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A VAR Analysis of FDI and Wages: The Romania's Case

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Abstract

According to Lall (1997), the FDI are strongly interconnected with a series of variables, such as: economic conditions (markets, natural resources, competitiveness), host country policies (macro policies, private sector, trade and industry, FDI policies), as well as MNE strategy (risk perception, location, sourcing of products/inputs, integration transfer). Recent studies have shown that the relationship 'FDI-Wages' is significant and the two variables have one on one influence. More precisely, the low wages have the role to attract FDI and the high volume of FDI generates the increase of the wages on the destination's country labor market. Also, the FDI augmentations determine inequalities on the structure of the wages. The paper analyses the 'behavior' of the relationships between the volume of FDI and the level of wages, in Romania, using an unrestricted vector autoregressive model (Unrestricted VAR). Based on the impulse functions generated by the model, some principal conclusions have resulted:

(1) The impact of the FDI on the wages is not uniform during the year, depending usually on the FDI flow and also on the self-regulation way and reaction of the wages on the labor market;

(2) The impact of the wages on the FDI is temporally sinuous in short term. In this situation, the FDI flow does not depend entirely on the signals received by investors regarding the level of wages in the destination country.

Keywords: FDI, Wages, VAR, Analysis, Impulse function, Effects

JEL Classification: F16, F21, C50

1. Introduction

According to Lall (1997, p.18), the FDI (Foreign Direct Investment) is strongly interconnected with a series of variables, such as: economic conditions (markets, natural resources, competitiveness), host country policies (macro policies, private sector, trade

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and industry, FDI policies), as well as MNE strategy (risk perception, location, sourcing of products/inputs, integration transfer).

The competitiveness, one of the economic conditions, refers to labor availability, wages, skills, trainability, managerial technical skills, input access, infrastructure, supplier base, technology and financial support. In fact, the wages are an appreciable impact to the FDI, but over the time the skills and technical efficiency become more important.

Recent studies have shown that the relationship ‘FDI-Wages’ is significant and the two variables have one on one influence. In such conditions, we can identify two statements of the relationship between FDI and wages: (a) ‘Wages first and FDI later’, that means wages have the capacity to modify FDI; and (b) ‘FDI first and wages later’, that means FDI generates the changes in the level of wages.

Moreover, the field literature offers contradictory results about the sign of the relationship between FDI and wages. This could have the same sign, but also contrary, no matter which statement is considered (‘Wages first and FDI later’ or ‘FDI first and wages later’).

2. Theoretical fundaments

(a) In the first statement’s case - ‘Wages first and FDI later’, Marr (1997, p. 6) argues that the decision to invest in low-income country has been heavily influenced by the prevailing low wage rate and the rapid growth in FDI has also been attributed primarily to the availability of low-cost labour. Moreover, in some countries when the cost of labor is relatively insignificant (when wage rates vary little from country to country), the skills of the labor force are expected to have an impact on decisions about FDI location.

For Holland and Pain (1998, p. 7), ‘the cost of labor in the host country is a potentially major factor in the location decision, particularly for firms seeking to produce labor intensive products for export’. According to Resmini (1999, p. 15), ‘the relevant presence of small investors and high percentage of foreign investments realized in the traditional sectors suggest that the endowment of labor force and its relative price may play a role in attracting FDI’.

On the contrary, Coughlin and Segev (1999, p. 12) reveal that ‘higher wages should deter foreign investment. In concrete, since higher wages might be due to higher productivity, ideally employee productivity should be controlled for in the regression analysis. However, they confirm that the past studies of FDI have found somewhat conflicting results for the effect of wages, but this is likely due to some extent to the omission of a productivity variable’. The study of Rahmah and Ishak (2003, p. 1), shows that ‘the labor market determinants differ between countries in terms of their role in FDI inflows’. The authors’ results suggest that, with regard to labor market competitiveness, different countries may require different policy recommendations in order to attract FDI inflows into their countries.

Amaro and Miles (2006, p. 3) consider that 'the opening of low wage nations to FDI has created much more competition for investment since the beginning of the 1990s'. Their analysis is made to determine the impact of both low wages and infrastructure as determinants of FDI. For Kyrkilis, Pantelidis and Delis (2008, p. 4), 'the labor cost and labor quality hold a prominent position in attracting FDI. Even though the empirical evidence is somewhat mixed, low wage costs prove that they have played a significant role in attracting FDI in developing countries, but the average wage was chosen as the approximation for labor cost with a negative relationship with FDI'.

(b) In the second statement's case - 'FDI first and Wages later', Aitken, Harrison and Lipsey (1995, p. 22), analyzing the relationships between wages and foreign direct investment in Mexico, Venezuela and the United States, find that 'higher levels of foreign direct investments are associated with higher wages'.

In the same spirit, Faggio (2003, p. 29), exploring the interaction between wages and foreign investment in Poland, Bulgaria and Romania, despite different economic conditions and levels of development, find that 'across all three countries higher levels of FDI are associated with higher manufacturing wages'. Almeida (2004, p. 18-19) considers that 'foreign firms have a more educated workforce and pay higher wages for all education groups even after accounting for sector and regional composition, as well as other firm and worker level characteristics usually not accounted for due to lack of data'.

On the contrary, the results of Vijaya and Kaltani (2007, p. 1) indicate that 'FDI Flows have a negative impact on overall wages in the manufacturing sector and this impact is stronger for female wages'. They argue that one possible explanation for such an impact may be a decrease in the bargaining power of labor due to new labor market arrangements in a global economy where capital is free to move across countries in search of more favorable conditions. Tomohara and Yokota (2007, p. 10), examining whether FDI inward is a source of wage inequality between skilled and unskilled labor in developing countries, show that the 'multinational companies tend to pay higher wages, even after controlling for factors such as industry and workers characteristics'.

Recent authors, such as Decreuse and Maarek (2008, p. 2), argue that 'FDI can have negative effects on the labor share of income, even though foreign firms pay higher wages than local firms and FDI benefit all the workers'. In the same time, Hale and Long (2008, p. 23) accept that 'the FDI presence in China is putting an upward pressure on wages of skilled workers through increased competition in the market for skilled labor, which are reflected in an increase in wages that private firms pay to their skilled workers and in a decline in quality of skilled labor in SOEs that appear to be constrained in terms of wages they can pay to their employees'.

Finally, we can note that the field literature offers contradictory results about the sign of the relationship between FDI and wages. Generally, it is considered that the low wages have the role to attract FDI and the high volume of FDI generates the increase of the wages on the destination's country labor market. Also, the FDI augmentations determine inequalities on the structure of the wages.

According to the mentioned premise, all the theoretical elements presented allow us to formulate two theoretical working assumptions. The hypotheses are:

H_1: The statement 'Wages first and FDI later': The level of FDI is growing as the wages are decreasing.

H_2: The statement 'FDI first and Wages later': The level of wages is growing as the FDI is increasing.

In summary, the meanings of the hypothesis' work relations are:

Table 1: The 'sings' of the hypothesis' work relations

The statement	Variable and 'tendency sign'	Variable and 'tendency sign'
'Wages first and FDI later'	Wages + or –	FDI – or +
'FDI first and Wages later'	FDI + or –	Wages + or –

In this assumption approach, the first statement's case relives that the relationship between wages and FDI have contrary sign (if the wages increase, the FDI decreases and vice-versa) and the second statement's case consider that the connexion 'FDI-wages' have the same sign (if the FDI grows, the wages increase and vice-versa).

3. Methods and results

Because the relationship between the two variables 'Foreign Direct Investment - FDI' and 'Wages - W' has a double sense, based on theoretical working assumptions, for analysis of the 'binome' we consider a vector autoregression model (VAR). This model is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. Moreover, according to Gujarati (2004, p. 848), in vector autoregression models some variables are treated as endogenous and some as exogenous or predetermined (exogenous plus lagged endogenous).

In this case, the two considered variables - FDI and W - are treated as endogenous variables. Assuming that each of the two equations contains *k* lag values of FDI and W, for the *t* period, the VAR can be written:

$$FDI_t = \alpha + \sum_{j=1}^{k} \beta_j FDI_{t-j} + \sum_{j=1}^{k} \gamma_j W_{t-j} + u_{1t} \quad (1)$$

$$W_t = \alpha' + \sum_{j=1}^{k} \varphi_j FDI_{t-j} + \sum_{j=1}^{k} \mu_j W_{t-j} + u_{2t} \quad (2)$$

or, equivalently, in matrix form:

$$\begin{bmatrix} FDI_t \\ W_t \end{bmatrix} = \begin{bmatrix} \alpha \\ \alpha' \end{bmatrix} + \begin{bmatrix} \beta_1 & \gamma_1 \\ \varphi_1 & \mu_1 \end{bmatrix} \begin{bmatrix} FDI_{t-1} \\ W_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} \beta_k & \gamma_k \\ \varphi_k & \mu_k \end{bmatrix} \begin{bmatrix} FDI_{t-k} \\ W_{t-k} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \quad (3)$$

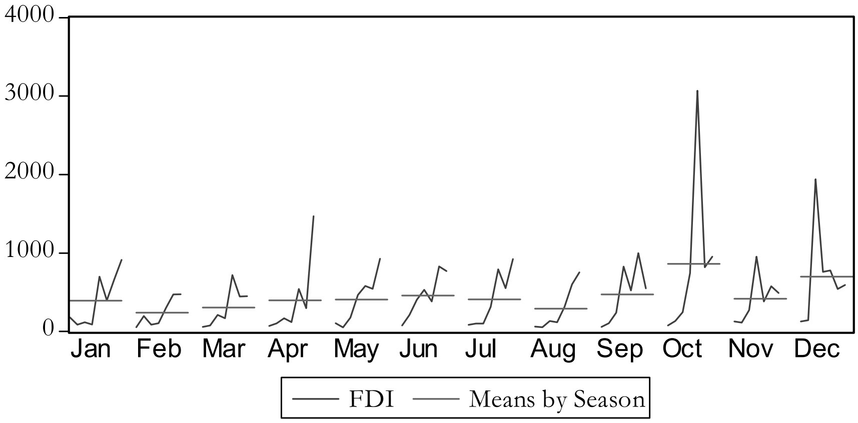
where $\alpha, \alpha^{'}$ are the intercept terms; $\beta, \gamma, \varphi, \mu$ are the coefficients of the endogen variables; and the u are the stochastic error terms.

The analysis data sets include the Foreign Investments Inflow in Romania (FDI) and the Net Average Wages (W), with monthly frequency, in nominal terms, in Romanian currency (Lei), communicated by The National Bank of Romania in its Monthly Bulletins, from January, 2002 to January, 2009 (85 observations).

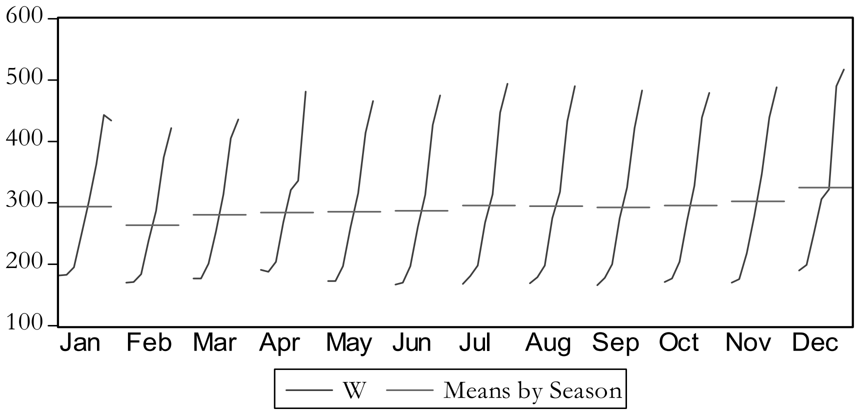
The principal steps of econometric analysis are: (a) variables' tests for seasonality components; (b) unit root tests of variables; (c) VAR and joint lag selection; (d) pairwise Granger Causality Tests; and (e) residuals' tests.

(a) Variables' tests for seasonality components use seasonal stacked line graphic methods. The graphic results are shown below:

Graph 1: FDI seasonal components



Graph 2: Wages seasonal components



Both series reveal some seasonal components. In this situation, we have adjusted the series by X12 ARIMA additive method, used by United States Census Bureau. What is more, after adjustment, the variable FDI becomes FDISA and W becomes WSA.

(b) Unit root tests of variables are based on Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results, shown in Appendix (Table 1-7), in both unit root tests, suggest that FDISA is I(0) and WSA is I(1).

(c) VAR and joint lags selection present the VAR constructions and the joint lags selection criteria.

The VAR construction's problem in our case is that one of series is stationary and another is non-stationary. We are working in levels, even if in the VAR methodologies all the variables should be stationary. The argument is that:

'The usual approach adopted by VAR aficionados is therefore to work in levels, even if some of these series are non-stationary. In this case, it is important to recognize the effect of unit roots on the distribution of estimators.' (Harvey, 1990, p. 83).

Also, Gujarati (1995, p. 749) affirms that transformations of the dates will not be easy if the model contains a mix of I(0) and I(1).

For selection of the *joint lags* we consider two tests: the VAR Lag Order Selection Criteria and the VAR Lag Exclusion Wald Tests.

(1) VAR Lag Order Selection Criteria illustrates (see Appendix, Table 8), for 5 theoretical lags, that the 4 of 5 criteria (LR, FPE, AIC and HQ, exception SC) recommend a joint lags 4 in the case of VAR 'FDISA-WSA'.

(2) VAR Lag Exclusion Wald Tests (see Appendix, Table 9), for 5 theoretical lags; confirm the results of the first criteria, in which the joint lags for considered VAR is 4.

In such conditions, for 4 joint lags, the 'Unrestricted VAR FDISA-WSA' may be written (see the estimates in Appendix, Table 10):

$$FDI_t = \alpha + \sum_{j=1}^{4} \beta_j FDI_{t-j} + \sum_{j=1}^{4} \gamma_j W_{t-j} + u_{1t} \tag{4}$$

$$W_t = \alpha' + \sum_{j=1}^{4} \varphi_j FDI_{t-j} + \sum_{j=1}^{4} \mu_j W_{t-j} + u_{2t} \tag{5}$$

(d) Pairwise Granger Causality Tests verifies how much of the current FDISA can be explained by past values of FDISA and whether adding lagged values of WSA can improve the explanation and vice-versa.

The Pairwise Granger Causality Tests, presented in Appendix, Table 11, for joint lags 4, suggests that we may reject the null hypothesis that 'FDISA does not Granger cause WSA' and 'WSA does not Granger cause FDISA'. In this context, the FDISA helps in the prediction of WSA (FDISA Granger causes WSA) and vice-versa (WSA Granger causes FDISA).

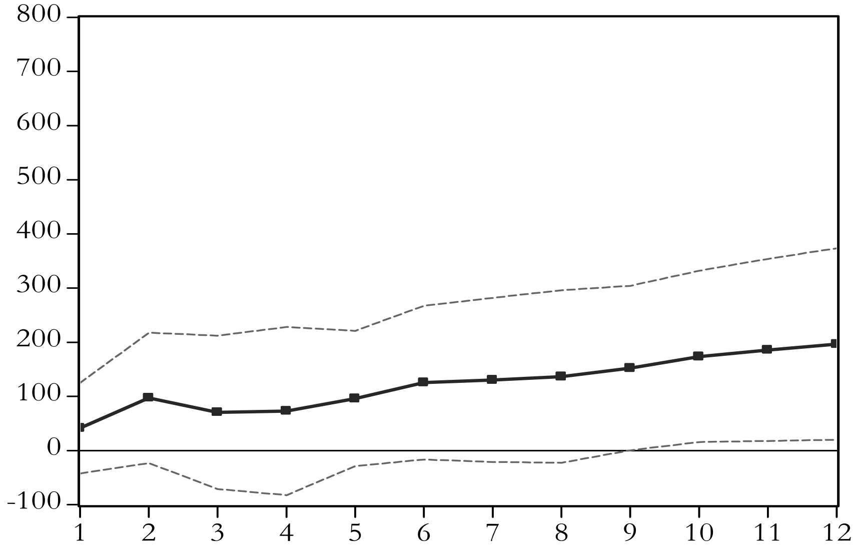
(e) Residuals tests are focused to VAR Residual Portmanteau Tests for Autocorrelations and VAR Residual Serial Correlation LM Tests. The results of the two tests are illustrated in Appendix, Tables 12 and 13. Both tests show that the null hypothesis of no serial autocorrelation in residuals cannot be rejected (at limit in Portmanteau's Tests).

In conclusion, the 'Unrestricted VAR FDISA-WSA' model may be considered representative to describe, in Romanian's case, the autoregressive connection between FDISA and WSA and vice-versa.

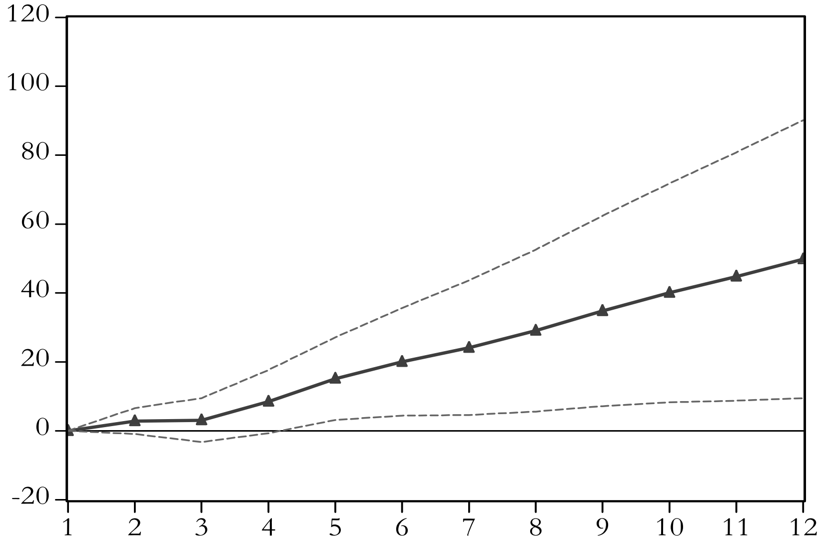
4. Conclusions

Based on the model, we can identify two impulse responses, because an impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables FDISA and WSA. In this case, the accumulated responses of FDISA and WSA to Cholesky One S.D. Innovations ± 2 S.E., for 12 months, are illustrated in Graph 3 and 4.

Graph 3: Accumulated Response of FDISA to WSA



Graph 4: Accumulated Response of WSA to FDISA



In this context, in Romania's case, some principal conclusions have resulted:

- The impact of the wages on the FDI is temporally sinuous in short term. In this situation, the FDI flow does not depend entirely on the signals received by investors regarding the level of wages in the destination country;

- The impact of the FDI on the wages is not uniform during a year, depending usually by the FDI flow and also by the self-regulation way and reaction of the wages on the labor market.

(a) In the first statement's case - 'Wages first and FDI later', the results confirm our assumption hypothesis. In this case, the level of FDI is not growing as the wages are decreasing. The results infirm the conclusion of Marr (1997), Resmini (1999) and Kyrkilis, Pantelidis and Delis (2008), regarding the sign of 'wages-FDI' connection. In the same context, our results confirm the acquisition of Rahmah and Ishak (2003).

In Romania's case, a +1% sock in WSA, determines a low level of FDISA inflow in the first month, an abrupt growth in the next two and a 'flat increase' trend in the next 9 months. This means that the FDISA inflow has a high sensibility in very short-term (1 month). The growth of FDISA inflow reactions in short-term (more then 1 month) could be explicated by the increase in the levels of labour productivity and quality, according Coughlin and Segev (1999). More, if the percent of wages in total production costs is low, then the 'lent growth' reaction of FDISA under the impact of wages increase is explicable.

(b) In the second statement's case - 'FDI first and Wages later', the results confirm our assumption hypothesis. In this case, the level of WSA is growing as the FDISA are increasing. The results are in accord with the conclusions of Aitken, Harrison and Lipsey

(1995), Faggio (2003), Hale and Long (2008), Decreuse and Maarek (2008) and Hale and Long (2008), but differ from the acquisitions of Tomohara and Yokota (2007) and, partially, Tomohara and Yokota (2007).

In the considered case, a +1% sock in FDISA, determines a low level of WSA in the first tree months and an 'accentuate increase' of WSA in the next 9 months. This fact is generated by the arguments that, on the one hand, a 'self-regulation' of the labor market at a labor force supply and demand level exists, and on the other hand, the competition in the market for skilled labor is increasing.

Also, the situations could be the result of competition in the labor market between multinational firms (Tomohara and Yokota, 2007), multinational firms and Romania's local firms (Decreuse and Maarek, 2008) or between private firms from Romania's local labor market (Hale and Long, 2008).

The effects of reaction function are most pronounced in the second statement's case, then in the first one. This means that the FDISA is more sensible to the WSA impact, then WSA to the FDISA. In the same time, the reaction of FDISA to WSA impulse has a high sensibility in very short-term (1 month) and depends on short-term by total production cost structures (the percentage of wages in total production cost is low) and labour productivity and quality.

On the contrary, the WSA response to FDISA impulse is the result of the competition in the skilled labor market between multinational firms and Romania's local firms and of 'self-regulation' of the labor market at a labor force supply and demand level.

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Appendix

Table 2: ADF 'unit root' test for FDISA - in level

Null Hypothesis: FDISA has a unit root Exogenous: Constant Lag Length: 1 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.969918	0.0025
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

Note: *MacKinnon (1996) one-sided p-values.

Table 3: PP 'unit root' test for FDISA - in level

Null Hypothesis: FDISA has a unit root Exogenous: Constant Bandwidth: 5 (Newey-West using Bartlett kernel)			
		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.382797	0.0000
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

Note: *MacKinnon (1996) one-sided p-values.

Table 4: ADF 'unit root' test for WSA - in level

Null Hypothesis: WSA has a unit root Exogenous: Constant Lag Length: 3 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.099655	0.9972
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

Note: *MacKinnon (1996) one-sided p-values.

Table 5: ADF 'unit root' test for WSA - 1st difference

Null Hypothesis: D(WSA) has a unit root Exogenous: Constant Lag Length: 2 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.678852	0.0000
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

Note: *MacKinnon (1996) one-sided p-values.

Table 6: PP 'unit root' test for WSA - in level

Null Hypothesis: WSA has a unit root Exogenous: Constant Lag Length: 3 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.099655	0.9972
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

Note: *MacKinnon (1996) one-sided p-values.

Table 7: PP 'unit root' test for WSA - 1st difference

Null Hypothesis: D(WSA) has a unit root Exogenous: Constant Lag Length: 2 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.678852	0.0000
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

Note: *MacKinnon (1996) one-sided p-values.

Table 8: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: WSA FDISA
Exogenous variables: C
Included observations: 80

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1075.421	NA	1.71e+09	26.93553	26.99508	26.95940
1	-935.5100	269.3286	57200129	23.53775	23.71640*	23.60938
2	-928.0880	13.91625	52523572	23.45220	23.74995	23.57158
3	-923.5768	8.232889	51886250	23.43942	23.85628	23.60655
4	-913.7826	17.38479*	44934834*	23.29457*	23.83052	23.50945*
5	-912.6743	1.911832	48380586	23.36686	24.02191	23.62949

Note: * 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

Table 9: VAR Lag Exclusion Wald Tests

VAR Lag Exclusion Wald Tests
Included observations: 80

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	WSA	FDISA	Joint
Lag 1	10.33481	2.094028	11.83395
	[0.005699]	[0.350984]	[0.018630]
Lag 2	1.757873	1.212232	3.320660
	[0.415224]	[0.545465]	[0.505666]
Lag 3	4.931144	0.786301	5.377916
	[0.084960]	[0.674927]	[0.250671]
Lag 4	18.19343	0.841669	18.74657
	[0.000112]	[0.656499]	[0.000881]
Lag 5	1.431584	0.452351	1.929203
	[0.488805]	[0.797578]	[0.748778]
df	2	2	4

Table 10: 'Unrestricted Vector Autoregression FDISA-WSA' estimates

Vector Autoregression Estimates
Included observations: 81 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	WSA	FDISA
WSA(-1)	0.357944	3.655469
	(0.11807)	(2.82926)
	[3.03161]	[1.29203]
WSA(-2)	0.189000	-3.139787
	(0.12998)	(3.11467)
	[1.45405]	[-1.00806]
WSA(-3)	-0.013239	-0.588492
	(0.12507)	(2.99702)
	[-0.10585]	[-0.19636]
WSA(-4)	0.419550	1.880287
	(0.11429)	(2.73856)
	[3.67106]	[0.68660]
FDISA(-1)	0.007499	-0.043933
	(0.00495)	(0.11857)
	[1.51550]	[-0.37053]
FDISA(-2)	-0.001597	0.081528
	(0.00501)	(0.12010)
	[-0.31858]	[0.67883]
FDISA(-3)	0.011730	0.113941
	(0.00506)	(0.12125)
	[2.31813]	[0.93974]
FDISA(-4)	0.012569	-0.026554
	(0.00522)	(0.12505)
	[2.40850]	[-0.21235]
C	9.325167	-122.9193
	(5.36787)	(128.627)
	[1.73722]	[-0.95563]
R-squared	0.981987	0.307769
Adj. R-squared	0.979985	0.230854
Sum sq. resids	17990.63	10330126
S.E. equation	15.80727	378.7796
F-statistic	490.6316	4.001438
Log likelihood	-333.7619	-591.0571
Akaike AIC	8.463256	14.81623

Schwarz SC	8.729306	15.08227
Mean dependent	297.4048	459.0141
S.D. dependent	111.7331	431.8991
Determinant resid covariance (dof adj.)		35422716
Determinant resid covariance		27988319
Log likelihood		-924.3336
Akaike information criterion		23.26750
Schwarz criterion		23.79960

Table 11: Pairwise Granger Causality Tests

Pairwise Granger Causality Tests
Date: 06/19/09 Time: 10:54
Sample: 2002M01 2009M01
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
FDISA does not Granger Cause WSA	81	3.70459	0.00847
WSA does not Granger Cause FDISA		2.48879	0.05075

Table 12: VAR Residual Portmanteau Tests for Autocorrelations

VAR Residual Portmanteau Tests for Autocorrelations
H0: no residual autocorrelations up to lag 4
Date: 06/19/09 Time: 11:36
Sample: 2002M01 2009M01
Included observations: 81

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	0.133313	NA*	0.134979	NA*	NA*
2	1.285452	NA*	1.316286	NA*	NA*
3	2.601136	NA*	2.682574	NA*	NA*
4	2.696371	NA*	2.782756	NA*	NA*
5	5.498544	0.2399	5.769283	0.2171	4

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

Table 13: VAR Residual Serial Correlation LM Tests

VAR Residual Serial Correlation LM Tests
H0: no serial correlation at lag order 4
Date: 06/19/09 Time: 11:43
Sample: 2002M01 2009M01
Included observations: 81

Lags	LM-Stat	Prob
1	1.441893	0.8369
2	10.03376	0.0399
3	5.574192	0.2333
4	0.484115	0.9750
5	3.707082	0.4471

Note: Probs from chi-square with 4 df.