VAR / VEC: FDI – NET EXPORTS ROMANIA

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Abstract:

We consider it important to analyze FDI-NX relationship in Romania, in terms of econometrics to demonstrate if there is one relationship between the two indicators investigated, and how this relationship works.

Econometric methodology used in this study is the vector autoregression (VAR). The choice of methodology is justified by the nature of the investigation. Macroeconomic phenomena manifest as complex dynamic systems with feedback and mutual causality. Consequently, the only type analysis system (simultaneous equations) are able to capture the interconnections between macroeconomic variables. Given that cointegration relationship exists between the two variables, we constructed the VEC model.

The main result of this study was that the FDI inflows and exports are cointegrated in the period of analysis. The finding that the time series variables were cointegrated implies that there was a long term relationship between them.

For the cases analyzed is confirmed generally valid hypothesis that there is a correlation in both direction between FDI and NX.

In these circumstances, the government must find solutions to attract FDI because in this way and net exports will increase which will contribute to the economic development of Romania.

For rapid expansion of exports, trade liberalization policies have to promote on sectors that will trigger FDI inflows to Romania.

Key words: *VAR; VEC; FDI; Net Exports; correlation; cointegration*

JEL Classification: F14, F21, C320

1. Literature Review

In empirical literature the role of FDI in exports promotion is controversial. Many studies (e.g. Pfaffermayr, 1996) find positive effect of FDI on exports. The main reason underlying is the export oriented TNCs. Since government provides facilities for export promotion, such facilities also attract foreign investors. In order to promote exports government can adopt FDI led export growth strategies with twin objectives of capturing the benefits of both FDI inflow and exports growth.

Hoekman and Djankov (1997) analyze the magnitude of change in the export structure in Central and Eastern European countries. The objective of the study is to find out common determinants of exports and FDI. The study also explores the relationship between export and FDI whether both are substitutes or compliments.

Such studies point out that the role of FDI in export promotion in developing countries remains controversial and depends crucially on the motive for such investment. If the reason behind FDI is to capture domestic market, it may not contribute to export growth. On the other hand, if the motive is top tap exports markets by taking advantage of the country's comparative advantage, then FDI may contributes to export growth.

It highlights several types of models that measure FDI correlated with indicators of foreign trade, export orientation from the host country and its correlation with exports growing demand (Jun and Singh, 1996; Rob and Vettas, 2003), FDI and heterogeneity of firms export, and export them (Greenaway and Kneller, 2007).

There is one way causality from FDI through exports accordingly to a study of 8 countries during 1986-2004 using VAR analysis (Hsiao&Hsiao, 2004). A positive causal relationship from FDI to exports in Mexico, results from VAR analysis, data set for 1980-1999 (Alguacil, Cuadros & Orts, 2002).

There is certainly a national tradition, relatively small, of econometric models relating to FDI, both as an exogenous variable, as well as endogenous variable. Investment

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phenomena appearing in Romanian academic literature, the models described either in terms of limiting attitudes, enjoying a special inertness (Pecican, 1994), or, mostly, targeting diverse and varied as multifactor models utility (Pecican, 1996, 2003, 2007; Voineagu, Ţiţan, Şerban, Ghiţă, Todose, Boboc and Pele, 2007; Andrei, Stancu, Iacob and Tuşa, 2008), emphasizing the importance of harnessing some modelling packages econometric software (EViews, Excel, SPSS, Statistics etc.), others addressing deep structural modelling (Pecican, 2007) or modeling combined indicators focused on reconstruction of comparable variables (Andrei and Bourbonnais, 2008).

2. The Importance of Analysis

We consider it important analysis conducted further research thesis on the study of FDI-trade relationship in Romania, in terms of econometrics to demonstrate if there is one relationship between the two indicators investigated, and how this relationship works.

It stands more or less degree high relativity of results of different theoretical and/or empirical FDI flows, as well as the international trade, as emphasized diversification and increasing complexity in time and space operations financial/investment /trade.

Foreign trade data, as long as no efforts are focused on the elimination of double entries (imports or exports) of amounts not covered by payments/receipts international or subassemblies corresponding intermediate goods flowing to/from different customs territories, can not foresee a true picture of it, and no configuration actual financial impact of the current account of balance of payments at national and /or global (IMF, 2011).

The issue of increasing the level of low relevance data occurs in the case of foreign investments, for example outputs the difference between FDI flows and inflows (theoretically equal) globally to over $ 170 billion in 2011. According to UNCTAD experts (2012), these differences are caused by: inconsistencies in data collection and data reporting different methods (eg on recording FDI transactions, treatment reinvested earnings, exchange rates used for conversion into national currency or vice versa); changing nature of transactions (foreign investment from indirect sources, exchange of shares between investors and acquired companies) and their increasing complexity (may involve funds from parent companies, private or government loans from assistance programs etc.); distinction between FDI transactions regarded as portfolio investment and / or to have speculative character (hot money); sustaining and in this respect the effects of the global crisis by showing a volatility of exchange rates in relation to data reporting times.

Considering these aspects, we called on the official data of the National Institute of Statistics (NIS) for net exports and official data of the National Bank of Romania (NBR) for foreign direct investment to ensure a better compatibility and a higher degree of relevance in achieving the econometric model proposed. Difficulties are here, because until 1999, data were established only in US dollars, 1999 to present are in euro.

Econometric methodology used in this study is the vector autoregression (VAR). The choice of methodology is justified by the nature of the investigation. Macroeconomic phenomena manifest as complex dynamic systems with feedback and mutual causality. Consequently, the only type analysis system (simultaneous equations) are able to capture the interconnections between macroeconomic variables.

Analysis of vector autoregression (VAR) has become macroeconometric studies starting in the 70s, its main promoter was Christopher Sims. VAR is a type analysis system, where all the variables are, a priori, endogenous and therefore modeled together.

VAR models focuses on the analysis of "shock" on the variables studied. Shocks or "innovation" is the part of the one variable that can not be explained by history (past values) that variables or other variables in the system. An innovation appears as the error term (residual) in equation stochastic system.

Vector Error Correction Model has been proposed and applied in the economic literature with the papers by Sargan (1964), Davidson et al. (1978), Hendry (1981) and has been given a formal mathematical treatment by Granger (1983). The main idea of VEC Model is to include an error correction term which adjusts short-run fluctuation, thus enabling the model to capture both long-run and short-run properties. Engle and Granger (1987) pointed out that if non-stationary variables are cointegrated, VAR would be a misspecified model, and cointegrated non-stationary variables can always be expressed by VEC Model. Given that cointegration relationship exists between the two variables, we can then construct the VEC model.

3. Analysis VAR/VEC

3.1 Description of the variables

Foreign direct investment (FDI) had an extremely low volume in the period 1991-2003. In October 2004, Romania received the status of a working economy, giving it a positive signal to foreign investors, which was reflected in the exponential growth of inward FDI in 2004-2008. Unfortunately, this "heyday" was interrupted by the outbreak of the financial crisis in 2009, which was reflected in the significant reduction in FDI inflows in the period 2009-2013, FDI fell by more than 70% of the average 2004-2008.

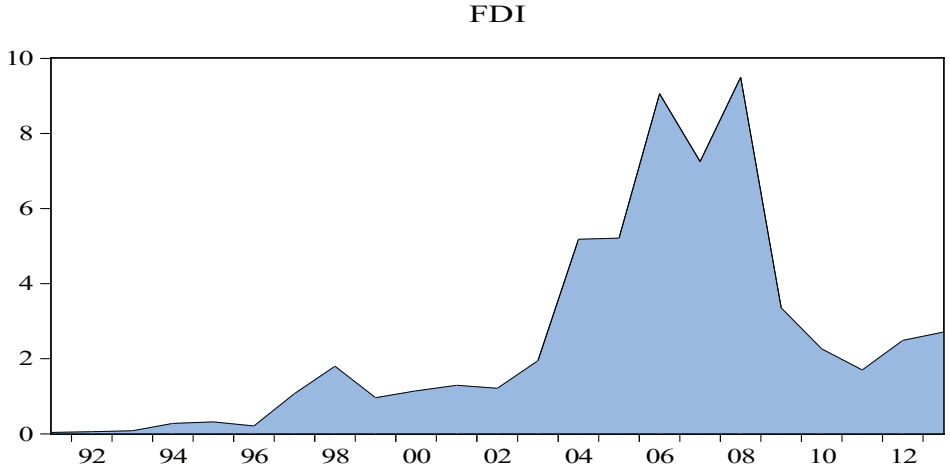

Figure no. 1 Evolution of Net FDI in Romania during 1991-2013

Source: processed by the author with Eviews 7.2

For highlighting the relationship between FDI and foreign trade, it should be analyzed data on external trade made by TNCs in Romania, unfortunately the data are available since 2006.

In these conditions, we used NIS official data on Romania's external trade balance for the period 1991-2013, as according to NBR Reports – TNC's activity has an impact of more than 2/3 of Romania's external trade balance.

Romania's foreign trade, which is reflected through net exports (NX), determining the difference between exports and imports, positive difference where exports greater than imports, had a consistent growth of trade deficit. If this deficit in 1991-2000 period did not exceed EUR 3 billion, evolution deteriorated significantly after 2000 leading to net exports of about -6 billion in 2013.Acest does not necessarily disturbing because the trade deficit can finance imports of technology, know-how, knowledge-based and knowledge that will contribute to the economic development of Romania.

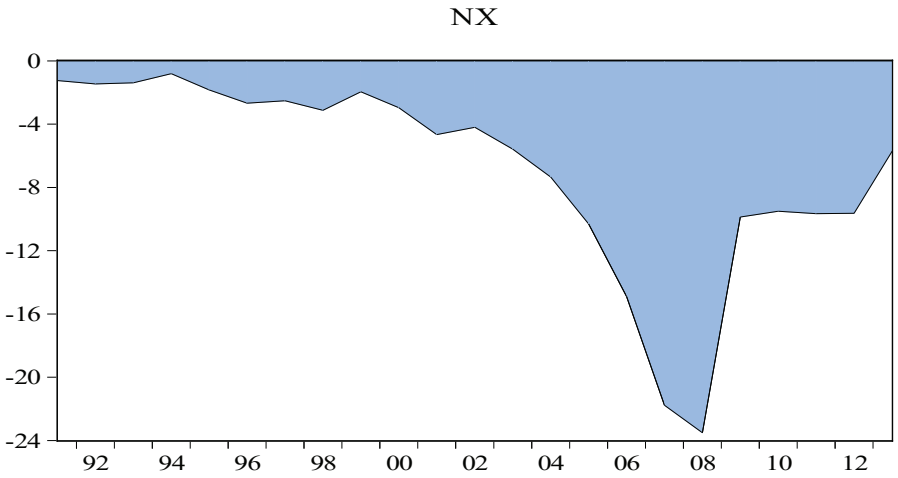

Figure no. 2 Evolution of Net Exports in Romania during 1991-2013

Source: processed by the author with Eviews 7.2

Statistics of FDI and NX in the period 1991-2013 can be easily intuited from fig no. 3, but will be verified empirically in the study.

The correlation close to -1 (-0.91) shows a strong negative correlation ie a variable tendency to decrease significantly when other variable increases. The correlation is reversed when FDI increases trade balance decreases (it reduces the NX deficit), and when the balance increases FDI falls.

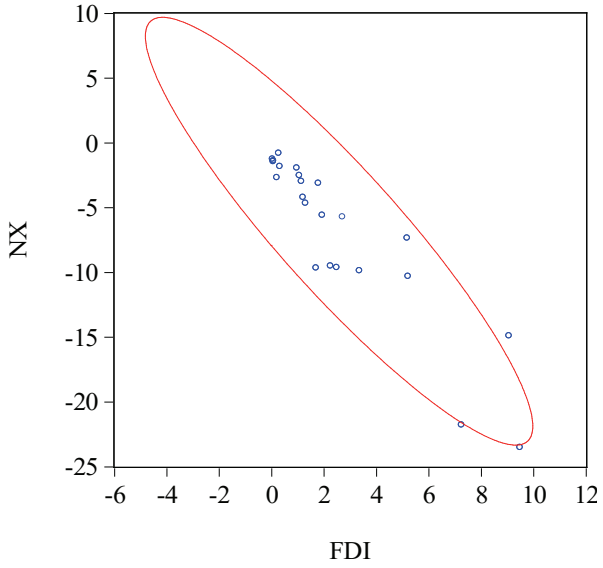

Figure no. 3 Simple scatter graph related FDI and NX

Source: processed by the author with Eviews 7.2

3.2 Method and results

To check whether there is correlation between foreign direct investment (FDI) and net exports (NX), we considered the following assumptions:

H1: FDI= f(NX)

H2: NX= f(FDI)

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

$$FDI_t = \alpha_1 + \sum_{j=1}^{p} \beta_j \times FDI_{t-j} + \sum_{j=1}^{p} \chi_j \times NX_{t-j} + \varepsilon_{1t}$$

$$NX_t = \alpha_2 + \sum_{j=1}^{p} \phi_j \times NX_{t-j} + \sum_{j=1}^{p} \varphi_j \times FDI_{t-j} + \varepsilon_{2t}$$

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

A. Stationarity tests.

Note that the null hypothesis is accepted, then the series are not stationary order 0.

We test the stationarity of order 1 because the ADF tests have shown that the time series are not stationary in their levels, but the first differences I (1).

Table no. 1 Testing the level stationarity of FDI & NX

Augmented Dickey-Fuller Test (For the Level)							
FDI				**NX**			
		t-Stat	Probability			t-Stat	Probability
ADF Test		**-2.248537**	0.1968	ADF Test		**-1.524071**	0.5030
Test Critical Values (Respected Levels)	1%	-3.808546		Test Critical Values (Respected Levels)	1%	-3.769597	
	5%	-3.020686			5%	-3.004861	
	10%	-2.650413			10%	-2.642242	

Source: processed by the author with Eviews 7.2

Table no. 2 Testing FDI & NX for the first differences

Augmented Dickey-Fuller Test (For the First Difference)							
FDI				**NX**			
		t-Stat	Probability			t-Stat	Probability
ADF Test		**-5.381568**	0.0003	ADF Test		**-3.611914**	0.0146
Test Critical Values (Respected Levels)	1%	-3.788030		Test Critical Values (Respected Levels)	1%	-3.788030	
	5%	-3.012363			5%	-3.012363	
	10%	-2.646119			10%	-2.646119	

Source: processed by the author with Eviews 7.2

Johansen cointegration testing is necessary because ADF tests have shown that the time series are not stationary in their levels, but the first differences I(1) and test whether variables are cointegrated and if there is long-term relation between them reject null hypothesis. We find that the null hypothesis is rejected, there is a cointegration relationship.

Table no. 3 Johansen cointegration test

Date: 08/22/15 Time: 18:09
Sample (adjusted): 1994 2013
Included observations: 20 after adjustments
Trend assumption: No deterministic trend
Series: FDI NX
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None *	0.564241	16.65795	12.32090	0.0088
At most 1	0.002228	0.044615	4.129906	0.8627

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Adjustment coefficients (standard error in parentheses)

D(FDI)	-0.944150
	(0.35945)
D(NX)	-1.142754
	(0.85208)

Source: processed by the author with Eviews 7.2

The presence of cointegration between variables suggests a long term relationship among the variables under consideration. Then, the VEC model can be applied.

B. VECM

Cointegration equation is of the form:

$Y_t = \beta x$ we can rewrite $Y_{t-1} = \beta_{11} \times FDI_{t-1} + \beta_{12} \times NX_{t-1} + \beta_{13}$

The VEC has the form $\Delta Y_t = \Phi + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Phi_i \times \Delta Y_{t-1} + \varepsilon_{1t}$, where $\Pi = \alpha\beta'$

Introducing the cointegration equation in VEC model, results the following equations:

$$\Delta FDI_t = \alpha_{11} \times Y_{t-1} + \sum_{i=1}^{p-1} \beta_i \times \Delta FDI_{t-1} + \sum_{i=1}^{p-1} \chi_i \times \Delta NX_{t-1} + \varepsilon_{1t}$$

$$\Delta NX_t = \alpha_{21} \times Y_{t-1} + \sum_{i=1}^{p-1} \phi_i \times \Delta FDI_{t-1} + \sum_{i=1}^{p-1} \varphi_i \times \Delta NX_{t-1} + \varepsilon_{2t}$$

After the test based on the lowest value of AIC and SC criteria, we chose lag = 2. Since ECT (-1) = -1.14 for NX (Tabel no 3) has no significance we put restrictions on vectors B(1,2)=1, A(2,1)=0.

Table no. 4 VEC model

Vector Error Correction Estimates
Date: 08/23/15 Time: 19:35
Sample (adjusted): 1994 2013
Included observations: 20 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,2)=1, A(2,1)=0
Convergence achieved after 3 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 1):

Chi-square(1)	2.260822
Probability	0.132684

Cointegrating Eq:	CointEq1	
FDI(-1)	2.555952	
	(0.11950)	
	[21.3894]	
NX(-1)	1.000000	
Error Correction:	D(FDI)	D(NX)
CointEq1	-0.480648	0.000000
	(0.11449)	(0.00000)
	[-4.19808]	[NA]

Source: processed by the author with Eviews 7.2

From VEC model results:

d(fdi)= -0.480647806462*(2.55595156145*fdi(-1)+nx(-1))+ 0.700215374145*d(fdi(-1)) + 1.51125808068*d(fdi(-2)) + 0.0238505722906*d(nx(-1))+ 0.599778657379*d(nx(-2));

d(nx)= 0*(2.55595156145*fdi(-1)+nx(-1))-0.160568120707*d(fdi(-1))-1.89614496606*d(fdi(-2)) + 0.154942824405*d(nx(-1)) - 1.05117466826*d(nx(-2)).

CointEq1 represents long-run equilibrium relationship and makes the connection between FDI and NX. Error correction is short-term relationship. From Table no. 4 results ECT (-1) = -0.48, the estimated coefficient for FDI indicates that about 48 per cent of this disequilibrium is corrected between 1 year.

C. The stability model

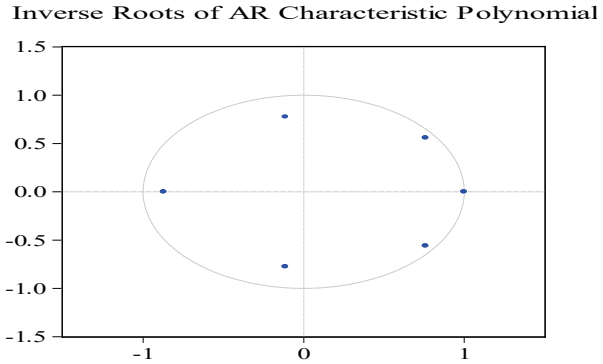

Figure no. 4 AR Roots Graph

After we get the estimation of the model using Eviews 7.2, an AR Roots test is used to test the stability of the model. The AR Roots Graph is shown in Figure no. 4, from the graph, we can see except the 1 unit root imposed by the model, all the roots lies within the unit circle, indicating that the model is stable, so further analysis can be carried on.

D. Testing for serial correlation

We tested also for serial-correlation, to see if we have included the right amount of lags. Note that there is no autocorrelation, so VECM model is especially good number of lags (figure no 5).

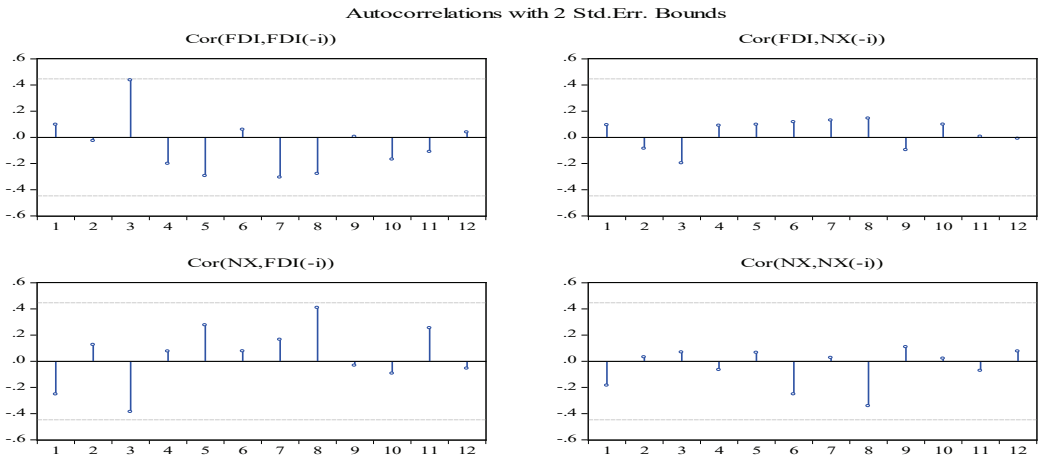

Figure no. 5 Autocorrelation: FDI-NX

Source: processed by the author with Eviews 7.2

E. Granger causality test

Since the normal Granger causality test only apply to the stationary series, according to Gao (2006) test on cointegrated non-stationary series have to be carried out based on the VEC Model, we employ an alternative using Granger Causality/Block Exogeneity Wald test to examine the long-run causal relationship.

For this test, performed for a lag =2, lies that the null hypothesis is rejected in the first case, which means that NX Granger cause FDI in Romania.

The null hypothesis is rejected also in the second case (for a confidence interval of 1%, 5%), which means that FDI Granger causes the NX.

It follows that between the two variables there is bidirectional causality.

F. Identification of impulse response functions and variance decomposition:

a. Impulse response function (IRF)

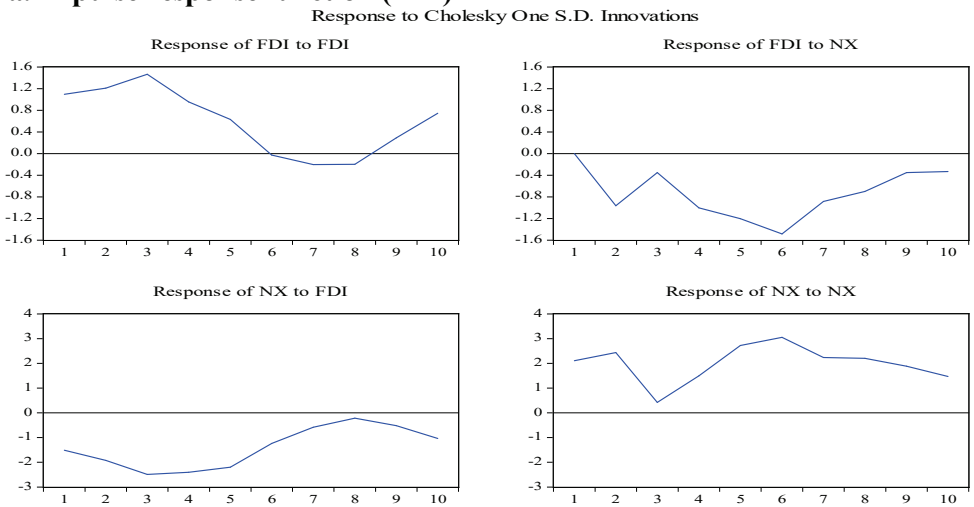

Figure no. 6 VEC model impulse functions: FDI-NX

Source: processed by the author with Eviews 7.2

Shock on FDI innovation NX performs a decrease reaching a maximum of -2.5% over the half of the period, then recovers from loss reaching -1% at the end of the forecast period (bottom left Figure 6).

Instead shock on NX innovation FDI achieved a decrease reaching a maximum of -1.5% at mid-term, after which recovers the loss reaching -0.4% at the end of the forecast period (top right Figure 6).

We see that in the latter part of the forecast period, we have an upward trend which means long-term evolution of FDI-NX correlation.

Note then that act on their own innovations in direct correlation own variables and innovations of each variable on the other cause the opposite effect which was demonstrated earlier by the existence of inverse correlation.

b. Variance decomposition

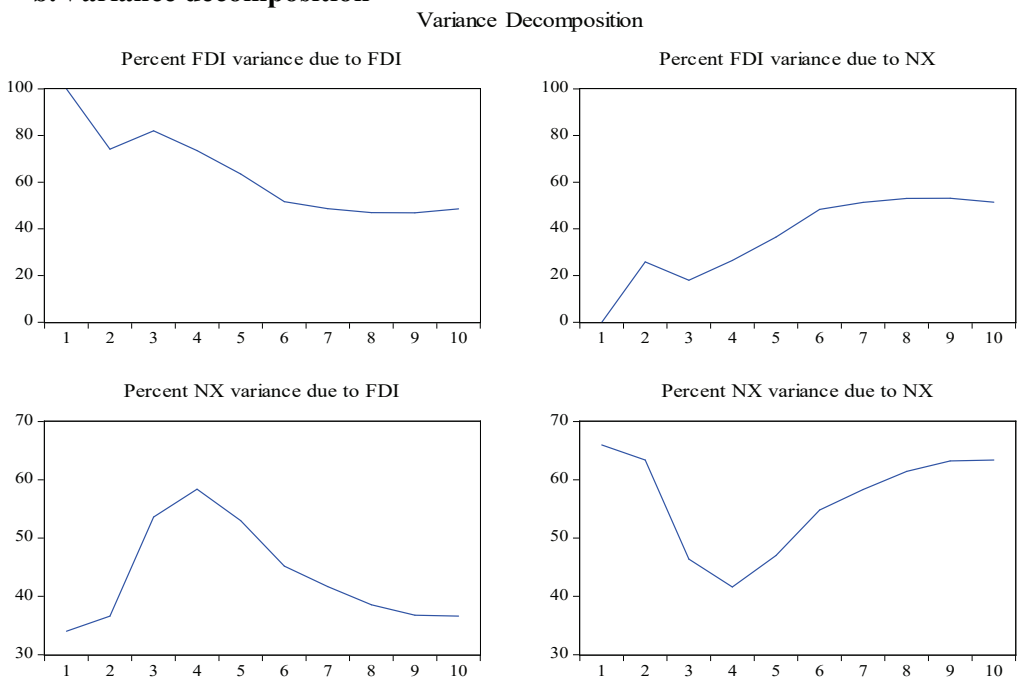

Figure no. 7 VEC model variance decomposition: FDI-NX

Source: processed by the author with Eviews 7.2

We observe that FDI variance is due to a 51% NX innovation and NX variance is due to a 37% FDI innovation at the end of the forecast period.

Analyzing the variance decomposition and impulse function we conclude that is a negative correlation and connection in both directions between the two variables. The correlation is reversed when FDI increases trade balance decreases (it reduces the NX deficit), and when the balance increases FDI falls.

4. Conclusions

The main result of this study was that the FDI inflows and net exports are cointegrated in the period of analysis. The finding that the time series variables were cointegrated implies that there was a long term relationship between them. For the cases analyzed is confirmed generally valid hypothesis that there is a correlation in both direction between FDI and NX.

In these circumstances, the government must find solutions to attract FDI because in this way and net exports will increase which will contribute to the economic development of Romania.

Romania has the potential, it is attractive, looks good in numbers, but to still be attractive to investors must meet certain conditions. There are vital areas such as agriculture, tourism, renewable energy, infrastructure, the state must outline a strategy for investment.

For rapid expansion of exports, trade liberalization policies have to promote on sectors that will trigger FDI inflows to Romania. Specifically, sectors which are able exploit exporting capabilities built on local suppliers. This approach must take into account a way to defeat poor linkages between foreign firms and local industry; as past study reveals that

technology transfers remain poor in host country. Economically speaking, this means that host government should promote activities as a potential exports which make use of our comparative advantage. In addition, FDI should be seen as a supplement, not as a substitute for local capital resources.

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