TRACKING FINANCIAL BUBBLES ON ROMANIA STOCK MARKET

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Abstract

The Log-Periodic Power Law (LPPL) is a consistent model capable of detecting explosives financial bubbles, which reflect the positive and nonlinear investors feedbacks. The regime imposed by the model is faster than an exponentially growth rate, combined with logarithmic oscillations. Applying the LPPL model on the top 25 most liquid companies traded on Bucharest Stock Exchange that are part of BET-XT Index basket on daily data between 26/01/1997 – 10/02/2017, we managed to find a total number of 54 financial bubbles regimes.

Keywords: financial bubble, financial modeling, log-periodic power law, stock market.

JEL Classification: C20, C49, C10

1. Introduction

This paper examines the existence of multiple bubbles regimes on top 25 blue chip stocks traded on Bucharest Stock Exchange between 1997 to 2017 period using a model called Log-Periodic Power Law (LPPL), that was independently proposed by Sornette, Johansen and Bouchaud (J. Phys. I. France 6 pp. 167-175, 1996). In this paper we use principles described in Sornette (2000 and 2004) and Pele (2012). The LPPL model propose an exponential nonlinear price trend with log-periodic movements around it that culminate ultimately with a possible price collapse.

Financial bubble is defined as a situation where the price growth rate of a financial asset is not related to the fundamental value, being mostly driven by investors future expectations. Since

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financial bubbles are very difficult to observe in real time, they are analyzed after the fact when assets prices collapse suddenly, returning to their core values.

According to Sornette (2003), the specific manner in which the prices of financial assets are collapsing is not very important, a collapse in prices occurring when the market enters into a unstable growth rate phase and any disturbance no matter how small can trigger this instability. The collapse is caused primarily due to the unstable position of the market, while the moment of shock (the trigger) is secondary in importance. So, the reason of collapsing is endogenous and the trigger is exogenous to the market.

Due to the extraordinary effect of financial crises over the world economy, the possibility of detecting financial bubbles before they burst have become a topic of interest for all market participants. Long-term investors that have a high level of risk aversion would definitely want to be protected against this type of extreme events, while short-term investors may try to profit from them. Even the Central Banks would benefit from the ability to anticipate financial bubbles regimes early on, by taking the adequate measures in order to prevent them or diminish their negative effects.

2. The log-periodic power law model (LPPL)

Sornette, Johansen and Bouchaud have developed a universal model capable of identifying bubbles using concepts used in physics. In his attempt to identify financial bubbles, the financial market is defined as a complex system where the assets prices collapse is seen as critical events. The behaviour of such a complex system is represented by the aggregation of its individual participants behaviour. On financial market the investors are the main participants, who are organized in a hierarchical structure (of different sizes).

When investors begin to replicate their decisions from each other, the psychological effect become so evident due to the fact that the interactions between them follows nonlinear patterns, the financial market reaching a point where the scale collective behaviour is developing into a speculative financial bubble regime. As time passes, the system becomes unstable due to the price growth caused by the effect of behavioural imitation among investors, so when the critical point is reached, the financial bubble burst is inevitable.

The price almost always presents two features before the collapse, namely:

- The price is growing faster than exponential
- The oscillations around the main trend have accelerated frequency

The LPPL is a consistent model capable of detecting explosives financial bubbles, which reflect the positive and nonlinear investors feedbacks. The regime imposed by the model is faster than an exponentially growth rate, combined with logarithmic oscillations.

The LPPL model is built as a function of time given by:

$$\ln p(t) = A + B(t_c - t)^{\beta}\{1 + Ccos[\omega \ln(t_c - t)^{\beta}] + \emptyset\}$$

Where:

P(t) is the price at t moment,

t_c is the critical moment (the most probable moment of price collapse),

$A, B, C, \beta, \omega, \emptyset$ are the model parameters.

In order to validate this model, there are some empirically observed restrictions on the values of the parameters, namely:

A > 0 - usually this is the price at critical time.

B < 0

C≠0, |C|<1 - this parameter controls the oscillations amplitude around the exponential tendency.

0<β<1 - this parameter controls the magnitude growth rate of the main tendency.

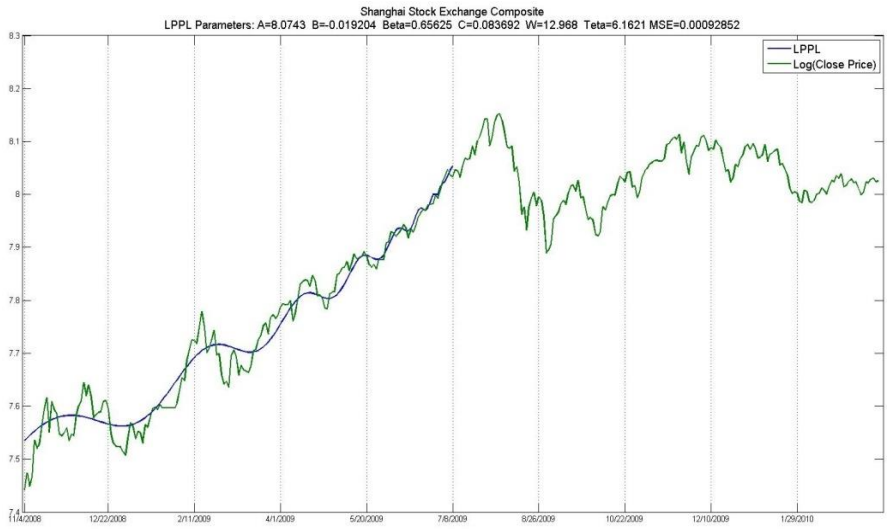
ω∈(0,∞) - this parameter controls the oscillations.

∅∈[0,4π] – represent a phase parameter.

Bastiaensen, Cauwels, Sornette, Woodard and Zhou published "The Chinese Equity Bubble: Ready to Burst" on 10 July 2009 in which they managed to detect a financial bubble regime formed on the Chinese index Shanghai Stock Exchange Composite between November 4th 2008 - July 8, 2009 (Figure 1).

Figure 1

LPPL fitted to Shanghai Stock Exchange Composite between November 4th 2008 - July 8 2009 on daily data



Data Source: Bloomberg

3. Calibration methods for the LPPL model

As explained in Fantazzini and Geraskin (2011), there are several methods for estimating the LPPL model parameters.

The 2-step Nonlinear Optimization (Johansen et al., 2000) that involves two operations: the use of default parameters (using a neighborhood search procedure called Taboo) and then Levenberg-Marquardt algorithm to minimize the sum of squared errors.

Genetic Algorithms (Jacobsson, 2009) that implies the usage of computer simulations in order to replicate the natural selection in biological systems, using four phases: a selection mechanism, a breeding mechanism, a mutation mechanism, and a culling mechanism.

The 2-step/3-step ML Approach (as detailed in Fantazzini 2010) which consist in reversing the analyzed time series and calibrate the LPPL for the case of an anti-bubble regime and using the estimated parameters as starting values for estimating all the LPPL parameters, by using again the reversed times series.

Applying the 2-step Nonlinear Optimization, the LPPL model can be written as follows:

$$y_t = A + Bf_t + Cg_t$$

Where:

$$y_t = \ln p(t),\ \ f_t = (t_c - t)^{\beta}\ \ and\ g_t = (t_c - t)^{\beta}\cos[\omega \ln(t_c - t)^{\beta} + \emptyset]$$

The A,B,C parameters can be estimated from the following system:

$$\begin{pmatrix} \sum_{t=1}^{T} y_t \\ \sum_{t=1}^{T} y_t f_t \\ \sum_{t=1}^{T} y_t g_t \end{pmatrix} = \begin{pmatrix} T & \sum_{t=1}^{T} f_t & \sum_{t=1}^{T} g_t \\ \sum_{t=1}^{T} f_t & \sum_{t=1}^{T} f_t^2 & \sum_{t=1}^{T} f_t g_t \\ \sum_{t=1}^{T} g_t & \sum_{t=1}^{T} f_t\, g_t & \sum_{t=1}^{T} g_t^2 \end{pmatrix} \begin{pmatrix} A \\ B \\ C \end{pmatrix}$$

$$\text{If } b = \begin{pmatrix} A \\ B \\ C \end{pmatrix},\ X = \begin{pmatrix} 1 & f_1 & g_1 \\ \cdots & \cdots & \cdots \\ 1 & f_T & g_T \end{pmatrix}, y = \begin{pmatrix} y_1 \\ . \\ . \\ . \\ y_T \end{pmatrix}$$

Then: $\widehat{b} = (X'X)^{-1}X'y$

Next starting from the A,BC parameters, we use Taboo procedure using the empirically observed restrictions and the Levenberg-Marquardt algorithm minimizing RMSE (in order to find the critical time t_c).

4. Data and methodology

The data used for our analysis consists of daily returns for the most liquid 25 companies traded on Bucharest Stock Exchange, that are part of BET-XT Index basket. We are applying the LPPL model on data between 26.01.1997 – 10.02.2017 (if we have historical data). More information about the companies and the available historical data can be found in the table below:

Table 1

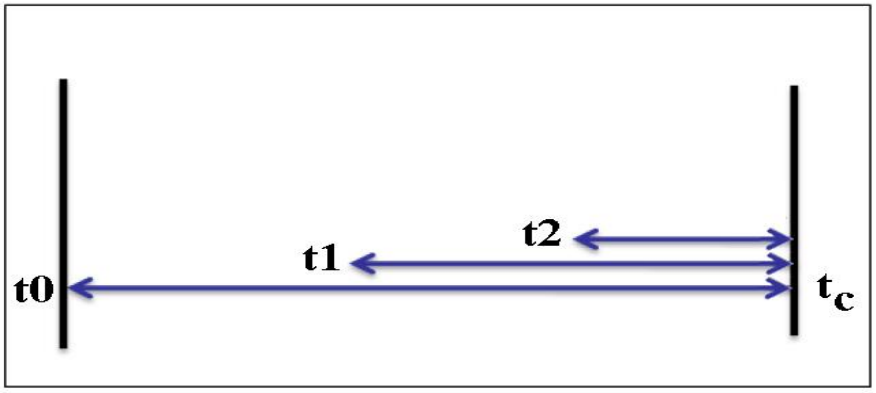
Companies from bet-xt index

Company Name	Bloomberg Symbol	Historical Data Interval
BANCA TRANSILVANIA S.A.	TLV RO Equity	26/11/1997 – 02/10/2017
FONDUL PROPRIETATEA	FP RO Equity	26/01/2011 – 02/10/2017
OMV PETROM S.A.	SNP RO Equity	04/09/2001 – 02/10/2017
S.N.G.N. ROMGAZ S.A.	SNG RO Equity	12/11/2013 – 02/10/2017
BRD – GROUPE SOCIETE GENERALE S.A.	BRD RO Equity	16/01/2001 – 02/10/2017
SOCIETATEA ENERGETICA ELECTRICA S.A.	EL RO Equity	04/07/2014 – 02/10/2017
S.N.T.G.N. TRANSGAZ S.A.	TGN RO Equity	24/01/2008 – 02/10/2017
C.N.T.E.E. TRANSELECTRICA	TEL RO Equity	29/08/2006 – 02/10/2017
SIF OLTENIA S.A.	SIF5 RO Equity	19/11/1999 – 02/10/2017
SIF BANAT CRISANA S.A.	SIF1 RO Equity	19/11/1999 – 02/10/2017
SIF MOLDOVA S.A.	SIF2 RO Equity	19/11/1999 – 02/10/2017
SIF TRANSILVANIA S.A.	SIF3 RO Equity	19/11/1999 – 02/10/2017
SIF MUNTENIA S.A.	SIF4 RO Equity	19/11/1999 – 02/10/2017
S.N. NUCLEARELECTRICA S.A.	SNN RO Equity	04/11/2013 – 02/10/2017
CONPET SA Ploiești	COTE RO Equity	31/01/2005 – 02/10/2017
BURSA DE VALORI BUCUREȘTI SA	BVB RO Equity	09/06/2010 – 02/10/2017
ANTIBIOTICE S.A.	ATB RO Equity	26/11/1997 – 02/10/2017
ALBALACT SA	ALBZ RO Equity	08/12/2004 – 02/10/2017
ELECTROMAGNETICA SA BUCUREȘTI	ELMA RO Equity	02/04/1999 – 02/10/2017
IMPACT DEVELOPER & CONTRACTOR S.A.	BCC RO Equity	11/06/2004 – 02/10/2017
BANCA COMERCIALA CARPATICA S.A.	IMP RO Equity	19/12/1997 – 02/10/2017
IAR SA Brașov	IARV RO Equity	22/04/1999 – 02/10/2017
SSIF BRK FINANCIAL GROUP SA	BRK RO Equity	14/03/2005 – 02/10/2017
ROMCAB SA TG. MUREȘ	MCAB RO Equity	09/10/2006 – 02/10/2017
ROMCARBON SA BUZĂU	ROCE RO Equity	05/04/1999 – 02/10/2017

Data Source: Bloomberg

Figure 2

LPPL calibration procedure



We are going to calibrate the LPPL model iterating through all the available data using a flexible windows period (Figure 2) and store all the cases were the LPPL parameters follows the empirically observed restrictions.

5. Results

Fitting the LPPL model on all the available data, we managed to identify a total number of 54 explosives financial bubbles regimes, described in the tables bellow for every company composing the BET-XT Index.

Table 2

All bubbles regimes detected applying the LPPL model to BANCA TRANSILVANIA S.A. (TLV RO Equity)

BANCA TRANSILVANIA S.A. (TLV RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
13/1/ 2005	16/01/ 2006	0.262438543	-0.073262762	0.4609375	0.079768682	8.952	6.162109375
07/01/ 2009	30/11/ 2009	-0.343306633	-0.010268613	0.8828125	0.121026919	19.096	6.142578125
20/01/ 2016	21/03/ 2016	7.390133061	-6.572482283	0.0078125	0.002252715	3.936	6.25

Applying the LPPL model to **BANCA TRANSILVANIA S.A. (TLV RO Equity)** on daily data between 26/11/1997 - 02/10/2017, we managed to identify a total number of 3 financial bubbles regimes (Table 2).

Table 3

All bubbles regimes detected applying the LPPL model to FONDUL PROPRIETATEA (FP RO Equity)

FONDUL PROPRIETATEA (FP RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
17/06/ 2014	30/09/ 2014	0.017747327	-0.058797124	0.296875	0.080318206	9.984	6.26953125

Applying the LPPL model to **FONDUL PROPRIETATEA (FP RO Equity)** on daily data between 26/01/2011 - 02/10/2017, we managed to identify only one financial bubble regime (Table 3).

Table 4

All bubbles regimes detected applying the LPPL model to OMV PETROM S.A. (SNP RO Equity)

OMV PETROM S.A. (SNP RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
25/05/ 2010	04/08/ 2011	-0.7070194	-0.083490747	0.328125	0.084938558	6.936	6.435546875

Applying the LPPL model to **OMV PETROM S.A. (SNP RO Equity)** on daily data between 04/09/2001 - 02/10/2017, we managed to identify only one financial bubble regime (Table 4).

Table 5

All bubbles regimes detected applying the LPPL model to S.N.G.N. ROMGAZ S.A. (SNG RO Equity)

S.N.G.N. ROMGAZ S.A. (SNG RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
20/05/ 2016	25/01/ 2017	7.127500021	-3.832056672	0.0078125	0.004998405	13.112	6.19140625

Applying the LPPL model to **S.N.G.N. ROMGAZ S.A. (SNG RO Equity)** on daily data between 12/11/2013 - 02/10/2017, we managed to identify only one financial bubble regime (Table 5).

Table 6

All bubbles regimes detected applying the LPPL model to BRD - GROUPE SOCIETE GENERALE S.A. (BRD RO Equity)

BRD - GROUPE SOCIETE GENERALE S.A. (BRD RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
15/04/ 2005	27/02/ 2006	2.948197237	-0.0071967	0.8984375	0.150921628	6	6.42578125
25/03/ 2009	26/08/ 2009	2.770714232	-0.166294681	0.359375	0.033433173	17.912	6.240234375
14/03/ 2014	30/06/ 2014	2.306509664	-0.053862111	0.3125	0.091282209	7	6.2109375
25/08/ 2015	24/11/ 2015	2.680355932	-0.120226957	0.2421875	0.066622587	12.032	6.416015625
26/05/ 2016	09/08/ 2016	2.519815855	-0.047681372	0.4453125	0.092792633	3.832	6.376953125

Applying the LPPL model to **BRD - GROUPE SOCIETE GENERALE S.A. (BRD RO Equity)** on daily data between 16/01/2001 - 02/10/2017, we managed to identify a total number of 5 financial bubbles regimes (Table 6).

Table 7

All bubbles regimes detected applying the LPPL model to SOCIETATEA ENERGETICA ELECTRICA S.A. (EL RO Equity)

SOCIETATEA ENERGETICA ELECTRICA S.A. (EL RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
17/04/ 2015	28/08/ 2015	2.562053686	-0.002084511	0.875	0.222210553	6.064	6.357421875

Applying the LPPL model to **SOCIETATEA ENERGETICA ELECTRICA S.A. (EL RO Equity)** on daily data between 04/07/2014 - 02/10/2017, we managed to identify only one financial bubble regime (Table 7).

Table 8

All bubbles regimes detected applying the LPPL model to S.N.T.G.N. TRANSGAZ S.A. (TGN RO Equity)

S.N.T.G.N. TRANSGAZ S.A. (TGN RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
03/03/ 2009	14/04/ 2010	5.900313827	-0.241306793	0.2578125	0.059047887	10.024	6.455078125
10/06/ 2011	21/02/ 2012	5.694214007	-0.124244658	0.234375	0.06729812	8.04	6.201171875

Applying the LPPL model to **S.N.T.G.N. TRANSGAZ S.A. (TGN RO Equity)** on daily data between 24/01/2008 - 02/10/2017, we managed to identify a total number of 2 financial bubbles regimes (Table 8).

Table 9

All bubbles regimes detected applying the LPPL model to C.N.T.E.E. TRANSELECTRICA (TEL RO Equity)

C.N.T.E.E. TRANSELECTRICA (TEL RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
30/08/ 2006	19/02 /2007	3.752589729	-0.018435371	0.671875	0.160175424	7.968	6.54296875
21/04/ 2009	08/10/ 2009	7.793650912	-5.134459262	0.0078125	0.003900378	4.128	6.25
15/12/ 2014	20/02/ 2015	8.530426463	-5.036427907	0.0078125	0.002574291	7.96	6.279296875

Applying the LPPL model to **C.N.T.E.E. TRANSELECTRICA (TEL RO Equity)** on daily data between 29/08/2006 - 02/10/2017, we managed to identify a total number of 3 financial bubbles regimes (Table 9).

Table 10
All bubbles regimes detected applying the LPPL model to SIF OLTENIA S.A. (SIF5 RO Equity)

SIF OLTENIA S.A. (SIF5 RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
10/07 /2003	06/09/ 2004	0.600134839	-0.9120526	0.1484375	0.025739445	4.992	6.50390625
01/12/ 2005	16/01/ 2006	1.475954601	-0.218929218	0.328125	0.091084163	5.088	6.46484375
05/10/ 2007	24/07/ 2007	1.704400292	-0.083789468	0.4375	0.06715313	9.104	6.171875
10/12/ 2009	04/02/ 2010	0.626409217	-0.007308415	0.90625	0.123845144	15.024	6.357421875
15/12/ 2011	21/02/ 2012	0.480254949	-0.067537654	0.4921875	0.081518914	8.936	6.416015625

Applying the LPPL model to **SIF OLTENIA S.A. (SIF5 RO Equity)** on daily data between 19/11/1999 - 02/10/2017, we managed to identify a total number of 5 financial bubbles regimes (Table 10).

Table 11
All bubbles regimes detected applying the LPPL model to SIF BANAT CRISANA S.A. (SIF1 RO Equity)

SIF BANAT CRISANA S.A. (SIF1 RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
21/01/ 2005	01/04/ 2006	1.44730778	-0.375482253	0.2265625	0.071323965	17.128	6.240234375
19/03/ 2007	24/07/ 2007	1.601151354	-0.077752117	0.4453125	0.078764304	3.952	6.044921875
31/03/ 2009	04/02/ 2010	0.495011847	-0.011208489	0.765625	0.09077931	18.016	6.23046875
08/09/ 2012	14/03/ 2013	0.41687293	-0.057751937	0.34375	0.094405037	6.032	6.1328125

Applying the LPPL model to **SIF BANAT CRISANA S.A. (SIF1 RO Equity)** on daily data between 19/11/1999 - 02/10/2017, we managed to identify a total number of 4 financial bubbles regimes (Table 11).

Table 12
All bubbles regimes detected applying the LPPL model to SIF MOLDOVA S.A. (SIF2 RO Equity)

SIF MOLDOVA S.A. (SIF2 RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
12/05/ 2003	06/11/ 2004	19.52325315	-20.59973737	0.0078125	0.003294161	5	6.162109375
11/11/ 2004	18/02/ 2005	0.27319719	-0.495935458	0.265625	0.04376212	10.112	6.220703125
29/03/ 2005	01/10/ 2006	0.302960037	-0.034258267	0.65625	0.089575553	8.96	6.435546875
07/06/ 2006	11/06/ 2006	0.682992316	-0.123767049	0.4140625	0.02187078	15.992	6.220703125
28/04/ 2009	21/09/ 2009	-0.144686405	-0.308271034	0.2421875	0.104309023	3.192	6.259765625
10/06/ 2011	02/06/ 2012	-0.292071536	-0.024851794	0.765625	0.101610988	11.84	6.259765625

Applying the LPPL model to **SIF MOLDOVA S.A. (SIF2 RO Equity)** on daily data between 19/11/1999 - 02/10/2017, we managed to identify a total number of 6 financial bubbles regimes (Table 12).

Table 13
All bubbles regimes detected applying the LPPL model to SIF TRANSILVANIA S.A. (SIF3 RO Equity)

SIF TRANSILVANIA S.A. (SIF3 RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
07/08/ 2005	01/04/ 2006	-0.584304995	-0.01334564	0.7265625	0.166863362	17.096	6.357421875
11/02/ 2011	03/01/ 2012	-1.021004615	-0.01763345	0.6875	0.229310859	16.968	6.376953125

Applying the LPPL model to **SIF TRANSILVANIA S.A. (SIF3 RO Equity)** on daily data between 19/11/1999 - 02/10/2017, we managed to identify a total number of 2 financial bubbles regimes (Table 13).

Table 14
All bubbles regimes detected applying the LPPL model to SIF MUNTENIA S.A. (SIF4 RO Equity)

SIF MUNTENIA S.A. (SIF4 RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
27/01/ 2005	01/09/ 2006	0.856676687	-0.139077824	0.3828125	0.109493197	5.104	6.34765625
04/08/ 2009	15/09/ 2009	6.966331626	-7.221226209	0.0078125	0.005007898	3.168	6.279296875
19/10/ 2011	13/02/ 2012	1.259485773	-1.472455596	0.0625	0.022745679	10	6.34765625
08/05/ 2013	23/01/ 2014	0.227710875	-0.203099989	0.2421875	0.083700933	3.144	6.328125

Applying the LPPL model to **SIF MUNTENIA S.A. (SIF4 RO Equity)** on daily data between 19/11/1999 - 02/10/2017, we managed to identify a total number of 4 financial bubbles regimes (Table 14).

Table 15
All bubbles regimes detected applying the LPPL model to S.N. NUCLEARELECTRICA S.A. (SNN RO Equity)

S.N. NUCLEARELECTRICA S.A. (SNN RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
None							

Applying the LPPL model to **S.N. NUCLEARELECTRICA S.A. (SNN RO Equity)** on daily data between 04/11/2013 - 02/10/2017, we didn't manage to identify any financial bubble regime (Table 15).

Table 16
All bubbles regimes detected applying the LPPL model to CONPET SA Ploiești (COTE RO Equity)

CONPET SA Ploieşti (COTE RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
29/11/	02/09/	5.058822277	-0.452642199	0.1171875	0.019785305	3.952	6.572265625

2016	2017						

Applying the LPPL model to **CONPET SA Ploiești (COTE RO Equity)** on daily data between 31/01/2005 - 02/10/2017, we managed to identify only one financial bubble regime (Table 16).

Table 17

All bubbles regimes detected applying the LPPL model to BURSA DE VALORI BUCUREȘTI SA (BVB RO Equity)

BURSA DE VALORI BUCUREŞTI SA (BVB RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
05/09/ 2013	23/12/ 2013	3.38793929	-0.00365008	0.9765625	0.130234616	7.912	6.3671875
16/06/ 2014	28/01/ 2015	14.12468381	-10.36079977	0.0078125	0.001118327	12.088	6.025390625

Applying the LPPL model to **BURSA DE VALORI BUCUREȘTI SA (BVB RO Equity)** on daily data between 09/06/2010 - 02/10/2017, we managed to identify a total number of 2 financial bubbles regimes (Table 17).

Table 18

All bubbles regimes detected applying the LPPL model to ANTIBIOTICE S.A. (ATB RO Equity)

ANTIBIOTICE S.A. (ATB RO Equity)							
Start Date	**Critical Time**	***LPPL Parameters***					
		A	***B***	***β***	***C***	***ω***	***Ø***
03/04/ 2004	19/01/ 2005	-0.355360487	-0.375123385	0.25	0.027322504	10.024	6.46484375
26/07/ 2010	13/01/ 2011	-0.769734953	-0.01857575	0.546875	0.142844897	7.016	6.26953125

Applying the LPPL model to **ANTIBIOTICE S.A. (ATB RO Equity)** on daily data between 26/11/1997 - 02/10/2017, we managed to identify a total number of 2 financial bubbles regimes (Table 18).

Table 19

All bubbles regimes detected applying the LPPL model to ALBALACT SA (ALBZ RO Equity)

ALBALACT SA (ALBZ RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
19/91/ 2007	18/07/ 2007	19.07755311	-19.16270764	0.0078125	0.005043993	5.936	6.40625

Applying the LPPL model to **ALBALACT SA (ALBZ RO Equity)** on daily data between 08/12/2004 - 02/10/2017, we managed to identify only one financial bubble regime (Table 19).

Table 20

All bubbles regimes detected applying the LPPL model to ELECTROMAGNETICA SA BUCUREȘTI (ELMA RO Equity)

ELECTROMAGNETICA SA BUCUREŞTI (ELMA RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
15/09/ 2009	04/06/ 2010	16.62543809	-16.88401549	0.0078125	0.002493568	6.048	6.064453125
25/05/ 2010	10/05/ 2010	13.66584166	-13.91759846	0.0078125	0.00203511	7.888	6.220703125

Applying the LPPL model to **ELECTROMAGNETICA SA BUCUREȘTI (ELMA RO Equity)** on daily data between 02/04/1999 - 02/10/2017, we managed to identify a total number of 2 financial bubbles regimes (Table 20).

Table 21

All bubbles regimes detected applying the LPPL model to IMPACT DEVELOPER & CONTRACTOR S.A. (BCC RO Equity)

IMPACT DEVELOPER & CONTRACTOR S.A. (BCC RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
19/04/ 2005	26/09/ 2005	4.592414691	-5.560348048	0.0078125	0.00809976	6.152	6.38671875

Applying the LPPL model to **IMPACT DEVELOPER & CONTRACTOR S.A. (BCC RO Equity)** on daily data between

11/06/2004 - 02/10/2017, we managed to identify only one financial bubble regime (Table 21).

Table 22

All bubbles regimes detected applying the LPPL model to BANCA COMERCIALA CARPATICA S.A. (IMP RO Equity)

BANCA COMERCIALA CARPATICA S.A. (IMP RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
03/08/2002	24/01/2003	0.468040815	-0.101681098	0.4375	0.222023751	4.112	6.279296875
09/08/2004	02/02/2005	1.083995612	-0.094563603	0.4375	0.046214867	13.064	6.416015625
16/09/2009	02/10/2010	-0.011176464	-0.118592812	0.375	0.108573489	5.064	5.927734375
09/09/2014	28/01/2015	6.658321726	-6.186880331	0.0078125	0.004721775	6.096	6.318359375

Applying the LPPL model to **BANCA COMERCIALA CARPATICA S.A. (IMP RO Equity)** on daily data between 19/12/1997 - 02/10/2017, we managed to identify a total number of 4 financial bubbles regimes (Table 22).

Table 23

All bubbles regimes detected applying the LPPL model to IAR SA Brașov (IARV RO Equity)

IAR SA Braşov (IARV RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
20/04/2006	26/10/2006	2.262519003	-0.087662471	0.5703125	0.112433033	3.024	6.298828125

Applying the LPPL model to **IAR SA Brașov (IARV RO Equity)** on daily data between 22/04/1999 - 02/10/2017, we managed to identify only one financial bubble regime (Table 23).

Table 24

All bubbles regimes detected applying the LPPL model to SSIF BRK FINANCIAL GROUP SA (BRK RO Equity)

SSIF BRK FINANCIAL GROUP SA (BRK RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
25/06/ 2009	04/01/ 2010	14.8653299	-15.97213532	0.0078125	0.004449697	5.936	6.376953125

Applying the LPPL model to **SSIF BRK FINANCIAL GROUP SA (BRK RO Equity)** on daily data between 14/03/2005 - 02/10/2017, we managed to identify only one financial bubble regime (Table 24).

Table 25

All bubbles regimes detected applying the LPPL model to ROMCAB SA TG. MUREȘ (MCAB RO Equity)

ROMCAB SA TG. MUREŞ (MCAB RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
None							

Applying the LPPL model to **ROMCAB SA TG. MUREȘ (MCAB RO Equity)** on daily data between 09/10/2006 - 02/10/2017, we didn't manage to identify any financial bubble regime (Table 25).

Table 26

All bubbles regimes detected applying the LPPL model to ROMCARBON SA BUZĂU (ROCE RO Equity)

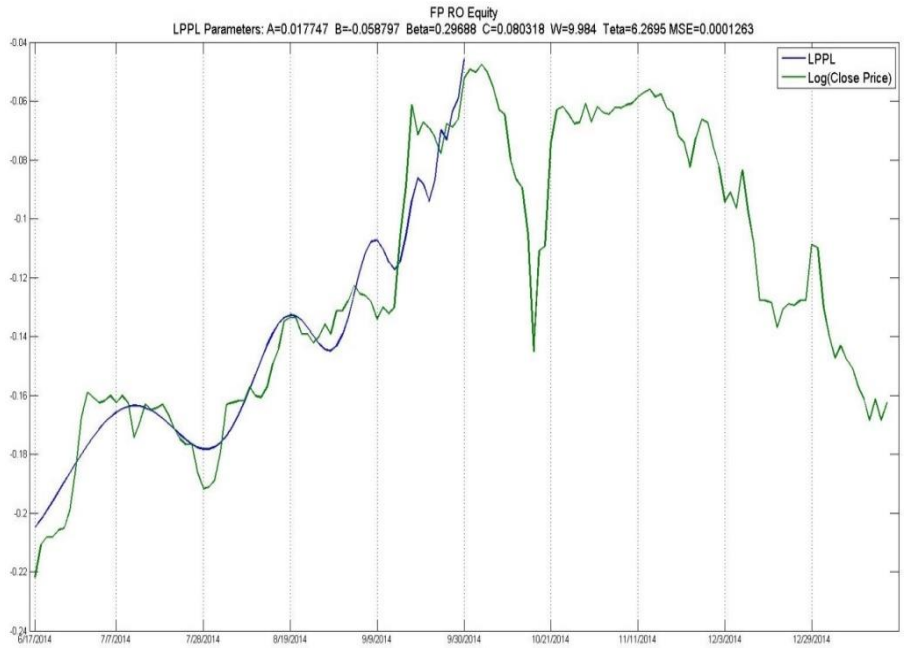
ROMCARBON SA BUZĂU (ROCE RO Equity)							
Start Date	Critical Time	*LPPL Parameters*					
		A	*B*	*β*	*C*	*ω*	*Ø*
15/12/ 2006	15/05/ 2007	3.584813992	-2.148807189	0.15625	0.03765896	4.16	6.572265625

Applying the LPPL model to **ROMCARBON SA BUZĂU (ROCE RO Equity)** on daily data between 05/04/1999 - 02/10/2017, we managed to identify only one financial bubble regime (Table 26).

Some representative LPPL calibrations can be found in the figures below:

Figure 3

LPPL fitted to FONDUL PROPRIETATEA (FP RO Equity) between June 17 2014 – September 30 2014 on daily data

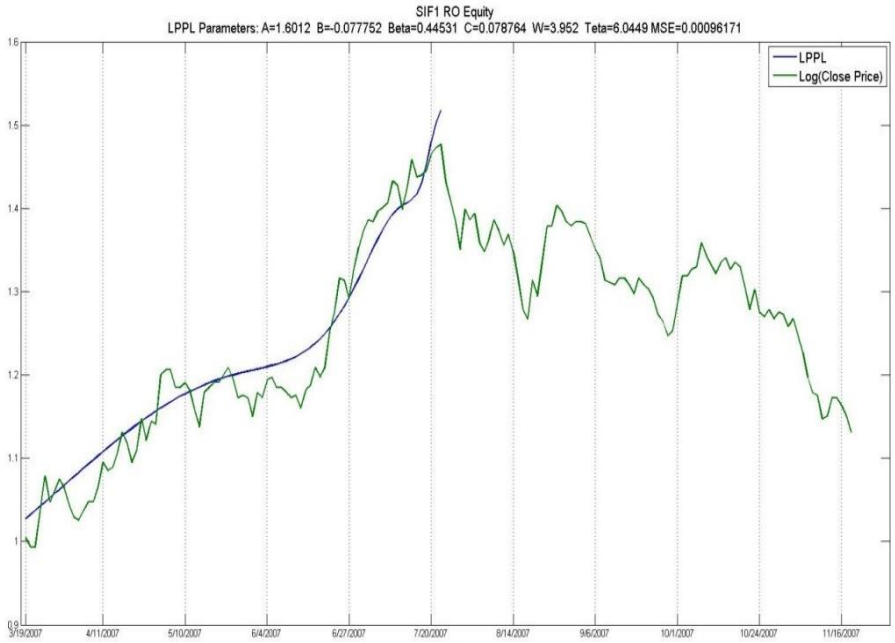


Data Source: Bloomberg

In the figure above (Figure 3) is exemplified the LPPL calibration to FONDUL PROPRIETATEA (FP RO Equity) between June 17 2014 – September 30 2014 on daily data with the following LPPL Parameters [$A = 0.018,\ B = 0.059,\ C = 0.08,\ \beta = 0.3,\ \omega = 10,\ \emptyset = 6.3$].

Figure 4

LPPL fitted to SIF BANAT CRISANA S.A. (SIF1 RO Equity) between March 19 2007 – July 24 2007 on daily data

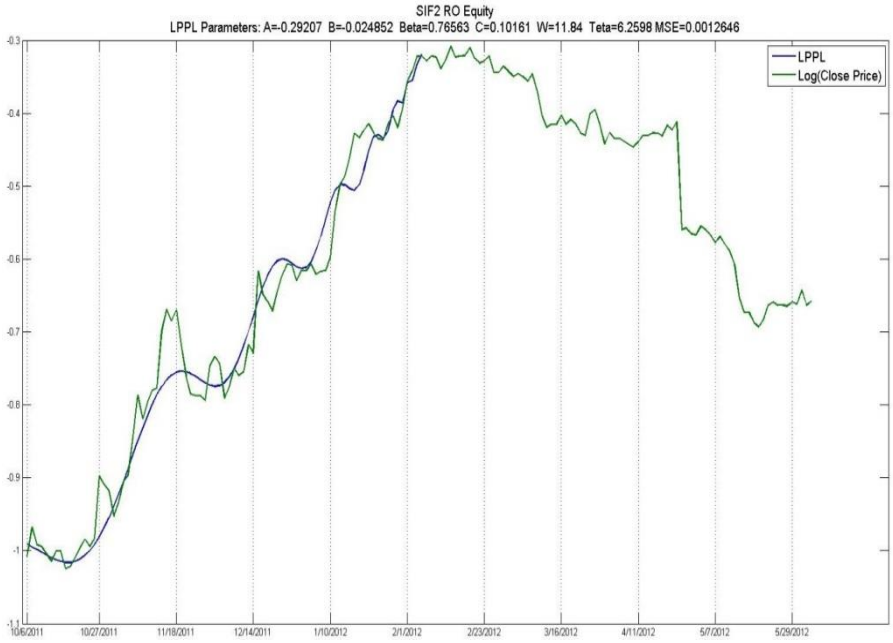


Data Source: Bloomberg

In the figure above (Figure 4) is exemplified the LPPL calibration to SIF BANAT CRISANA S.A. (SIF1 RO Equity) between March 19 2007 – July 24 2007 on daily data with the following LPPL Parameters [A=1.6, B=-0.08, C=0.08, β=0.45, ω=4, ∅=6].

Figure 5

LPPL fitted to SIF MOLDOVA S.A. (SIF2 RO Equity) between October 6 2011 – February 6 2012 on daily data

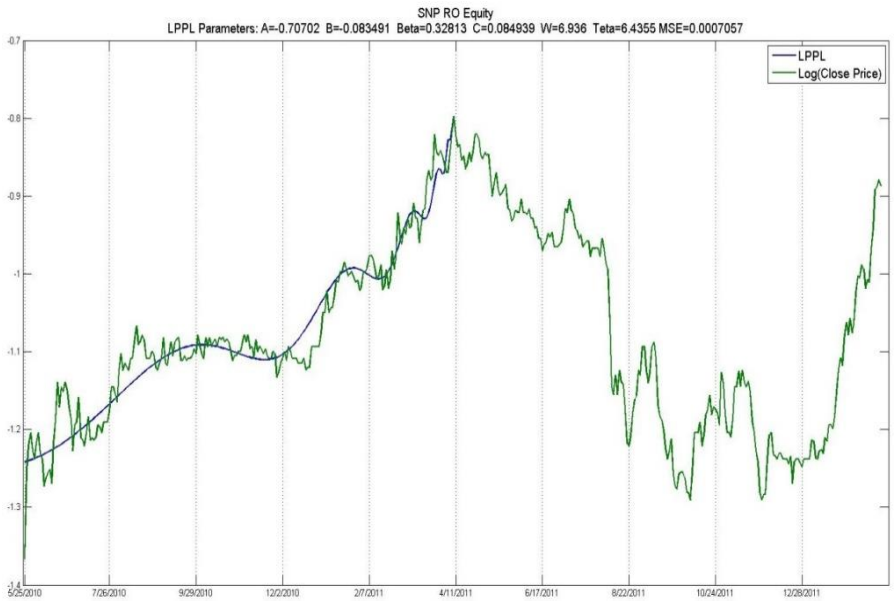


Data Source: Bloomberg

In the figure above (Figure 5) is exemplified the LPPL calibration to SIF MOLDOVA S.A. (SIF2 RO Equity) between October 6 2011 – February 6 2012 on daily data with the following LPPL Parameters [A=-0.3, B=-0.025, C=0.1, β=0.8, ω=12, ∅=6.3].

Figure 6

LPPL fitted to OMV PETROM S.A. (SNP RO Equity) between May 25 2010 – April 8 2011 on daily data



Data Source: Bloomberg

In the figure above (Figure 6) is exemplified the LPPL calibration to OMV PETROM S.A. (SNP RO Equity) between May 25 2010 – April 8 2011 on daily data with the following LPPL Parameters [A=-0.7, B=-0.08, C=0.08, β=0.33, ω=7, ∅=6.4].

6. Conclusions

We managed to find a total number of 54 LPPL model calibrations that follows the empirically observed restrictions, applied on top 25 blue chip stocks traded on Bucharest Stock Exchange between 1997-2017, using daily Bloomberg data.

In the recent global financial crisis (2007-2008) that was triggered by the collapse of the investment bank Lehman Brothers on September 15 2008, the LPPL model identified financial speculative bubbles simultaneously on 8 companies composing the BET-XT Index (C.N.T.E.E. TRANSELECTRICA, SIF OLTENIA S.A., SIF BANAT CRISANA S.A., SIF MOLDOVA S.A., SIF MUNTENIA S.A., ALBALACT SA, IAR SA Brașov, ROMCARBON SA BUZĂU).

Also, in the Greek government-debt crisis (2010-2011) that was a byproduct of the global financial crisis, the LPPL model identified speculative bubbles simultaneously on 13 companies (BANCA TRANSILVANIA S.A., OMV PETROM S.A., BRD - GROUPE SOCIETE GENERALE S.A., S.N.T.G.N. TRANSGAZ S.A., C.N.T.E.E. TRANSELECTRICA, SIF OLTENIA S.A., SIF BANAT CRISANA S.A., SIF MOLDOVA S.A., SIF MUNTENIA S.A., ANTIBIOTICE S.A., ELECTROMAGNETICA SA BUCUREȘTI, BANCA COMERCIALA CARPATICA S.A., SSIF BRK FINANCIAL GROUP SA).

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