(0.09050)
	[0.73459]	[1.04094]

GDP(-4)	0.169450	0.069816
	(0.60378)	(0.07223)
	[0.28065]	[0.96658]
GDP(-5)	0.408287	0.025516
	(0.56991)	(0.06818)
	[0.71641]	[0.37425]
FDI(-1)	0.598267	-0.917386
	(3.32743)	(0.39805)
	[0.17980]	[-2.30468]
FDI(-2)	0.573810	-0.379527
	(3.29316)	(0.39395)
	[0.17424]	[-0.96338]
FDI(-3)	-4.431796	-1.641379
	(2.96806)	(0.35506)
	[-1.49316]	[-4.62278]
FDI(-4)	-0.343684	-1.411194
	(3.77764)	(0.45191)
	[-0.09098]	[-3.12272]
FDI(-5)	-8.691384	-2.972308
	(5.31442)	(0.63575)
	[-1.63544]	[-4.67526]
C	-26.60671	-13.07141
	(21.0615)	(2.51954)
	[-1.26329]	[-5.18801]
R-squared	0.994152	0.987666
Adj. R-squared	0.974657	0.946552
Sum sq. resids	108.7538	1.556359
S.E. equation	6.020903	0.720268
F-statistic	50.99722	24.02276
Log likelihood	-34.21535	-4.488180
Akaike AIC	6.459335	2.212597
Schwarz SC	6.961452	2.714714
Mean dependent	66.68571	3.495000
S.D. dependent	37.82134	3.115509
Determinant resid covariance (dof adj.)		2.338781
Determinant resid covariance		0.107393
Log likelihood		-24.11146
Akaike information criterion		6.587351
Schwarz criterion		7.591584

Source: data processed by means of Eviews 5.0.

As a conclusion, the VAR "FDI-GDP" model can be considered representative to describe autoregressive connections between FDI and economic growth of Romania. Based on the model, we can identify four impulse responses (illustrated in Figure 4), which evaluates the effect of a shock on variations in current or future values of the FDI and GDP variables.

Accumulated response to Cholesky one S.D. innovations ± 2 S.E.



Source: data processed by means of Eviews 5.0.

Figure 4. *Impulse functions of the VAR "FDI-GDP" model*

Based on the chart analysis we can state the following *estimations*:

1. A +1% shock in the FDI level (top right chart) generates almost no effect on the Romanian GDP in the first five years of the forecast. Over the next five years one can notice that the same positive impact of FDI will lead to GDP contraction, therefore the relationship between the two variables will be negative.

2. A +1% shock in the GDP level (left chart below) will generate a significant increase in FDI flows, even spectacular starting with the eight year of the forecasting.

Conclusions

In spite of the expectations and results of other empirical studies undertaken (Bosworth, Collins, 1999, Bengo, Sanchez-Robles, 2003, Hansen, Rand, 2004), we reached the conclusion that the VAR model estimations indicate a reverse connection between FDI flows and economic growth of Romania. This conclusion is perhaps the expected one, but it has economic political implications, meaning that authorities will have to adopt, in the future, several measures which may facilitate the dissemination of positive effects from FDI to economic growth. Among such measures, mention must be made regarding: the income per capita (especially by the significant increase of the minimum income in the Romanian economy) (Bloomstrom et al., 1994), development and implementation of some strategies of commercial export-based policy (Balasubramanyam et al., 1996), increased skilled labor force (Borensztein, 1998), increasing the capacity to absorb new technologies and, last but not least, encourage and support economic stability, infrastructure development (physical and financial), and liberalization of markets.

The second estimation shows that FDI flows are particularly sensitive to economic growth in Romania, as confirmed by other recent developments of the two variables (as a rule, they grow in the same direction) and by the empirical results of the studies of Choe (2003) and Chowdhry and Mavrotas(2006).

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