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TESTING THE EXISTENCE AND STABILITY OF PHILLIPS CURVE IN ROMANIA

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ABSTRACT

The main objective of this study is to check the existence and the stability of Phillips curve for Romania, on the horizon from 1990 to 2013. According to Phillips Perron tests, all the variables are integrated of order 1. ARDL and DOLS approaches to co-integration were used to analyse the Philips relations and ECM to study short run dynamics. There is a negative relation between inflation and unemployment rate in the short run and a positive relationship in the long run in Romania. The tests like recursive residual, CUSUM and CUSUMsq tests confirm that there is a stable Philips relation.

***KEY WORDS**: Phillips curve, dynamic model, Co-integration, ARDL, DOLS*

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1. INTRODUCTION

The nominal wage inflation was graphed against unemployment rate in England, and a stable negative and tight relationship was observed in the last century, this graph representing Phillips curve. Moreover, this relation was checked for the developed economies and in most cases the Phillips curve was not valid. Authors like Solow (1970), Onder (2004) and Faridul *et al*. (2011) studied the theoretical background of the Phillips curve.

The eventual trade-off helps policymakers to solve the macroeconomic disequilibrium. The Phillips curve did not succeed to predict the economic crisis in 1970s. There are more groups of researchers regarding their opinion about Phillips curve validity: the group against the use of this curve (Phelps (1967), Friedman (1968), Okun (1975), Lucas (1976)) and the group that demonstrated a non-linear relationship (Onder (2004), Kustepeli (2005), Furuoka (2007), Tang and Lean (2007), Schreiber and Wolters (2007), Dammak and Boujelbene (2009)). On the other hand, there are authors that proved an unstable relationship between the two variables (Okun (1975), Lucas (1976), Turner (1997); Atkeson and Ohanian (2001); Niskanen (2002); Demers (2003) and Reichel (2004)).

Karanassou et al. (2005) proposed models under the assumption of low inflation, existing long-run trade-off between inflation and GDP. Franz (2005) showed a long-run inflation-unemployment trade-off for Germany.

Most of the studies regarding the relationship between the two variables refer to developed countries. The aim of this research is to study the existence of Philips curve and its stability in Romania.

The rest of study is organized as it follows: after the literature review, the methodology is described and then the empirical results. Conclusions are drawn in last part of the study.

2. LITERATURE REVIEW

The failure of Phillips relation in 1970s made Friedman (1968) to argue that the relation is valid only on short term. On long run the employees and the employers consider the inflation evolution in employment contracts that the salary increases at rates closed to anticipated inflation.

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Lipsey (1960) proved the existence of an inverse relation for England during the war from 1914-1918 and Hansen and Pancs (2001) for Latvia. The instability of the Phillips curve since the 1970s might be cause, according to Turner (1997) and Atkeson and Ohanian (2001), by the structural break.

Malinov and Sommers (1997) and Turner and Seghezzea (1999) used the Seemingly Unrelated Regression to show the existence of Phillips relation. Using a panel data approach, DiNardo and Moore (1999) put in evidence the Philips relation in OECD countries. Eliasson (2001) proposed a linear Phillips curve for USA, Sweden and Australia, checking the parameters stability.

Niskannen (2002) stated that the original Philips curve comports misspecification, the positive slope of the long term relationship being due to lack of indexed tax code. Reichel (2004) proved the existence of trade-off for USA and Japan when co-integration approach was used. Rudd and Whelan (2005) and Gali et al. (2005) did not find enough evidence for Phillips relation, even if they applied the GMM approach. For some European countries, Karanassou et al. (2003) showed that there is a long run trade-off. Islam *et al*. (2003) did not find a strong evidence for USA Philips curve during 1950-1999.

Evidence for Phillips curve was brought by Bhanthumnavin (2002) for Thailand, Graham and Snower (2002) for Chile, Furuoka (2007) and Tang and Lean (2007) for Malaysia and Schreiber and Wolters (2007) for Germany (based on VAR co-integration approach), Del Boca *et al*. (2008) for Italy, Cruz-Rodriguez (2008) for Dominican Republic, Faridul et al. (2011) for North Cyprus (based on ARDL bounds testing and Dynamic Ordinary Least Squares).

Russell and Banerjee (2008) analysed the vertical Phillips curve for non-stationarity data series, finding positive relationship between inflation and unemployment on short term for the USA. Paul (2009) gave reasons for the lack of Phillips relation in India: oil price shocks and liberalization-policy. Only after the shocks adjustment the Phillips curve is evident, being also a short-term trade-off between inflation and industrial output.

3. METHODOLOGY AND EMPIRICAL RESULTS

The methodology is based on autoregressive distributed lag models (ARDL) discussed by Pesaran and Shin (1999), that does not imply the variables pre-testing, eliminating the uncertainty. The ARDL approach is used to test the existence of a relation between variables in level. It is applicable if repressors are *I*(0) or I(1). According to Pesaran et al. *(*2001), it is used the Wald or F-statistic in a generalised Dickey-Fuller regression for testing the significance of the variables with lagged levels in a conditional unrestricted equilibrium correction model (ECM). The estimates based on ARDL model of co-integration analysis are efficient and unbiased. The advantages of these models are: the possibility of using a small sample, the use of long-run and short-run components of the model at the same time, eliminating the problems generated by omitted variables and autocorrelation, the distinction between dependent and independent variables.

Some authors extended the estimation of Phillips curve using also real GDP and marginal cost of production. The gross national product is seldom used for unemployment rate. In order to compute the inflation for developing economies, the consumer price index (CPI) might be used, according to Faridul et al. (2011). In this research we used like variables inflation rate, unemployment rate, real gross domestic products and money supply through M2. The data sources are represented by the National Institute of Statistics from Romanian, The National Bank of Romania and Eurostat.

The study used data from 1990 to 2013 and before applying co-integration approach, the data are subject to stationary tests (Philip Perron test).

The Philips-Perron test has the following statistic:

$$\tilde{t}_{\alpha} = t_{\alpha}\left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T\,(f_0 - \gamma_0)(se(\hat{\alpha}))}{2\,f_0^{1/2}\,s} \quad (1)$$

$\hat{\alpha}$ - the estimate

$\tilde{t}_{\alpha}$ - t-ratio of $\alpha; se(\hat{\alpha})$ - standard error of the coefficient;

T - sample size and

s - standard error of test regression.

γ_0 - consistent estimate of the error variance in standard Dickey-Fuller equation

f_0 - estimator of residual spectrum at null frequency

The co-integration approach is used for long-term relationship. For co-integrated variables, the long-run relations are estimated using co-integrating vectors. ARDL is valid irrespective the order of integration is. But ARDL does not work if a variable is I(2). The "dynamic OLS" (DOLS) approach is used, where the estimators are asymptotically equivalent to the Johansen estimators. For finite sample, the estimators are better, compared to the rest of asymptotically efficient estimators.

The DOLS method supposes partial knowledge of the data series for co-integration ant it eliminates the problems generated by simultaneity, endogeneity and auto-correlation by using leads and lags in low sample. This procedure works also if the data series has different lags orders as Stock and Watson (1993) showed. If parameters inferences of the co-integrating vectors based on DOLS are made, the estimators are efficient. The ARDL is used with the unrestricted error correction model. According to Faridul et al. (2011) the model has the following form:

$$INF_t = \psi_0 + \sum_{i=1}^{p} \varphi_t INF_{t-1} + \sum_{t=0}^{q} \eta_t UNP_{t-1} + \varepsilon_t \quad (2)$$

INF- inflation rate

UNP- unemployment rate

We expect a significant and negative UNP coefficient in the case of Philips curve presence. The short and the long run models are written:

$$\Delta \inf = a_0 - b_1 \inf_{t-1} + c_1 un_{t-1} + d_2 y_{t-1} + d_3 m2 + \sum_{i=1}^{p} e_i \Delta \inf_{t-1} + \sum_{i=1}^{p} f_i \Delta un_{t-1} + \sum_{i=1}^{p} g_i \Delta y_{t-1} + \sum_{i=1}^{p} h_i \Delta m2_{t-1} + \varepsilon_t \ldots \quad (3)$$

p- number of lags

k - lag length of leads terms

e - error term

The Akaike criterion (AIC) is used to select the leads and lags.

The structural breaks are checked using Chow test. In ARDL approach, the CUSUM and CUSUMsq tests are applied. If there is structural break in the data, the traditional approaches may not identify co-integrating relationship. This can influence the result of unit root tests and the predictive powers as Leybourne and Newbold (2003) proved. The ARDL model is applied using the unrestricted error correction method (UECM) form presented by Pesaran et al. (2001):

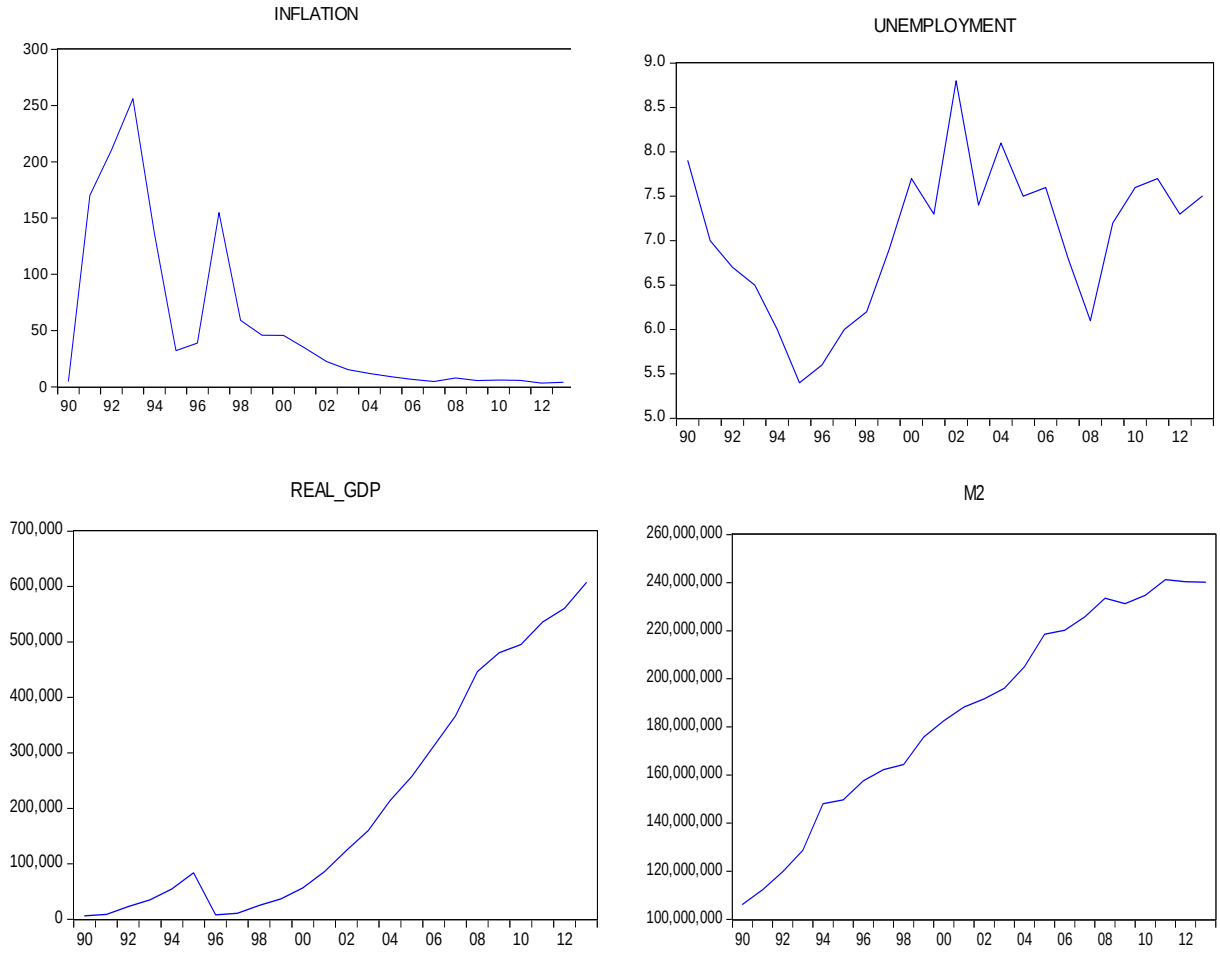
$$\Delta \inf = a_0 + \sum_{i=1}^{p} e_i \Delta \inf_{t-1} + \sum_{i=1}^{p} f_i \Delta un_{t-1} + \sum_{i=1}^{p} g_i \Delta y_{t-1} + \sum_{i=1}^{p} h_i \Delta m2_{t-1} + jECM_{t-1} + \varepsilon_t \ldots \quad (4)$$

The ARDL supposes the calculation of *(p+1)*k regressions.

A sensitivity analysis was applied to test for auto-correlation, functional form, normality, White heteroscedisticity, model specification and ARCH. CUSUM and CUSUMsq verify the long and short term parameters stability.

The nature of the time series is analysed.

Figure 1: The evolution of the four variables during 1990-2013



According to the graphs, all the data are not stationary. For inflation and unemployment rate there are larger fluctuations.

Table 1: Phillips Perron test

Variable	*PP statistic*	*Critical values (level of significance: 5%)*	*Order*
Inflation	-2.183810	-2.998064	I(1)
	-4.108216	-3.622033	
	-1.681813	-1.956406	
Unemployment	-2.317815	-2.998064	I(1)
	-2.870132	-3.622033	
	-0.351234	-1.956406	
Log(GDP)	-1.474822	-2.998064	I(1)
	-2.582218	-3.622033	
	1.590257	-1.956406	
M2	-3.893982	-2.998064	I(1)
	-0.071279	-3.622033	
	3.830018	-1.956406	

Source: author's computations.

Using the Philip Perron test, all the variables are stationary at first difference. This shows that the variables are integrated of order 1: I(1) and the ARDL model could be estimated.

Table 2: Co integration Test: Bound Test

Model For Estimation	*F-Statistics*	*Lag*	*Outcome*
$F_{INF}(INF)$	4.4587**	2	Co integration
Critical Bounds	Lower		Upper
1%	3.86		5.33
5%	2.77		3.95
10%	2.35		3.3542

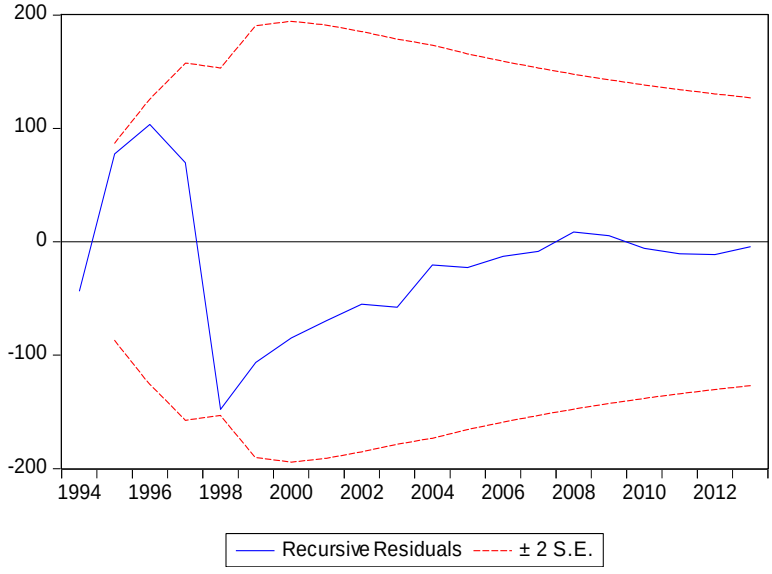
As we expected, the relation between the two variables is negative on short run—a low unemployment rate conducts to an increase in the inflation. A percent of increase in unemployment reduces inflation with 1.87 percent compared to the value in the previous period. On long term, the relation is positive. If the unemployment rate increases with one percentage, the inflation rate increases by 0.33 percent. The negative and significant parameter of the first lag of inflation (-0.2745) confirms a true long run relationship of the bound test result.

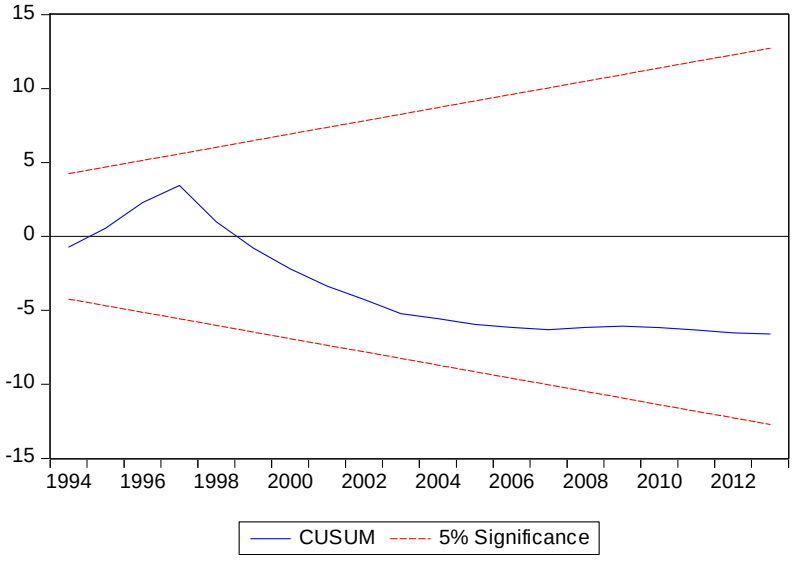
$$\Delta INF(t) = 0.3304*UN(t-1) - 1.8722*\Delta UN(t-1) - 0.2745*ECM(t-1)$$
$$\textit{0.0768} \qquad \textit{0.4811} \qquad \textit{0.0068} \qquad \textit{Probability}$$

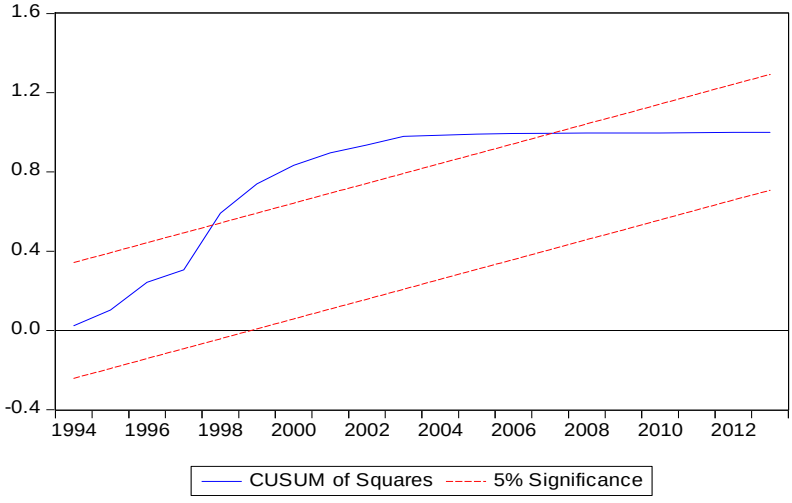
$R^2 = 0.3396$

The ECM coefficient includes information about whether the previous values of the variables influence the current values. The absolute value of the ECM coefficient shows that about 27.45% of the disequilibrium in the Philips model. So, the disequilibrium over time should be decreased in order to keep the equilibrium between the two variables in Romania.

Figure 2: Tests for parameters' stability







For checking coefficients' stability, Bahmani-Oskooee and Shin (2002) applied the cumulative sum of recursive residuals (CUSUM) to the residuals of the model. According to the figure, neither the recursive residuals nor CUSUM of squares plots move outside the 5% critical lines. The result shows relative stable *coefficients stability*. However, the CUSUM test results indicate an evolution outside the critical line between 2001 and 2013, implying variance instability.

5. CONCLUSION

This study main objective was the estimation of Philips Curve for Romania using ARDL and DOLS frameworks. There is evidence of co-integration between inflation, unemployment, real GDP and money supply M2 for Romania, showing a long run relationship over the period from 1990 to 2013. There is a theoretical trade-off between the two variables in the short run but prove otherwise statistically in the long run. Phillips curve is not valid for Romania on the long run. Moreover, the recursive residual, the CUSUM and CUSUMsq tests indicate the relative stability of the parameters.

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