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Is the Labour Force Participation Rate Non-Stationary in Romania?

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Abstract: The purpose of this paper is to test hysteresis of the Romanian labour force participation rate, by using time series data, with quarterly frequency, covering the period 1999Q1-2013Q4.The main results reveal that the Romanian labour force participation rate is a nonlinear process and has a partial unit root (i.e. it is stationary in the first regime and non-stationary in the second one), the main breaking point being registered around year 2005. In this context, the value of using unemployment rate as an indicator for capturing joblessness in this country is debatable. Starting from 2005, the participation rate has not followed long-term changes in unemployment rate, the disturbances having permanent effects on labour force participation rate.

Key words: Labour, Participation, Hysteresis, Process, Nonlinearity, Policy Implications

JEL Classification: J01, J21, C12

Introduction

In the past years, many researchers have focused their analyses on labour market characteristics or functions, especially by using the unemployment rate as the main measure of labour market state. There are two main hypotheses on employment behaviour.

The first one refers to the natural rate of unemployment and represents the "structuralist" theory. According to Camarero et al. (2008), this hypothesis characterizes unemployment dynamics as a mean reverting process, which means that in spite of its cyclical movements, unemployment rate tends to revert to its equilibrium in the long-run. The concept was developed by Friedman (1968), Phelps (1968) and Roed (1997). Lee et al. (2009) show that, in this case, unemployment will fluctuate around a certain natural rate, so that shocks to the series dissipating over time will only have a temporary effect.

The second hypothesis is the so called "hysteresis" hypothesis that was formulated by Blanchard and Summers (1986). The authors state that due to labour market rigidities,

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shocks have permanent effects on the level of unemployment. In other words, cyclical fluctuations have permanent effects on the level of unemployment, due to labour market restrictions. In this case, the level of unemployment can be characterized as a non-stationary process, or unit root process.

Unfortunately, the use of unemployment rate in the hysteresis hypothesis generates several issues (i.e. the individuals frequently move in and out of the workforce) which are related to the concepts of 'discouraged worker' and 'added worker' effects (Benati, 2001; Stephens, 2002). The effect of 'discouraged worker' shows that the labour force moves in and out of the labor market with the business cycle, while the 'added worker' effect appears as labor supply feed-back of wives to their husbands' job loss.

In this context, Murphy and Topel (1997) conclude while investigating the trends in joblessness among American males: "The unemployment rate has become progressively less informative about the state of the labour market. We find that long-term changes in labour demands have reduced the returns to work, most notably among the least skilled. Declining labour market opportunities have led to reduced employment rates among these men, reflected in both higher unemployment, and withdrawal from the labour force. Since unemployment data exclude persons who have withdrawn from the labour force for market driven reasons…these data may miss a key part of the story" (p. 295).

Having the above explanation, some of the current investigations started to explore the hysteresis in unemploymentby using the labour force participation rate. Madsen et al. (2008) offers two arguments for this choice: "First, the participation rate is preferred to the unemployment rate, because unemployment is unlikely to reflect the number of individuals wanting to work as discussed above. Second, theories of hysteresis are derived from models of employment and not models of unemployment". (p. 167).

The relationship between the structuralist and hysteresis hypothesis is grounded in the property of participation rate series which is related to the "stationarity" process. More precisely, a series is stationary or reveals a non-unit root process when the shocks do not have permanent effects. On the contrary, if the shocks are permanent, the series is non-stationary or represents a unit root process. Two research alternatives outline the analysis of participation rate property.

In the first case, according to the structuralist theory, the participation rate is stationary, being mean reverting. As Liu (2011) notes, "Structuralist theories imply that the most shocks result in temporary fluctuations of employment around the natural rate, but some shocks cause a structural change in the natural rate itself. …As results, the unemployment would be stationary around its equilibrium path and is subject to structural breaks."(p. 390).

In the second case, when participation rate is non-stationary, the value of using unemployment rate as an indicator for capturing joblessness is debatable. More precisely, when the hysteresis in unemployment increases the participation rate, the unemployment rate rises. Conversely, the unemployment rate remains unaffected, as long as the unemployment rate equalises the natural rate through the adjustments of wage rate. It can be concluded thataccording to Ozdemir et al. (2013) "if the labor force participation rate series is non-stationary, that is the unemployment is characterized by hysteresis, changes in unemployment rates do not translate into changes in employment rates" (p. s142).

Thus, the new explorations inliterature have shifted their attention from unemployment rates to labour force participation rate. It is this researching "platform" that the paper tests the participation rate stationarity in Romania's case on, in the presence of nonlinearity by using the TAR model of Caner and Hansen (2001). The reason for using a non-linear threshold model stems from the evidence suggesting that labour responds differently when employment prospects weaken and when they improve. These asymmetric responses, in turn, contribute to the non-linear behaviour observed in the labour force participation rate (and unemployment rate) over time. Several studies found a tendency for the proportion of labour force participants who drop out of the labour market to increase quickly during periods of economic weakness and fall slowly during times of economic recovery. These asymmetric effects differ according to age, education and gender. Such a model was already used in labour market studies (e.g. Ghosh and Dutt, 2008; Madsen et al., 2008; and Tiwari, 2014). We focus on Romania because this country registered strong fluctuation in labour force participation rate, and was an emerging economy during the period of analysis (i.e. January 1994 - December 2013).In the case of the Romanian labour market, the main results provide a clear evidence of non-linearity in the full sample data, and non-stationary of participation rate for major part of the investigated period, mainly starting from year 2005.

The paper follows a new labour market topic "wave", which considers the property of participation rate to be the main research point. The work extends the literature in the field offering the first results regarding the hysteresis of participation rate in the case of Romania. We note that the existent literature about this country regarding the hysteresis as registered on labour market focuses on unemployment rate exclusively. Another novelty of this investigation is related to the linear and nonlinear tests performed in order to check the main assumed hypotheses.

The rest of the paper is organized as follows: Section 2 contains the literature review. Section 3 presents methodology, description of variables and data. Section 4 shows the estimations and empirical results, while Section 6 concludes.

Literature Review

Over the years, many scientists have focused their analyses on the labour market, especially testing the hysteresis hypothesis in unemployment. Some of them claim the existence of the unit root in unemployment rate series, while others state the opposite.

A new tendency arose in the last years and has the hysteresis implications of the participation rate as the main target. In this context, the literature that explores the participation rate is not so prolific.

One of the pioneer papers recognizing the importance of participation rate in the study of labour market was written by Lazear (1987). The author states that, on the one hand, decisions related to the labour force participation are designed in an irreversible way, and on the other hand, any adverse shocks generate a decline of temporary participation into persistent reductions. In the same note, but looking for the evidence of hysteresis in the unemployment rate in the case of U.S., Roberts and Morin (1999) emphasize that participation rate can be another direction of investigation in the labor market topic. However, the authors argue that this topic has a secondary importance in discussing unemployment as labor force participation involves consideration of demographic developments.

Madsen et al. (2008) offer the first consistent contribution which considers participation rate in empirical labor explorations. They follow a nonlinear approach and use a unit root test with threshold in order to analyze the hysteresis of participation rate in the case of G7 countries, for a period of 130 years. The authors find mix outputs and conclude that the labor force participation rate is trend reverting for Canada, Italy, Japan and the U.S., while for Italy and the US, the rate is mean reverting and trend reverting. Gustavsson and Österholm (2010) show strong evidence against mean reversion in disaggregated participation rates of subpopulations of the U.S. labour force. The major implication is that resorting to unemployment rates for subpopulations does not overcome the informational problems of a non-stationary aggregate participation rate. The authors suggest that unemployment ratesbe combined with other labour market statistics before conclusions can be drawn about labour market conditions.

Duval et al. (2010) select 30 industrial countries, over the period of 1960-2008, in order to investigate the effects of downturns on labour force participation. The main outputs reclaim a partial rather than full participation hysteresis, as result of cohort effects. In the same year, Ozdemir et al. (2013) investigate the unit root in the presence of endogenously determined multiple structural breaks. The main targeted series are total, female and male labour force participation rates for Australia, Canada and the U.S.A. Using an extension of Gil-Alana (2008) procedure, they find that under endogenously determined structural breaks, the total, female and male series are stationary, or mean reverting.

In their recent paper, Queneau and Sen (2013) focus their attention on a group of 12 OECD countries. The authors explore the characteristics of participation rates across gender, obtaining different results. They reveal that the female labour participation rates are relatively more persistent in Australia, Canada, Germany, Japan, the Netherlands, Portugal, and Spain, while in the case of male participation rate, the persistence is registered only for Finland, Norway, Sweden, and the U.S. Finally, the last contribution belongs to Liu (2014) who, using the Fourier stationarity test proposed by Enders and Lee (2012), extends the paper of Gustavsson and Österholm (2012) in the case of the U.S. The paper concludes by demonstrating the stationary property of labor force rate.

The literature that uses the participation rate in the case of Romania is practically absent; several papers focus only on unemployment rate hysteresis. The results are contradictory. Some of them put in evidence the unemployment hysteresis (e.g. Dinu et al., 2011; Gozgor, 2013; and Furuoka, 2014), while others reveal the mean reverting status of unemployment rate (e.g. León-Ledesma and McAdam, 2004).

The main literature findings that used the participation rate are heterogeneous, especially as a result of different econometric tools used to explore the main properties of analyzed data set. On this framework, following a "battery" of econometric tests, our paper investigates the hysteresis property of participation rate in Romania, offering the first such output for this country.

Empirical Methodology: The Caner and Hansen (2001) Threshold Autoregressive (TAR) Unit Root Test

We already stated that the relationship between the structuralist and hysteresis hypothesis of participation rate is connected to the concept of "stationarity" process. The structuralist theory implies the idea of stationary series (i.e. that the shocks do not have permanent effects), while the hysteresis hypothesis is related to non-stationary series (i.e. the shocks have permanent effects, the series is a unit root process). The econometrics field offers many tools to investigate the stationary property of a series. These tools are often called unit root tests. Thus, if we statistically test the unit root property of participation rate, we can obtain important information regarding the persistence of shocks.

In the case of the Romanian labour market, three sets of unit root tests are performed in order to investigate the properties of participation rate. The first one uses traditional tests, the second one focuses on the presence of a deterministic trend in data coupled with one or more structural breaks, while the last one tests both non-linearity and unit root in the data series.

The nonlinear unit root approach includes nonlinear unit root tests which consider in estimations non-linear functions (i.e.graphs do not have shape of a straight line), such as polynomial function, exponential function, logarithmic function etc. The classical unit root tests follow linear approach and use linear functions in estimations (i.e. the graphs represent straight lines).The participation rate is taken from Eurostat and expresses the percentage of people of working age (from 15 to 64 years) in the total population who are actually employed. The sample has a quarterly frequency andcovers the period of 1999Q1-2013Q4. The seasonal component has been removed by using the Tramo/Seats method. For robustness, we also use the participation level as number of workers expressed in thousand persons, with monthly frequency, from 1994M1-2010M11. This series is taken from the Monthly Bulletin of the Romanian National Bank.

In the first step of the analysis we follow the standard unit root tests of Dickey and Fuller (1979) - ADF, Phillips and Perron (1988) - PP, and Kwiatkowski et al. (1992) - KPSS. One might argue that the lack of support for stationarity of these traditional tests might be caused by the presence of a deterministic trend in the data coupled with one or more structural breaks over a long period. Ng and Perron (2001) - NP test is employed to investigate the trend stationarity of the series. In this case, four main test components are offered: MZa, MZt, MSB, and MPT. Actually, MZa and MZt represent modified versions of the Phillips' (1987) and Phillips-Perron's (1988) Za and Zt tests, while the MSB is a test related to Perron and Ng's (1996) approach. MPT test also is important because its limiting distribution is the same with that of the feasible point optimal test performed by Elliott, Rothenberg and Stock (1996).

However, the tests such as NP are found to give misleading results (i.e. biased towards the non-rejection of null hypothesis when structural breaks are present in the data series (Perron, 1989). Therefore, we have adopted in the present study two different tests of unit root to check the stationary property of the data in the presence of structural breaks. The first test is that by Zivot and Andrews (1992), while the second one by Lee and Strazicich (2003, 2004). The Zivot and Andrews (1992) approach tests the null of non-stationary against a single-break stationary. However, the Zivot and Andrews (1992), and Lumsdaine and Papell (1997) ADF-type endogenous break unit root tests both have the limitation that the critical values are derived, while assuming no break(s) under the null hypothesis.

Nunes et al. (1997) show that this assumption leads to size distortions in the presence of a unit root with structural breaks. As a result, when using ADF-type endogenous break unit root tests, one might conclude that a time series is trend stationary, when in fact it is non-stationary with break(s), which means that spurious rejections might occur. In contrast to the ADF-type tests, the LM unit root test is unaffected by breaks under the null hypothesis (Lee and Strazicich, 2001). Therefore, the Lee and Strazicich (2003, 2004) test is adopted as the appropriate approach. This test uses the Lagrange Multiplier (LM) test statistics and incorporates one and two structural breaks in the null and alternative hypotheses.

None of the aforementioned tests takes the non-linearity implications of series into account. In this context, we also follow – in our last methodological step –the approach of Caner and Hansen (2001). They made the first attempt to develop a rigorous asymptotic theory which would test for non-linearity and unit root in the data series simultaneously, without assuming stationarity to be a priori. Caner and Hansen (2001) proposed a TAR model based approach which jointly tests for non-stationarity and non-linearity. Following Caner and Hansen (2001), a TAR model with a two-regime and an autoregressive unit root can be described by the following data generating process:

$$\Delta l_t = \phi'_1 x_{t-1} I_{\{Z_t < \lambda\}} + \phi'_2 x_{t-1} I_{\{Z_t \geq \lambda\}} + \xi_t, \tag{1}$$

where $t = 1, \dots, T$, $x_{t-1} = (l_{t-1}, v'_t, \Delta l_{t-1}, \dots, \Delta l_{t-k})'$, l_t is the labour force participation rate for $t = 1,2, \dots, T$, $I_{\{\bullet\}}$ is the indicator function, ξ_t is a white noise process, $Z_{t-1} = l_{t-1} - l_{t-m}$ is the threshold variable, m is the delay parameter such that $l \leq m \leq k, v_t$ is a vector of exogenous variables that includes intercept and liner time trend, λ the threshold value. The λ is unknown and $\lambda \in \Lambda = [\lambda_1, \lambda_2]$ where λ_1 and λ_2 are selected according to $P(Z_t \leq \lambda_1) = 0.10$ and $P(Z_t \leq \lambda_2) = 0.90$, based on the tabulation offered by Andrew (1993). The component of ϕ_1 and ϕ_2 can be partitioned as follows:

$$\phi_1 = \begin{pmatrix} \mu_1 \\ \beta_1 \\ \alpha_1 \end{pmatrix}, \phi_2 = \begin{pmatrix} \mu_2 \\ \beta_2 \\ \alpha_2 \end{pmatrix}, \tag{2}$$

where μ_1 and μ_2 are scalar terms, v_t, β_1 and β_2 have the same dimensions, and α_1 and α_2 are k-vectors. Thus, the slope cofficients on l_{t-1} are (μ_1, μ_2), the slope on determinstec componetns are (β_1, β_2), and the slope coefficients on into two regimes are (α_1, α_2).

In the equation (1), the null hypothesis of $H_0: \phi_1 = \phi_2$, tests for the presence of the threshold effect by using the Wald statistic of the following form:

$$\mathrm{W}_t = \mathrm{W}_t(\hat{\lambda}) = sup_{\lambda \in \Lambda} \mathrm{W}_t(\lambda) = T \left(\frac{\hat{\sigma}_0^2}{\hat{\sigma}^2(\lambda)} - 1 \right), \tag{3}$$

where $\hat{\sigma}_0^2$ and $\hat{\sigma}^2$ respectively, are the residual variances from least squares estimation of the liner and TAR model.

Stationarity of the process l_t can be established in two ways. The first case is related to the evidence when we have a unit root in both regimes. This is called a complete unit root process. In the first case, thus, the null hypothesis is of the form $H_0: \mu_1 = \mu_2 = 0$, against the unrestricted alternative $\mu_1 = 0 \; or \; \mu_2 = 0$ is tested by using the Wald statistic. The μ_1 and μ_2 that from equation (1) will control the regime dependent unit root process of the labour force participation rate. The labour force participation rate has a unit root, if $\mu_1 = \mu_2 = 0$ holds and the test statistics is:

$$\mathrm{R}_{2T} = t_1^2 + t_2^2, \tag{4}$$

From the ordinary least squire estimation for $\hat{\mu}_1$ and $\hat{\mu}_2$, t_1 and t_2 is obtained. However, Caner and Hansen (2001) proposed the use of one-sided Wald statistic, arguing that the two-sided Wald statistic may have less power over the one-side version of the test. The one sided Wald test may be defined as follows:

$$\mathrm{R}_{1T} = t_1^2 I_{(\mu_1<0)} + t_2^2 I_{(\mu_2<0)}, \tag{5}$$

Caner and Hansen (2001) suggest, using individual t-statistic, that it is t_1 and t_2 what distinguish between the stationary (H_1) and the partial unit root case (H_2). The partial unit root supposes a series for a particular regime (i.e. for a sample of time period over the entire period under consideration) which may have unit root (based on one-sided Wald statistic), but not for the whole period under consideration. Of course, this is useful not only when we find that the unit root hypothesis is rejected (one-sided Wald statistic) for the whole period under consideration, but also when it is not rejected. In this case, the whole period under consideration may be influenced by the dominant nature of the particular regime.

The evidence of the partial unit root, H_2, is consistent, if and onlyone of $-t_1$ and $-t_2$ is statistically significant. This implies that significant evidence of partial unit root in the labour force participation rate will be found when it is a non-stationary process in one regime, and a stationary process in the other. We have generated critical values using bootstrap simulations with 10,000 replications in order to obtain maximum power from these tests, as suggested by Caner and Hansen (2001).

Even so, their approach has several disadvantages, as Smith (2006) notes: “the test of threshold effect is only nearly optimal, ... , the procedure is analytically complex and computationally expensive, while the sequential structure of the approach subjects it is to a pretesting bias. Finally, the Caner and Hansen’s testing procedure is not easily generalizable to alternative nonlinear specifications, such as Markov switching processes” (p. 8).

Empirical Results

In the case of Romania, the evolution of the participation rate for the period of 1999Q1-2013Q4 is illustrated in Figure 1 in the Appendix. The participation rate reveals two main trend parts: The first part accentuates descending tendency (until 2005), while the second one shows an ascending segment (starting from 2005).The participation rate has a sinusoidal dynamics for the entire analysed period.

The empirical section follows, considering the three sets of unit root tests described above. The results of the first set of unit root tests are presented in Table 1 which includes the standard ADF, PP and KPSS tests, with the constant included in the model.

Table 1 Traditional ADF, PP and KPSS Unit Root Tests With The Constant Included in the Model

Test	Level	1^{st} difference
ADF	-2.133	-7.847***
PP	-2.091	-7.881***
KPSS	0.407**	0.303***

*Note: ***, **, and * reflect significance at 1%, 5% and 10 % level of significance, respectively.*

The outputs clearly indicate that onthat level the participation rate in Romania has a unit root for all conventional levels of significance, except for the KPSS test (i.e. the null of stationarity is rejected only for 5% level of significance).

In the second step of the empirical part we further more analysed unit root property of the data series with the NP tests of Ng and Perron (2001), with a constant and trend. This was carried out in order to test whether labour force participation rate is trend stationary. The results of the NP tests are presented in Table 2.

Table 2 Univariate Unit Root Tests: The Constant and Trend Included in the Model

Romanian labour force participation rate	Test statistics in level form			
	MZa	MZt	MSB	MPT
	-4.14	-1.301	0.314***	20.58***

Note:
*(1) *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively.*
(2) Lag length selection is based on Schwarz information criterion (SIC) and it is one here.

These results indicate that the null of unit root is not rejected, the labour force participation rate revealing a non-stationary process[3] for two components of the NP approach. At the same time, the outputs of the unit root analysis with incorporation of endogenously determined structural breaks are presented in Table 3.

[3] Tiwari (2010, 2012) mentioned that MZa and MZt are the more powerful test statistics of Ng and Perron (2001) tests.

Table 3 Univariate Unit Root Tests: Constant and Trend Included in the Model with Structural Breaks

Lee-Strazicich's LM unit Root Test							
T_{B1}	T_{B2}	k	LM Test statistics	B_{t1}	B_{t2}	D_{t1}	D_{t2}
Results for univariate LM unit root test with one and two structural break in intercept/constant only							
2001:04		0	(-2.79)	(-4.28)***			
2001:04	2009:02	0	(-3.07)	(-4.32)***	(1.17)		
Results for univariate LM unit root test with one and two structural break in intercept/constant and trend both							
2002:01		0	(-4.64)**	(-0.11)		(-2.99)***	
2001:02	2002:03	0	(-5.35)*	(2.12)**	(0.86)	(-3.77)***	(2.54)***
Zivot-Andrews unit root test: Allowing for Break in both Intercept and Trend							
2002:01		0	-6.94***				

Note:
(1) Critical Values for Zivot-Andrews Unit Root Test are -5.57 and -5.08 at 1% and 5% level of significance respectively.
*(2) TB1 and TB2 are the dates of the structural breaks; k is the lag length; Bt1 and Bt2 are the dummy variables for the structural breaks in the intercept. Dt1 and Dt2 are the dummy variables for the structural breaks in the slope. Figures in parentheses are t-values. Critical values of LM test statistics of both test (that is when breaks occur intercept and intercept and trend jointly are reported in Lee and Strazicich (2003, 2004) two-break and one-break cases respectively. * (**) *** denote statistical significance at the 10%, 5% and 1% levels respectively.*

Table 3 clearly shows that Zivot-Andrews unit root test of one structural break rejects the null hypothesis of unit root in labour force participation rate at the 1% level of significance. The LM unit root test of Lee-Strazicich also corroborates with the findings of Zivot-Andrews unit root test particularly when one or two breaks occur both in constant/intercept and trend. Hence, this provides evidence to support our argument that labour force participation rate is mean and trend reverting.

Table 4 Wald Test for Threshold Effect Using Fixed Delay Parameter

m	Wald statistics	Bootstrap critical values			Bootstrap p-value
		10 %	5%	1%	
1	**60.33**	**26.50**	**32.25**	**46.34**	**0.004**
2	24.86	26.21	31.61	44.81	0.124
3	16.56	26.32	31.68	44.79	0.339
4	41.99	26.05	31.59	45.19	0.016

Note: "m" denotes optimal delay Parameter. We set a maximum lag of 4 and base all our bootstrap tests on 10,000 replications.

As a final empirical step, Caner and Hansen (2001) proposed a nonlinear TAR unit root test which is used to jointly check for the presence of nonlinearities and unit root hypothesis in the Romanian labour force participation rate; the results obtained are presented in Tables 4–7. We begin with testing for the presence of non-linearity in the Romanian labour force participation rate through the Wald test. The related results are provided in the Table 4.

The bootstrap critical values and bootstrap p-values are obtained with 10,000 bootstrap replications for the labour force participation rate of the form $Z_{t-1} = l_{t-1} - l_{(t-(m-1))}$ for the delay parameters $m = 1, \dots, 4$. Following Caner and Hansen (2001), the m is endogenously determined by selecting the least squares estimate of m that minimizes the residual variance. In other words, such m is selected at which the value of W_t statistic is maximized, and in the presented case the W_t statistic is maximized for labour force participation rate when $m = 1$. Based on the bootstrapped p-value we find strong evidence to reject the null hypothesis of linearity at the 1% level of significance, which implies that simple linear models are inappropriate for testing the unit root property of labour force participation rate, and thus we got motivation to use the TAR model. Finally, based on the R_{1T} and R_{2T} statistics, and for the each delay parameter $m = 1, \dots, 4$, we explored the threshold unit root properties of labour force participation rate with emphasising our preferred model. The results related to the R_{1T} and R_{2T} statistics, together with the bootstrap critical values at the 1%, 5% and 10% levels of significance and the bootstrap p-value, are reported in Table 5.

Table 5 One- and Two-sided Unit Root Tests

m	R_{1T} Wald statistics	Bootstrap critical values 10 %	5%	1%	Bootstrap p-value	R_{2T} Wald statistics	Bootstrap critical values 10 %	5%	1%	Bootstrap p-value
1	**16.07**	**12.74**	**16.42**	**26.23**	**0.054**	**16.07**	**13.99**	**17.40**	**27.56**	**0.066**
2	6.11	13.35	17.25	26.63	0.365	6.11	14.30	18.32	27.52	0.438
3	10.58	13.42	17.38	27.84	0.167	10.58	14.51	18.41	28.51	0.202
4	34.54	13.97	18.03	28.34	0.004	34.54	14.83	18.68	29.28	0.004

Note: "m" denotes optimal delay Parameter. We set a maximum lag of 12 and base all our bootstrap tests on 10,000 replications.

For $m = 1$, the null hypothesis of unit root for the Romanian labour force participation rate is rejected at the 10% level of significance in Table 5 which provides an evidence of stationarity property of labour force participation rate. Given that the R_{1T} and R_{2T} are unable to discriminate the complete and partial unit root in labour force participation rate, we examine the evidence on the unit root hypothesis through the individual t-statistics, t_1 and t_2 and report related results in Table 6.

Table 6 shows that, for $m = 1$, the t_1 test statistics is higher than the critical value at the 5% level of significance. This leads us to conclude that Romanian participation rate is characterized by partial unit roots. Specifically, we find that the Romanian participation rate is stationary in the first regime and non-stationary in the second one. Finally, for

$m = 1$, the least square estimates for the threshold model, as well as the point estimate of the threshold, $\hat{\lambda}$, are presented in Table 7.

Table 6 Partial Unit Root Results

m	t-Statistic	t_1^2 Statistic Bootstrap critical values 10 %	5%	1%	Bootstrap p-value	t-Statistic	t_2^2 Statistic Bootstrap critical values 10 %	5%	1%	Bootstrap p-value
1	**3.76**	**2.80**	**3.35**	**4.56**	**0.031**	**1.38**	**2.82**	**3.37**	**4.41**	**0.416**
2	2.25	2.85	3.37	4.55	0.190	1.01	2.90	3.49	4.55	0.527
3	3.22	2.88	3.51	4.66	0.069	0.40	2.89	3.41	4.53	0.687
4	5.84	2.97	3.62	4.76	0.001	0.61	2.94	3.43	4.50	0.651

Note: "m" denotes optimal delay Parameter. We set a maximum lag of 4 and base all our bootstrap tests on 10,000 replications.

Table 7 Partial Unit Root Results

Regressors	*Estimates,* $m = 1$, $\hat{\lambda} = -0.511139$ $Z_{t-1} < \hat{\lambda}$ *Estimates*	St Error	$Z_{t-1} > \hat{\lambda}$ *Estimates*	St Error	Test for equality of individual coefficients: Wald statistics	Bootstrap p-value
Constant	23.83	6.72	4.22	3.02	7.06	0.36
Y(t-1)	-0.38	0.10	-0.06	0.04	8.09	0.22
DY(t-1)	-0.43	0.24	-0.05	0.17	1.63	0.58
DY(t-02)	0.24	0.20	-0.17	0.11	3.11	0.45
DY(t-03)	-2.01	0.49	0.12	0.09	17.97	0.03
DY(t-04)	0.98	0.30	-0.08	0.10	10.82	0.11

Note: "m" denotes optimal delay Parameter. We set a maximum lag of 4 and base all our bootstrap tests on 10,000 replications.

For $m = 1$, the value of threshold point estimate $(\hat{\lambda})$ is -0.511139 and indicates that the TAR model breaches the regression equation into two regimes contingent upon whether a quarter change in the Romanian labour force participation rate lies below, or above -0.511139.[4] The first regime transpires for $Z_{t-1} < -0.511139$, which occurs when the labour force participation rate has fallen over more than 51.1 per cent over a quarter period. When $Z_{t-1} > -0.511139$, the second regime appears which constitutes all the remaining observations. The first regime shows that Romanian labour force participation rate has 9 numbers of observations and the second regime, which shows non-stationary behaviour of the Romanian labour force participation rate, has 46 observations.

[4] The value of $\hat{\lambda}$ is calculated by minimizing $\sigma^2(\lambda)$. See also Figure 2 in the Appendix for better understanding. The figure shows the partition of the sample data in both regimes and presents about which observation point belongs to upper or lower thresholds.

As far as Romanian labour market is concerned, there is clear evidence of non-linearity and non-stationary of the participation rate for the major part of the investigated period, mainly starting from 2005. This last characteristic is also reinforced by both figures in Appendix, the main breaking point being registered around year 2005.

Finally, when verifying for robustness, we find that similar results can be replicated by using the participation level as number of workers, with monthly frequency, for the period of 1994M1-2010M12[5].

Conclusions

The basic objective of the study was to provide empirical validity of hysteresis of labour force participation rate in Romania. We used quarterly data for the period of 1999Q1-2013Q4. For the analysis, we adopted three main approaches. The first one follows traditional unit root tests, the second one focuses on the presence of a deterministic trend in data, coupled with one or more structural breaks, while the last one investigates both nonlinearity and unit root in the data series, by using the TAR model of Caner and Hansen (2001).

All of the traditional tests allow us to consider the participation rate in Romania as a unit root process. Finally, the non-linear framework approach of Caner and Hansen (2001) reveals that the Romanian labour force participation rate is a non-linear process and has a partial unit root (i.e. it is stationary in the first regime, and non-stationary in the second one).

The value of using unemployment rates as an indicator for capturing the joblessness in this country is debatable, especially after 2005. Starting from this year, the participation rate does not follow long-term changes in unemployment rate. In this context, on the second part of the analysed period, the cyclical shocks have permanent effects on the labour force participation rate, the Romanian labour market revealing a high level of rigidity. The levels of unemployment rate are not translated into long-term changes in employment rates.

Regarding the policy implications, as the participation rate in Romania is a nonlinear process, it is required for Romanian policy-makers to follow forecasting nonlinear models in any further estimations of the participation rate. On the other hand, regulations of Romanian government should be made in order to obtain "laxity" on the labour market.

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[5] Access to these results can be requested from the authors.

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Appendix

Figure 1 The participation rate in Romania, in the period 1991Q1-2013Q4 (%)

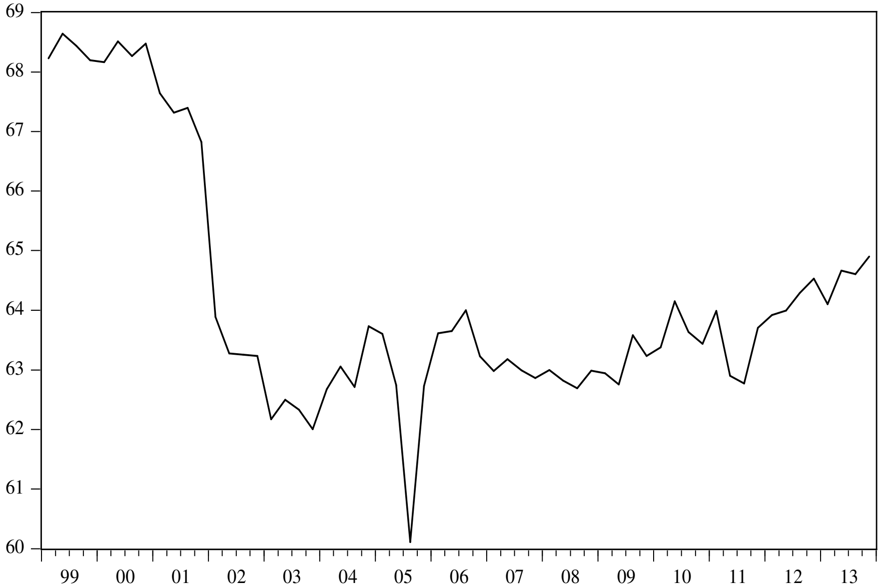

Figure 2 Thresh hold regime plotof participation rate in Romania (%)