Cointegration and causality between Romanian exports and imports

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COINTEGRATION AND CAUSALITY BETWEEN ROMANIAN EXPORTS AND IMPORTS

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Abstract: *This paper explores the dynamic relations between the Romanian exports and imports using monthly data from January 2005 to March 2009. We test the cointegration and causality between the two variables. The results of Engle-Granger, Johansen and cointegration tests are ambiguous while the Breitung test infirmed the hypothesis of cointegration between exports and imports. In these circumstances we conclude that we can't consider Romanian current account deficits as sustainable. We also find evidence of the bidirectional Granger causality between the exports and the imports explained by the significant interactions between the two variables.*

Keywords: Causality, Cointegration, Romanian Foreign Trade

JEL Classification: F10, F19, F40

1. INTRODUCTION

The analysis of relations between the exports and the imports is an important tool for studying the perspectives of a country foreign trade. In the recent years these relations were investigated by cointegration and causality techniques. Husted (1994) pioneered the use of cointegration techniques in the analysis of the exports and imports convergence in the long-run. Arize (2002) found that a country current account was sustainable if the exports and the imports were cointegrated and the cointegration coefficient was statistically equal to one. The reciprocal influences between the exports and the imports could be studied in a Granger – Causality framework that reveals if the information relevant to the prediction of them is contained solely in the two time series data (Granger 1969).

The study of dynamic relationships between Romanian exports and imports has some particularities provided by the frequently significant changes that occurred in the last years. In these circumstances, in this article we use monthly data from January 2005 to March 2009 employing tests of stationarity and cointegration that allow taking into account the structural breaks.

The remaining part of this paper is set out as follows. The second part approaches the data and methodology we employ. The empirical results of the analyses are presented in the third part and the fourth part concludes.

2. DATA AND METHODOLOGY

In this analysis we employ monthly data about the Romanian exports and imports of goods and services transactions provided by National Bank of Romania. Our sample covers the period from January 2005 to March 2009. Because of the significant seasonality of these values we apply the ARIMA (Autoregressive Integrated Moving Average) technique to obtain seasonally adjusted values. We use four variables:

- NEXP for the natural logarithms of seasonally adjusted values of nominal exports of goods and services;
- NIMP for the natural logarithms of seasonally adjusted values of nominal imports of goods and services;
- d_ NEXP for the first differences of NEXP;
- d_ NIMP for the first differences of NIMP.

We analyze the stationarity of the four time series applying two unit root tests: the classic Augmented Dickey Fuller (1979) and a test proposed by Saikkonen and Lutkepohl (2002) and Lanne et al. (2002) which allows taking into account the structural breaks. For selecting the numbers of lagged differences we use four criteria: Akaike Info Criterion (AIC), Final Prediction Error (FPE), Hannan-Quinn Criterion (HQC) and Schwarz Criterion (SC).

In the investigation of the cointegration between exports and imports we employ three techniques: the classical Engle-Granger method (1987), the Johansen Trace Test with structural breaks (Johansen et al.; 2000) and the nonparametric test developed by Breitung (2002). We study the Granger – Causality between the exports and imports in a Vector Autoregressive framework.

3. EMPIRICAL RESULTS

We test the stationarity of exports and imports for level values and for their first differences. For level values we use intercept and time trend as deterministic terms (see Figure 1).

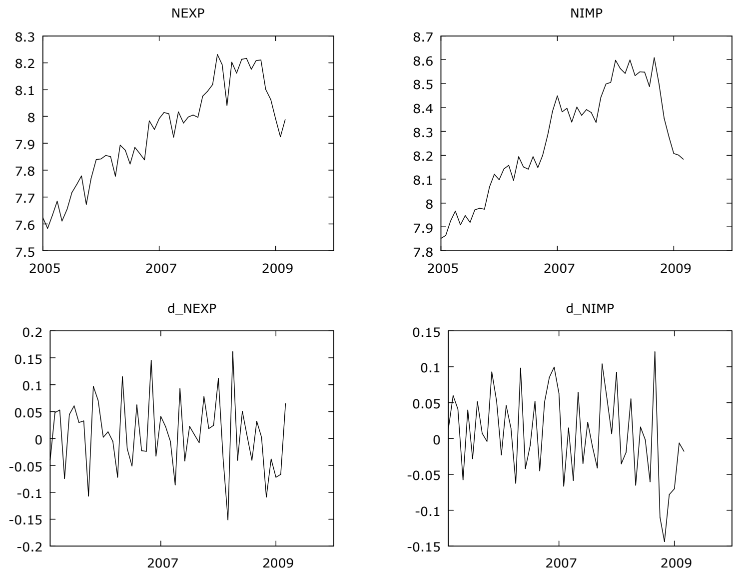

Fig. 1. Evolution of NEXP and NIMP for the level values and for their first differences

The results of Augmented Dickey Fuller Test, presented in the Table 1, suggest that we cannot rule out, for both NEXP and NIMP, the null hypothesis of a unit root.

Table 1. Augmented Dickey Fuller Unit Root Test for NEXP and NIMP

Variable	Lagged differences	Test statistics
NEXP	AIC, FPE: 6	-1.0765
	HQC, SC: 0	-2.2692
NIMP	AIC, FPE: 4	0.8637
	HQC, SC: 0	-0.1891

We continue by applying unit root tests with structural breaks for level values. The results presented in the Table 2 indicate again that both variables have unit roots.

Table 2. Unit root tests with structural breaks for NEXP and NIMP

Variable	Shift Function	Break Date	Lagged differences	Test statistics
NEXP	Impulse dummy	2008 M3	AIC, FPE, HQC: 6	-1.7542
		2008 M3	SC: 1	-1.7783
	Shift dummy	2008 M3	AIC, FPE: 3	-1.8302
		2008 M3	HQC, SC: 0	-2.4104
NIMP	Impulse dummy	2008 M9	AIC, FPE, HQC, SC: 0	-1.1329
	Shift dummy	2008 M11	AIC, FPE, HQC: 3	-2.1579
		2008 M11	SC: 0	-1.8503

Based on the graphical representation we use, for the first differences values only intercept as deterministic term. The results of Augmented Dickey Fuller Test, presented in the Table 3, suggest that both d_NEXP and d_NIMP are stationary time series.
We also analyze the stationarity of the first differences values of the two variables using unit root tests with structural breaks. The results presented in the Table 4 indicate that we can reject, for both time series, the null hypothesis of a unit root.

Table 3. Augmented Dickey Fuller Unit Root Test for d_NEXP and d_NIMP

Variable	Lagged differences	Test statistics
d_NEXP	AIC: 4	-2.6461**
	FPE, HQC, SC: 0	-9.4315***
d_NIMP	AIC, FPE: 3	-3.3721**
	HQC, SC: 0	-7.0608***

** Indicates the rejection of the null hypothesis at 5% significance;
*** Indicates the rejection of the null hypothesis at 1% significance.

Table 4. Unit root tests with structural breaks for d_NEXP and d_NIMP

Variable	Shift Function	Break Date	Lagged differences	Test statistics
d_NEXP	Impulse dummy	2008 M3	AIC, FPE: 2	-2.9567**
		2008 M4	HQC, SC: 0	-7.4208***
	Shift dummy	2008 M10	AIC, FPE: 6	-4.0604***
		2008 M2	HQC, SC: 3	-2.8252*
d_NIMP	Impulse dummy	2008 M9	AIC, FPE: 3	-3.0187**
		2008 M9	HQC, SC: 0	-5.8507***
	Shift dummy	2008 M10	AIC, FPE, HQC : 8	-5.5608***
		2008 M10	,SC: 3	-3.2326**

* Indicates the rejection of the null hypothesis at 10% significance;
** Indicates the rejection of the null hypothesis at 5% significance;
*** Indicates the rejection of the null hypothesis at 1% significance.

Since both NEXP and NIMP are stationary for the level values and non stationary for their first differences values, we can proceed analyzing their cointegration using only intercept as a deterministic term. We begin with Engle-Granger cointegration techniques. In the first step we perform a regression between the two variables, with NIMP as dependent variable. In the second step we apply the Augmented Dickey Fuller test on the residuals of the cointegration regression. The results presented in Table 5 are ambiguous. The residuals could be considered as stationary only when we select the number of lagged differences indicated by the Hannan-Quinn Criterion and the Schwarz Criterion. Instead, we find a unit root when we use the number of lagged differences indicated by the Akaike Info Criterion and the Final Prediction Error criteria.

Table 5. Engle-Granger cointegration test between NEXP and NIMP

Cointegration regression (dependent variable: NIMP)	**Variable**	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**
	const	-1.05796	0.384156	-2.7540	0.00824
	NEXP	1.17386	0.0483753	24.2658	<0.00001
	R^2	0.923177			
	Durbin-Watson statistic	0.895807			
Augmented Dickey Fuller Unit Root Test for the residuals of cointegration regression		**Lagged differences**	**Test statistics**		
		AIC, FPE: 2	-1.4595		
		HQC, SC: 0	-3.3522**		

** Indicates the rejection of the null hypothesis at 5% significance.

We also test the cointegration using Johansen Trace Test with structural breaks (we choused a significance level of 1%) . The results, presented in the Table 6, are again ambiguous.

Table 6. Johansen Trace Test for cointegration with structural breaks

Lagged differences	First Break Date	Second Break Date	Rank	LR	p-value	Critical value		
						90%	95%	99%
AIC, FPE: 2	2008 M3	2008 M11	0	31.75	0.0264	26.90	29.53	34.88
			1	12.49	0.1051	12.64	14.69	19.08
HQC, SC: 1	2008 M3	2008 M11	0	42.62	0.0007	26.90	29.53	34.88
			1	8.37	0.3522	12.64	14.69	19.08

We continue the cointegration analysis using the nonparametric Breitung test for the case with no drift. We find a cointegration rank of zero (see Table 7).

Table 7. Breitung test for cointegration

H0	H1	Test statistic	Critical value	
			10%	5%
r = 0	r > 0	98.54	261.00	329.90
r = 1	r > 1	11.90	67.89	95.60

In a Vector Autoregressive framework we analyze the Granger causality between the first differences values of the two variables. The results are presented in the Table 8. It is suggested a bidirectional causality, although at different levels of significance.

Table 8. Granger causality test between d_NEXP and d_NIMP

Null hypothesis	F-statistic	p-value
d_NIMP do not Granger-cause d_NEXP	9.3393	0.0029
d_NEXP do not Granger-cause d_NIMP	4.1900	0.0435

4. CONCLUSIONS

In this paper we analyzed the cointegration and the causality between Romanian exports and imports using monthly values from January 2005 to March 2009. The results of Engle-Granger Test, Johansen Trace Test and nonparametric Breitung Test failed to prove a cointegration relation between exports and imports so we can't consider Romanian current account deficits as sustainable.

The Granger causality test between the first differences values of the two variables indicated bidirectional causality proving significant interactions between exports and imports. However, the different levels of significance suggest that influence of imports over exports is much higher than the impact of exports over imports.

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