FOREIGN DIRECT INVESTMENT (FDI) IN ROMANIA. EMPIRICAL EVIDENCE USING RESTRICTED AND UNRESTRICTED ECM MODELS

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Abstract
This article examines the FDI in Romania using the autoregressive distributed lag model (ARDL) compared with conventional (error correction model) ECM. The results based on the bounds testing procedure implemented by Pesaran in 2001, confirm that a stable, long-run relationship exists between FDI and GDP, trade and labour in Romania. Our results also reveal that after applying the ARDL model we obtain the same results of long run association as in applying the conventional ECM models.

Keywords: FDI, ECM model, ARDL model

Jel classification: C50, E27, F21

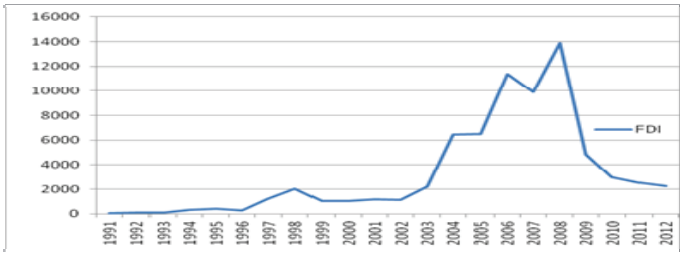
1. Introduction

Two significant periods are to discuss about for Romania, as regarding the FDI story. The first one includes nearly the whole 90ies decade. It was a period of what is today called insignificant FDI and investors; the other was the opposite and the year 2000 of it was conclusive, together with contemporary development. FDI was also more tigthly connected to home investments. Top multinationals world-wide were finally present in Romania as well and Romania's FDI-related landscape radically changed (Andrei, 2008). Then, ten years later, in 2009 and next 2010 the FDI inflow changed once more, but this time in the negative way due to crisis, but maybe not only.

Back to the 2003-2010 years interval, the Romania's FDI inflow met a relatively stable growth up to 2004, then speeded up on 2004-2007, as concomitantly with EU's important two waves extension. Actually, the country succeeded on multinationals' interest later one decade later than its neighbour countries. In 2004-2005 the country that had missed FDI ten years earlier was receiving the highest inflow in the region. It was a moment in which FDI inflow and economic growth were really going hand in hand for Romania (Andrei 2008). But there also was the moment of EU and especially Euro-zone member investor countries' domination in Romania. However, there wasn't any individual investor

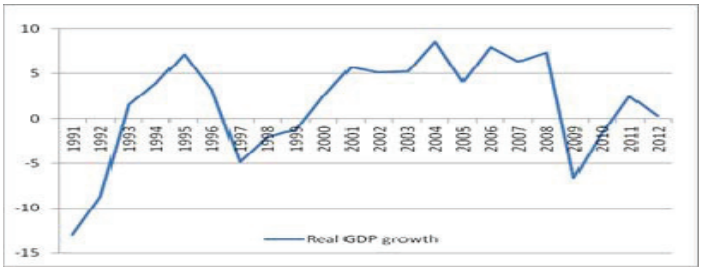
country's domination in this case (Andrei 2002-2010). Then the 2010 decline of FDI (after having performed 2004, 2006 and 2008 peaks) was reducing the inflow by some 22%, as compared to the previous 2009. Then, FDI seem to meet a certain recovery in recent years 2011 and 2012, but the heights of before crisis are yet expected to come back.

Figure 1: FDI evolution 1991-2012



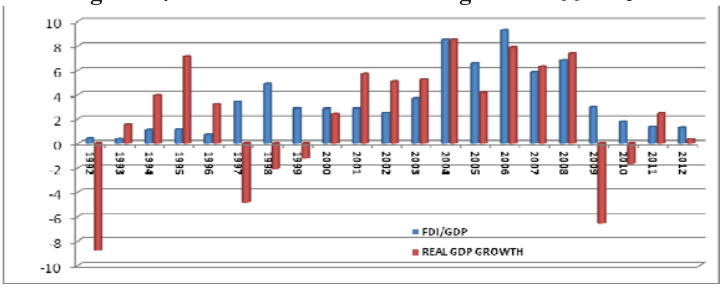
See nearly the same for GDP growth in Figure 2 about the end of period:

Figure 2: Real GDP growth evolution 1991-2012



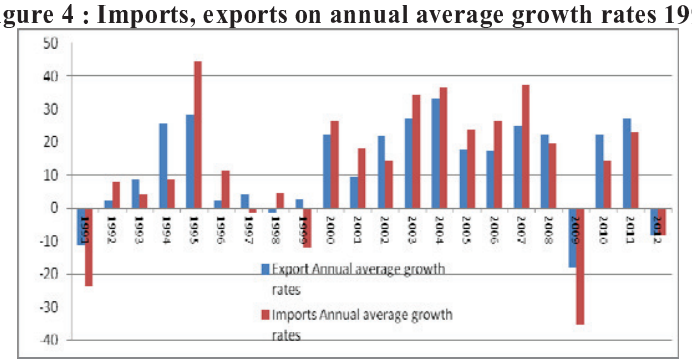
As a result for the same 1991-2012 interval the FDI/GDP ratio that obviously varies:

Figure 3: FDI/GDP and real GDP growth 1991-2012



And apart from the above imports and exports annual average growth rates in Figure 4:

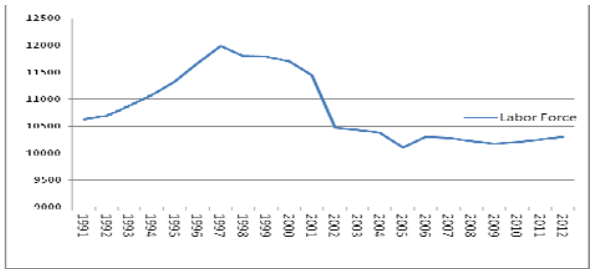
Figure 4 : Imports, exports on annual average growth rates 1991-2012



Also, in 2012[1], the EU **labor market** was still driven by the economic crisis. Key figures for the EU did not improve: they either continued to show negative trends (i.e. rising unemployment), or remained relatively stable in relation to the year before (i.e. employment level). In addition, developments in the labor market did not affect Member States in the same way or to the same extent. As a result, the differences between EU Member State investors increased.

Labor force total in Romania was last measured 10.200 (thousands) in 2012, according to the World Bank. Total labor force comprises people ages 15 and older who meet the International Labor Organization definition of the economically active population: all people who supply labor for the production of goods and services during a specified period. It includes both the employed and the unemployed or economically inactive.

Figure 5: Evolution of total labor force (absolute value in thousands)



2. Data definitions and sources:

This paper uses annual time series data for FDI (as related to GDP), real GDP growth, Export (annual average growth rates), Imports (annual average growth rates) and labour force (annual growth). All data are collected from UNCTAD

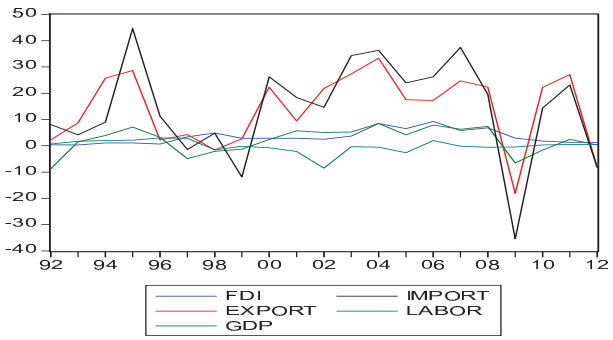
[1] *According to Eurostat , 2014*

statistics on 2014 that would also ensure relevance and substance of data [20], [21], [22].

3. Results - Augmented Dickey-Fuller test statistic for unit roots

Before running ARDL, it is important to know the stationary status of all variables to determine the order of integration; this is needed to ensure that no one of the variables is I (2) because in this case this model will collapse. Usually, most economic variables are non-stationary. It is therefore important for the research to test for stationary before generalizing any relationship. So we are starting to test for the presence of unit roots using the Augmented Dickey-Fuller tests [9]. The test reveals that all the variables are non-stationary.

Figure 6: non stationary data



The Augmented Dickey-Fuller (ADF) test was used for testing the stationarity of data. This is the basic test for checking the unit root in the series. There are three types of different conditions in the ADF test which could be applied to any time series. First, random process includes no intercept (c) and trend (t). Second, random process includes intercept (c) but no trend (t). Third, random process includes intercept (c) and trend (t). It was found that second condition will be most suitable for the data series in this study. So, unit root test applied first on non-stationary data reveals that series had unit roots and need to be differenced. After first difference all the variables become stationary as Augmented Dickey-Fuller test statistic show below. The value of ADF test for differenced data is lower than test critical values for 1%, 5% and 10 % significance level a p value is less than 5% for all the variables which prove the absence of unit roots in series.

Figure 7: differenced and stationary data

4. Bound testing Autoregressive distributed lag model (ARDL)

Bound testing Autoregressive distributed lag model (ARDL) or Unrestricted Error Correction Model (UECM) has some special advantage over other relevant alternatives. Firstly, this approach is simple to analyse and to run as it allows to OLS once lag order can be identified. Secondly, it can be run irrespective to the order of the variables –either I (0) or I (1). Finally, for small or finite sample data it is relatively efficient method but the limitation of this method is that this procedure will collapse in the presence of I(2) series. In this approach, the long run relationship and the short run dynamic interactions among the variables can be tested using ARDL or bound testing estimating method. The model for this approach has the following form:

$$\Delta yt = \beta 0 + \Sigma\, \beta i \Delta yt\text{-}i + \Sigma \gamma j \Delta x1t\text{-}j + \Sigma \delta k \Delta x2t\text{-}k + \Sigma \delta k \Delta x3t\text{-}k + \Sigma \delta k \Delta x4t\text{-}k + \theta 0 yt\text{-}1 + \theta 1 x1t\text{-}1 + \theta 2\, x2t\text{-}1 + \theta 3\, x3t\text{-}1 + \theta 3\, x3t\text{-}1 + et \quad ; \quad (I)$$

This "unrestricted" error-correction model (ECM) will be a particular type of ARDL model. We can see from the form of the generic ARDL model given in equation (1), that such models are characterised by having lags of the dependent variable, as well as lags (and perhaps the current value) of other variables, as the regressors. In our case there are five variables that we are interested in modelling: a dependent variable, FDI, and four other explanatory variables, export, import, labour and Gdp. More generally, there will be (k + 1) variables - a dependent variable, and k other variables. According to general form of ARDL model, we can estimate the equation:

D_FDI = C(1) + C(2)*FDI(-1) + C(3)*GDP(-1) + C(4)*IMPORT(-1) + C(5)*EXPORT(-1) + C(6)*LABOR(-1) + C(7)*D_FDI(-1) + C(8)*D_GDP(-1) + C(9)*D_IMPORT(-1) + C(10)*D_EXPORT(-1) + C(11)*D_LABOR(-1) (II)

Substituted Coefficients:

D_FDI = 0.8396460399 - 0.5853343992*FDI(-1) - 0.5500832185*GDP(-1) + 0.2814084076*IMPORT(-1) - 0.1010625384*EXPORT(-1) - 0.4609606387*LABOR(-1) - 0.1178460332*D_FDI(-1) - 0.09192556544*D_GDP(-1) - 0.1338046687*D_IMPORT(-1) + 0.1104144066*D_EXPORT(-1) + 0.4440361292*D_LABOR(-1) (III)

The value of coefficients of FDI (-1), GDP (-1), Import (-1) and Export (-1) are negative and significant, which is a condition for long run association between the dependent FDI and independent variables. Also on the short run, import and labour coefficients are significant.

We obtained the long run coefficients but we have to find the long run and short run effects (equilibrium effects). We will normalize the equation (II), on FDI dividing all the coefficients of independent variable by the dependent FDI (-1).

Long run effects	- (c3/c2) = 0, 9397	- (c5/c2) = 0, 1726	- (c6/c2) = 0, 7875
Short run effects	- (c9/c2) = 0, 2285	- (c11/c2) = - 0,7586	-

Validity of the model is proven by tests applied on residuals. Residuals series must be normally distributed, with no serial correlation and homoskedastic. We will use the LM test to test the null hypothesis that the errors are independent as series, against the alternative hypothesis, and we obtain that there is no serial correlation of the residuals for 10% significance level(p= 0,06.) Also to test the normal distribution of the residuals, we used Jarque Berra test and with the p value of 0, 59 we can accept the null hypothesis of normal distribution.

We also check for heteroskedasticity of the errors through Breusch-Pagan-Godfrey test and the results of p= 0, 85 allow us to accept the null hypothesis of homoscedasticity. Our results also reveal that after incorporating the CUSUM and CUSUM of squares tests, ARDL model is stable.

Figure 8.1: CUSUM test

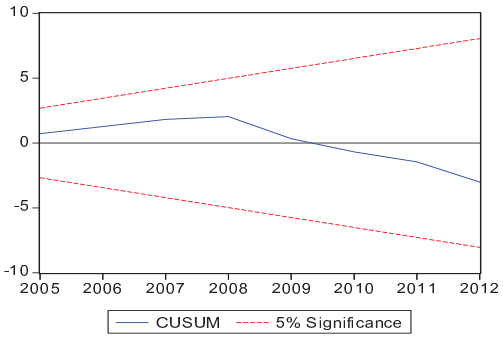
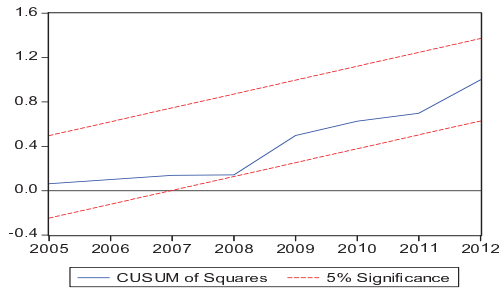
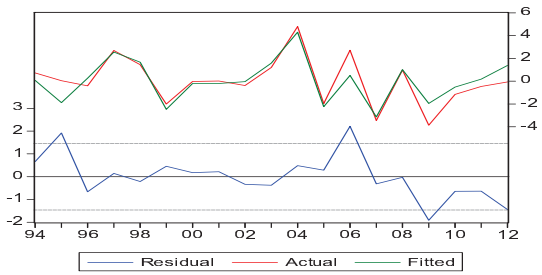


Figure 8.2: CUSUM test of squares



Before proceeding to the Bounds we plotted the unrestricted ECM

Figure 9: Actual / Fitted / Residuals- Graph



There are two steps to be taken for implementing the ARDL approach of co-integration. First, we need to test the existence of long run relationship among the variables in the system where null hypothesis is to have no cointegration or no long run relationship among the variables in system, and the alternative hypothesis is the existence of co-integration. According to Pesaran, [16], [17], [18], F-statistic value is not standard, and suggests different critical values for this system. For each cases there are two critical values-one upper bound and a lower bound considering

the integrated order of the variables, either I(1) or I(0) respectively. If the computed F-statistic is higher than the appropriate upper bound of the critical values, the null hypothesis of no integration is rejected; and if it is less than the lower bound then, null cannot be rejected; if it is within this two bounds then the test is inconclusive regarding integration between or among the variables.

Table 1: Wald test for long run association between variables

Wald Test:			
Equation: ARDL			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	**5.328779**	**(4, 8)**	**0.0217**
Chi-square	**21.31512**	**4**	**0.0003**
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2) - C(6)		-0.12437	0.225256
C(3) - C(6)		-0.08912	0.287178
C(4) - C(6)		0.742369	0.226019
C(5) - C(6)		0.359898	0.199188

For our data, we perform a "Bounds Test" to see if there is evidence of a long-run relationship between the variables. Under Wald test we reject null hypothesis H0: c2=c3=c4=c5 = 0 and we accept H1 of cointegration between variables.

For k = 4 (four dependent), we are testing the asymptotic critical value bounds for the F-statistic for the existence of a levels relationship (case III: unrestricted intercept and no trend page 300, Pesaran et al. 2001). We haven't constrained the intercept of our model, and there is no linear trend term included in the ARDL. The lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are represented in the table:

Table 2: Bounds Test

Critical value	0.100		0.050		0.025		0.010	
Integration degree: I(0)/I(1)	Lower Bound Value	Upper Bound Value	Lower Bound Value	Upper Bound Value	Lower Bound Value	Upper Bound Value	Lower Bound Value	Upper Bound Value
Bound values	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06

Source: "Bounds testing approaches to the analysis of level relationships", Pesaran et al.2001, page 300

As the value of our F-statistic 5.38, exceeds the upper bound at the 5% significance level, we can conclude that there is evidence of a long-run relationship

between the two time-series (at this level of significance or greater). We also apply the Wald test in order to test if the lags of independent variables could be "0" The null hypothesis H0: c7=c8=c9=c10 =c11=0 is rejected and this fact demonstrate that there is also a short run association between FDI and the rest of the variables.

Table 3: Wald test for short run association between variables

Wald Test:			
Equation: ARDL			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	**3.549862**	**(5, 8)**	**0.0549**
Chi-square	**17.74931**	**5**	**0.0033**
Normalized Restriction (= 0)		Value	Std. Err.
C(7)		-0.11785	0.208959
C(8)		-0.09193	0.124721
C(9)		-0.13381	0.052834
C(10)		0.110414	0.063965
C(11)		0.444036	0.15273

5. Conditional ECM (error correction model)

In order to compare the modern procedure of ARDL with the traditional ECM we will follow the two steps procedure:

a) we estimate the long-run equilibrium relationship between the variables:
$yt = \alpha 0 + \alpha 1x1t + \alpha 2x2t + vt$; estimate by OLS (IV)

b) we estimate the usual ECM:
$\Delta yt = \beta 0 + \Sigma \beta i \Delta yt\text{-}i + \Sigma \gamma j \Delta x1t\text{-}j + \Sigma \delta k \Delta x2t\text{-}k + \varphi zt\text{-}1 + et$
where $zt\text{-}1 = (yt\text{-}1 - a0 - a1x1t\text{-}1 - a2x2t\text{-}1)$, (V)

For our data, we first estimate the levels model, by OLS, and construct the residuals series, RESIDECM1 (-1) in order to fit a regular (restricted) ECM:

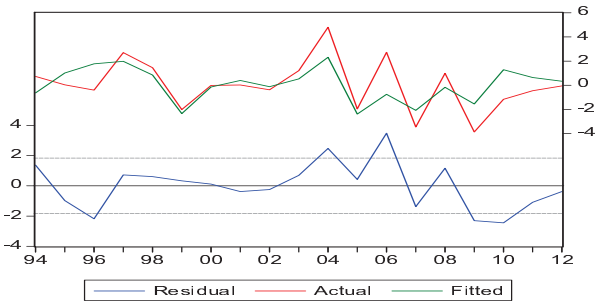
D_FDI = C(1) + C(2)*D_GDP(-1) + C(3)*D_EXPORT(-1) + C(4)*D_IMPORT(-1) + C(5)*D_LABOR(-1) + C(6)*RESIDECM1(-1) (VII)

Substituted Coefficients:

D_FDI = 0.2226592587 - 0.2418564386*D_GDP (-1) + 0.01764625981*D_EXPORT (-1) + 0.01382678029*D_IMPORT (-1) + 0.1913166855*D_LABOR (-1) - 0.5176759587*RESIDECM1 (-1)

The coefficient of the error-correction term, RESIDECM1 (-1), is negative (-0, 51) and significant (p value =0.0186). This is what we expected if there is cointegration between FDI, export, import, and labour and Gdp. The magnitude of this coefficient implies that nearly 51% of any disequilibrium between FDI and the rest of variables is corrected within one period (one year).Our restricted ECM plot looks like:

Figure 10: Actual / Fitted / Residuals- Graph



Validity of the model is proving by tests applied on the residuals. Residuals series must be normally distributed, with no serial correlation and homoskedastic. We will use the LM test to test the null hypothesis that the errors are serially independent, (p=0, 42) against the alternative hypothesis, and we obtain that there is no serial correlation of the residuals.

Also to test the normal distribution of the residuals, we used Jarque Berra test and with the p value of 0, 85 we can accept the null hypothesis of normal distribution. We also check for heteroskedasticity of the errors through Breusch-Pagan-Godfrey test and the results. We can accept the null hypothesis of homoscedasticity (p=0,81).

Conclusions:

The purpose of this paper was to analyse and test relationship among certain economic indicators in Romania by using restricted ECM models and ARDL approach of cointegration introduced by Pesaran. This study contributes to clarify cointegrating between foreign direct investment, economic growth, exports, imports and labour force in Romanian case. This paper identified that there is strong statistical indication of long run relationship between foreign direct investment and the rest of the variables in both models restricted and unrestricted ECM models.

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