EMPIRICAL INQUIRY OF GREGARIOUS BEHAVIOR: EVIDENCE FROM EUROPEAN EMERGING MARKETS

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Abstract

This paper investigates the presence of gregarious behavior of investors for the European emerging stock markets: Romania, Bulgaria and Croatia at industry level using an adjusted CSSD method, in order to correct the multicollinearity and to improve the power of the model. The herding behavior is associated with the market participants' tendency to mimicry the strategies of others investors, thus disregarding the information they hold. Using a quantile regression model, we highlight the existence of herding behavior both for lower and upper quantiles. Furthermore, the period when the investors exhibit herding behavior is various: for Croatia the herding occurs in the pre-crisis period, in the case of Bulgaria, it is prevalent during crisis period, and finally for Romania it was found to be predominant in the post-crisis period.

Keywords: *herding behavior, emerging market, quantile regression*

JEL Classifications: *C1, C5, G1*

1. Introduction

The evolution of financial markets is influenced by the appearance of speculative bubbles. One of the main causes of the speculative bubbles is the irrational behavior of investors who purchase assets based on their

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expectations about the favorable evolution of the futures prices, thus ignoring the real rate of return of the investments (Kindleberger & Aliber, 2005). The irrational behavior of the investors generates deviations of the stock prices from their fundamental value, which leads to an untenable increase in prices that will be materialized in destabilization of the financial markets and the imminent occurance of market crashes, as was highlighted by Claessens and Kose, 2013. Therefore, bubbles are caused by a flawed perception of investors about the evolution of financial assets, so their actions may be influenced by subjective expectations regarding risk-return connection.

An extensive financial literature provides proofs about obvious manifestations of gregarious behavior of investors. Considering the significant opinion of Pretcher (2001), the herding behavior of investors is caused by inadequate level of knowledge that they hold, so the market participants prefer to follow the herd in the detriment of their own beliefs, thus creating the premises of the appearance of "information and impulsivity loop" that generates the financial market trends. According to Devenow and Welch (1996) the herding behavior represents a particular type of behavior which indicates the existence of correlation between individuals, which can be explained by mimicry, one of the basic characteristics of the human race, so the financial market is the place where their occurs an interconnection between frenzy, fickle price changes and speculative bubbles. This hypothesis is also sustained by Sornette and Johansen (1997) who mention that the crashes have their origin in the gregarious behavior of investors who interact on the market. In other words, this approach makes reference to human component and places the herding behavior of investors at the border of two sciences: psychology and finance.

Most often, the theoretical models that highlight the presence of gregarious behavior of investors are abstract and there are different approaches between theoretical literature and empirical studies. Most of empirical studies do not test theoretical models, but only checks the appearance of collective decisions on the market or the existence of a similar behavior in a group of investors.

Generally, the emerging markets are characterized by the presence of less informed investors that is associated with a poor financial culture and a slow assimilation of information in stock prices. Therefore, the quality of information held by the market participants and the existence of long memory could be significant reasons that support the investors' tendency to imitate the

behavior of other market participants, so they despise their own beliefs and information and decide to follow the strategies of the other participants. Considering the relevant characteristics of the emerging markets, we believe that is propitious to examine whether the investors from these markets exhibit herding behavior. The objective of this paper is to analyze the investors' inclination to precisely adopt the actions of other market participants for some European emerging markets: Romania, Bulgaria, Croatia. The paper is structured as follows: Section 2 presents an inclusion in the literature, Section 3 describes the data and methodology, Section 4 provides the empirical results and Section 5 concludes.

2. Literature review

Recently, especially after the global financial crisis of 2007-2009, the herding behavior of investors was a widely debated topic in the financial literature. There are various studies that investigate the behavior of investors, both for developed and emerging markets, highlighting the actions of institutional and individual investors.

Although in the literature is a wide range of studies, most of them are related to the developed stock markets. Christie and Huang (1995) have studied the existence of herding behavior by using standard deviations of returns as a measure of the dispersion. The authors have considered that if the value of dispersion decrease during the periods of extreme market conditions compared with the value of dispersion calculated for the normal market conditions, this will highlight the presence of gregarious behavior. The results obtained provide no evidence of herding for the US stock market.

Chang et al. (2000) have extended the methodology used by Christie and Huang (1995). Using the CSAD methodology as a measure of return dispersions, the authors have examined the existence of herding behavior both for developed and emerging markets. The results have provided no herding behavior in the case of developed markets, namelly US and Hong-Kong, but on the other side, in the case of emerging markets, South Korea and Taiwan, the authors pointed out that investors tend to follow the actions of the other market participants.

Cajueiro and Tabak (2009) have improved the existent models by including in the analysis the variables that capture the long memory, so highlighting the assumption according to the herding behavior is one of the causes of multifractality.The authors have examined the Japanese stock

market during the period 200-2006 and concluded that the existence of long memory may be caused by the herding behavior.

Furthermore, regarding the Asian stock markets, another study was realized by Chiang, C.T et al (2010) for the Chinese stock market, by considering all the markets: SHA, SHB, SZA and SZB, during the period 1996-2007. The results obtained by the CSAD method provide evidence that the Chinese stock market is characterized by the existence of herding behavior. The empirical results have emphasized an asymmetry in the herding behavior, for the investors from section A, it manifests both for bull and bear markets and for the participants from section B, the results indicates no evidence of herding for bull markets. The novelty in this study is brought by the quantile regression, the results indicates the existence of herding behavior, especially in the case of lower quantiles. Another analysis of the Asian stock market was realized by Teng and Liu (2014). The authors have examined the contagion phenomenon between Taiwanese, Hong Kong, Shanghai and Shenzen stock markets during the global financial crisis from 2007-2009. The results obtained from the usage of Hwang and Salmon (2004) model highlighted that investors from these markets have a herding behavior in every individual market and there is a contagion across markets which was realized through the herding behavior of investors. Moreover, Yao et al. (2014) have analyzed the Chinese stock market, both A and B sections by using an adjusted CSSD methodology, in order to correct the problems of multicollinearity and autocorrelation. The authors have analyzed the period from 1999 to 2008 and have concluded that the herding behavior occurs only in B section, especially during periods of downturn in the market.

Moreover, making reference to studies for developed markets, we focus our attention on the US stock market. Klein (2013) improves the existent methodologies from the literature that have been used to quantify the herding behavior by including in the analysis the time variations of the investors' behavior, depending on peacefully or noisy periods of the market. Using a Markov switching SUR model applied for US and euro area capital markets during the period 2001-2011, the results argue that herding behavior is characterized by time variations and there is an amplification of them in turbulent episodes of the market. Furthermore, we mention the analysis that was realized by Zhou and Anderson (2013) for US REIT stock market. Using quantile analysis, the results indicate the existence of herding behavior in the

case of higher quantile, highlighting that investors imitate others during periods of market decline.

In the case of emerging markets, the financial literature is less numerous. Pop (2012) has investigate the herding behavior for the Romanian capital market by using Hwang and Salmon (2004, 2008) model. The author concluded that during crisis, the investors' tendency to follow the actions of other market participants is reduced. Moreover, Pele et al. (2013) have used the LPLL model in order to examine the correlation between herding behavior of investors and speculative bubbles for the Romanian stock market. Analyzing the BET-FI Index evolution, the authors have concluded that LPPL model represents a suitable method that can be used to achieve accurate prediction of stock market crashes. Filip and Pochea (2014) have studied the gregarious behavior of investors for the CEE stock markets (Romania, Poland, Czech Republic, Hungary, Bulgaria) during the global financial crisis from 2007-2009. The results highlighted that the volatility has an asymmetric effect on herding behavior and it is manifest under low volatility conditions in the case of Bulgaria, Hungary and Poland and under excessive volatility conditions in the case of Czech Republic.

3. Data and methodology

The data used in this study contains daily returns for the companies listed on the emerging European stock markets: Romania, Bulgaria and Croatia during the period January 2006-December 2013. The analysis was realized at industry level based on daily logarithmic returns, calculated based on the following formula: $: R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$, where Pi,t represents the closing price of the stock i for the day t. As proxy variables for market portfolio we have used the market indices.

The objective of this study is to investigate the existence of the gregarious behavior of investors from European emerging markets. In order to test this assumption, we have applied the adjusted methodology CSSD that was developed by Yao J. et al (2014).

We have applied the CSSD method, as a measure of return dispersions, that was developed by Christie and Huang (1995). The cross-sectional standard deviations of returns are calculated by using the below formula:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}\left(R_{i,t} - R_{m,t}\right)^2}{N-1}}$$

where $CSSD_t$ represents the return dispersion at time t, N represents the number of companies from the portfolio, $R_{i,t}$ represents the stock return of company i at time t and $R_{m,t}$ represents the market return at time t. The existence of herding behavior can be identified if there is a low value of dispersion around the mean.

The equation of the model is the following:

$$CSSD_t = \alpha + \gamma_1\left|R_{m,t}\right| + \gamma_2\left(R_{m,t}\right)^2 + \varepsilon_t$$

The variable $R_{m,t}^2$ was introduced in order to capture the nonlinear component, because under extreme market conditions, the relation between stock return and market return is nonlinear. The negative and statistically significant γ_2 coefficient indicates the presence of gregarious behavior of investors.

Following Yao J. et al (2014) in order to improve the results of the model, we have introduced two additional variables, namely: $\overline{R_m}$ - the arithmetic mean of the variable $R_{m,t}$, which has the purpose to reduce the effect of multicollinearity and a lag term of the dependent variable $CSSD_{t-1}$ which has the objective to increase the power of the model. For the estimation of the model we have used the Newey West (1997) methodology.

After adding the new variables in order to improve the power of the model, the final equation that will be estimated in order to identify the herding behavior of investors has the following form:

$$CSSD_t = \alpha + \gamma_1\left|R_{m,t}\right| + \gamma_2\left(R_{m,t} - \overline{R_m}\right)^2 + \gamma_3 CSSD_{t-1} + \varepsilon_t$$

4. Empirical results

The below tables provides the results of the adjusted CSSD model for Romanian, Bulgarian and Croatian stock markets. In this paper we have applied the quantile regression model in order to take into consideration various curves of independent variables against each quantile of dependent variable CSSD. Compared with OLS method, the quantile regression method performs better in identifying the tails of return distribution and in the treatment of outliers (Chiang and Tan, 2010).

Table 1. Herding behavior for the investors from Romania stock market - Quantile regression

Period/ Quantile	2006-2007				
	α	γ_1	γ_2	γ_3	Adj. R^2
Services					
τ = 10%	0.003***	0.62***	3.52	0.01***	0.10
τ = 25%	0.007***	0.41**	6,46*	0.04	0.07
τ = 50%	0.008*	0.35*	5.05	0.38**	0.11
τ = 75%	0.006	0.51**	-1.23	0.92***	0.19
τ = 90%	0.02***	0.17	-0.64	0.98***	0.28
Construction					
τ = 10%	0.002	0.89***	-8.72	0.01	0.07
τ = 25%	0.04*	0.77**	-5.07	0.13**	0.08
τ = 50%	0.01***	0.03	9.19	0.32***	0.08
τ = 75%	0.02***	0.24	5.05	0.51***	0.11
τ = 90%	0.04***	0.54	45.61	0.62***	0.13
Agriculture					
τ = 10%	0.002	0.86***	-9.74	0.05***	0.06
τ = 25%	0.009***	0.31	2.84	0.18***	0.06
τ = 50%	0.01***	0.11	8.44	0.28***	0.06
τ = 75%	0.03***	0.21	1.70	0.31***	0.06
τ = 90%	0.04***	0.09	6.67	0.65***	0.09
Oil					
τ = 10%	0.003**	0.69***	-12.25***	0.09***	0.04
τ = 25%	0.01***	0.10	6.42	0.17**	0.04
τ = 50%	0.01***	0.19	15.60***	0.29***	0.08
τ = 75%	0.01***	0.14	7.30	0.46***	0.12
τ = 90%	0.03***	0.27	0.14	0.61***	0.09
Pharmaceuticals					
τ = 10%	0.003***	0.42***	2.45	0.06	0.15
τ = 25%	0.004***	0.46***	1.86	0.20***	0.17
τ = 50%	0.007***	0.18	14.35***	0.29***	0.18
τ = 75%	0.008***	0.33*	10.42***	0.58***	0.17

τ = 90%	0.03***	1.29*	40.26**	0.77***	0.18
Financials					
τ = 10%	0.005***	0.15*	0.32	0.08	0.04
τ = 25%	0.006***	0.15*	-0.007	0.12***	0.05
τ = 50%	0.009***	0.09	2.91	0.18***	0.05
τ = 75%	0.015***	0.21	12.60***	0.25**	0.05
τ = 90%	0.02***	0.61	27.08	0.43***	0.09

2008-2009					**2010-2011**				
α	γ_1	γ_2	γ_3	Adj. R^2	α	γ_1	γ_2	γ_3	Adj. R^2
0.001	0.75***	0.76	0.03	0.37	0.001***	0.80***	0.14	0.02**	0.20
0.002***	0.79***	1.15**	0.06**	0.36	0.002***	0.78***	0.23	0.08***	0.17
0.004***	0.70***	1.32**	0.23***	0.34	0.004***	0.73***	0.21	0.24***	0.16
0.008***	0.57***	3.95***	0.39***	0.28	0.01***	0.48**	3.47	0.41***	0.12
0.03***	0.56	1.74	0.37***	0.18	0.03***	0.23	3.72	0.50***	0.08
0.002	0.89***	-8.72	0.01	0.07	0.002**	0.64***	-4.00***	0.10***	0.06
0.004*	0.77**	-5.07	0.13**	0.08	0.006***	0.43***	-1.13	0.23***	0.07
0.015***	0.03	9.19	0.32***	0.08	0.01***	0.37***	-1.32	0.41***	0.11
0.02***	0.24	5.05	0.51***	0.11	0.02***	0.39**	-2.54	0.69***	0.14
0.04***	0.54	45.61	0.62***	0.12	0.04***	0.76*	-7.36**	0.82***	0.20
0.004**	0.18	1.49	0.10***	0.05	0.001	0.82***	-3.70	0.02	0.11
0.01***	0.31	0.98	0.07*	0.08	0.002***	0.74***	-2.67	0.11*	0.11
0.02***	0.31	3.31	0.10**	0.08	0.005***	0.57***	-0.81	0.38***	0.13
0.02***	0.47***	2.64**	0.17**	0.12	0.01***	0.31***	2.42**	0.66***	0.20
0.03***	0.75***	-0.14	0.27***	0.16	0.02***	0.34**	1.40	0.88***	0.30
0.005***	0.45***	-0.02	0.05*	0.18	0.003***	0.56***	-0.80	0.005**	0.05
0.009***	0.42***	1.38	0.01	0.16	0.007***	0.51***	0.37	0.01***	0.04
0.01***	0.30**	2.54	0.08	0.15	0.005***	0.44***	-0.51	0.42***	0.13
0.02**	0.31**	3.09*	0.18	0.11	0.004***	0.36***	-1.33	0.99***	0.35
0.03***	0.61**	0.19	0.30**	0.09	0.01***	0.35*	-1.46	0.99***	0.47

0.05***	0.33***	3.37***	0.03***	0.18	0.003***	0.51***	-2.31**	0.01	0.07
0.009***	0.42***	2.45***	0.03***	0.18	0.004***	0.39***	0.72	0.20***	0.09
0.01***	0.44***	1.97***	0.07	0.19	0.0009	0.33***	0.08	0.77**	0.20
0.01***	0.44***	1.64*	0.19*	0.16	0.005***	0.28***	2.97***	0.98***	0.42
0.03***	0.13	4.91	0.29	0.11	0.01***	0.32***	1.72*	0.98***	0.57
0.005***	0.09	2.12	0.14***	0.11	0.005***	0.242***	-0.89*	0.004***	0.04
0.008***	0.02	4.23***	0.19***	0.14	0.007***	0.22***	-0.36	0.005	0.04
0.011***	0.005	4.61***	0.27***	0.21	0.005*	0.20***	-0.98***	0.42	0.09
0.01***	0.09	3.94	0.43***	0.24	0.002***	0.22***	-1.78***	0.97***	0.26
0.02***	0.22	2.85**	0.46***	0.25	0.005***	0.38***	-3.57***	0.98***	0.40

Source: Authors' calculation; ***statistical significance at the 1% level **statistical significance at the 5% level, *statistical significance at the 10% level

The results from Table 1 indicate the presence of herding behavior of investors from Romanian capital market in the case of various sectors of activity: construction, oil, pharmaceutical and financial. The results revealed different time periods when market investors manifest the tendency to imitate the actions of other market participants, mainly for the periods after crisis in the case of financial, construction and pharmaceutical sectors. On the other hand, for oil sector the results pointed out the existence of herding before the crisis. Furthermore, the γ_2 coefficient is negative and statistically significant, especially for lower quantiles $\tau = 10\%$, but also for higher quantiles $\tau = 90\%$, showing that herding is more significant at lower quantiles of the return dispersions.

Table 2. Herding behavior for the investors from Bulgaria stock market - Quantile regression

Period/ Quantile	**2006-2007**				
	α	γ_1	γ_2	γ_3	Adj. R^2
Services					
$\tau = 10\%$					
$\tau = 25\%$					
$\tau = 50\%$					

$\tau = 75\%$					
$\tau = 90\%$					
Construction					
$\tau = 10\%$	0.000	1.36***	-25.70	0.017	0.17
$\tau = 25\%$	0.003***	0.95***	-4.84	0.07*	0.11
$\tau = 50\%$	0.008***	0.88***	-8.68	0.18***	0.07
$\tau = 75\%$	0.019***	0.07	16.25	0.35*	0.06
$\tau = 90\%$	0.02***	0.33	33.30	0.66***	0.12
Agriculture					
$\tau = 10\%$					
$\tau = 25\%$					
$\tau = 50\%$					
$\tau = 75\%$					
$\tau = 90\%$					
Oil					
$\tau = 10\%$	0.000	1.21***	-18.90***	0.01***	0.15
$\tau = 25\%$	0.004***	1.15***	-18.43***	0.014***	0.10
$\tau = 50\%$	0.011**	0.84***	-10.30	0.04	0.05
$\tau = 75\%$	0.017**	0.47*	-3.16	0.26	0.04
$\tau = 90\%$	0.02***	0.52*	-3.76	0.40	0.04
Pharmaceuticals					
$\tau = 10\%$	0.000	0.98***	-4.47	0.0134	0.23
$\tau = 25\%$	0.0009*	1.05***	-5.34*	0.02	0.19
$\tau = 50\%$	0.004***	1.05***	-6.57	0.09**	0.15
$\tau = 75\%$	0.009***	1.09***	-12.74	0.22***	0.10
$\tau = 90\%$	0.017***	1.23	-22.14	0.61*	0.06
Financials					
$\tau = 10\%$	0.0002	1.38***	-25.95	0.05***	0.17
$\tau = 25\%$	0.005***	0.92***	-7.56*	0.06**	0.13
$\tau = 50\%$	0.008***	0.84***	-8.79*	0.24***	0.11
$\tau = 75\%$	0.011***	1.14**	-13.25	0.45***	0.09
$\tau = 90\%$	0.018***	2.13**	-45.90**	0.55***	0.10
2008-2009			**2010-2011**		

α	γ_1	γ_2	γ_3	Adj. R^2	α	γ_1	γ_2	γ_3	Adj. R^2
					0.000	1.01***	-0.61	0.003	0.23
					0.000	1.22***	0.001	0.001	0.20
					0.003***	1.19***	-0.34	0.001	0.13
					0.013**	2.46***	-13.46***	0.06	0.08
					0.02***	3.33***	17.00	0.19	0.15
0.0007	0.77***	-3.29	0.14***	0.19	0.001***	0.87***	-1.87	0.01	0.11
0.0055***	0.57***	-0.12	0.21***	0.18	0.005***	0.71***	3.10	0.16	0.07
0.009***	0.65***	-2.79*	0.47***	0.19	0.013**	0.61***	4.83	0.09*	0.04
0.019***	0.43	-0.30	0.65***	0.24	0.023***	0.61***	7.49	0.14**	0.03
0.039***	0.15	4.54	0.74***	0.23	0.04***	0.057	47.87	0.30*	0.03
0.0004	0.98***	-3.99	0.02	0.11	0.0003	1.12***	-2.34	0.008	0.15
0.004**	0.96***	-2.84*	0.042	0.12	0.000	1.41***	0.000	0.000	0.10
0.012***	1.16***	-4.70*	0.09	0.13	0.014***	0.75***	-2.59	0.14***	0.04
0.023***	1.84**	-11.00	0.25*	0.12	0.029***	1.28***	1.61	0.15***	0.04
0.04***	2.19***	-10.08	0.26***	0.13	0.05***	0.94***	26.50***	0.22**	0.04
0.000	1.19*	-10.38	0.01	0.14	0.000	1.22***	0.000	0.000	0.12
0.006***	0.75***	-1.17	0.10*	0.12	0.0002	1.07***	15.67***	0.09***	0.07
0.013***	0.813***	-3.08	0.25***	0.14	0.018***	0.758***	18.53**	0.20***	0.03
0.023***	1.07***	-7.40***	0.45***	0.15	0.04***	0.68**	7.08	0.21***	0.03
0.039***	1.055*	1.29	0.517***	0.17	0.07***	1.13*	-16.75**	0.28***	0.03
0.0017	0.83***	-1.79*	0.02***	0.14	0.0014**	0.79***	-0.10	0.003	0.16
0.007***	0.78***	-1.82	0.02***	0.11	0.003***	0.713***	1.72	0.03**	0.12
0.015***	0.598***	0.298	0.17*	0.08	0.007***	0.63***	0.50	0.85***	0.08
0.025**	0.35*	1.25	0.54	0.10	0.015***	0.604***	-1.57	0.19***	0.04
0.038***	1.09	-5.74	0.905***	0.18	0.03***	0.22	35.41*	0.21***	0.03
0.007***	0.44***	3.07***	0.07***	0.20	0.007***	0.646***	-0.01	0.005	0.09
0.01***	0.44***	2.60***	0.09***	0.20	0.009***	0.57***	1.62	0.06	0.08

0.01***	0.70***	-1.25	0.24***	0.21	0.01***	0.56***	0.14	0.09**	0.07
0.017***	0.33*	2.98	0.49***	0.21	0.017***	0.46***	-1.53	0.34**	0.06
0.019***	0.67**	-3.42	0.78***	0.20	0.019**	0.32*	-0.74	0.82	0.09

Source: Authors' calculation; ***statistical significance at the 1% level **statistical significance at the 5% level, *statistical significance at the 10% level

In the case of Bulgaria, the results obtained provide evidence of herding behavior for all the sup-periods that we have analyzed: pre-crisis, crisis and post-crisis. For the period before the crisis, the herding behavior has a major impact on financial, pharmaceutical and oil sectors. In the case of financial sectors, we have obtained mixed results, there is a strong evidence of herding both for lower quantile and upper quantile and on the other hand, in the case of oil and pharmaceutical sectors, the herding behavior is more substantial in lower tail of stock returns.

Related to Romania, in the case of Bulgaria the gregarious behavior is more evident during the crisis period, when according to the results obtained, it was identified for most sectors: construction, agriculture, oil and pharmaceutical. In the case of construction, agricultural and pharmaceutical sectors, the results provide evidence of herding at lower tails and median level and for the case of oil the herding is more evident in upper quantiles. During decline periods, the investors' tendency is to follow the market, in order to avoid risky strategies and to limit their losses, thus the return dispersion reduces.

For the post-crisis period, the results pointed out the existence of herding behavior in the case of upper quantiles for services and oil sectors.

Table 3. Herding behavior for the investors from Croatia stock market - Quantile regression

Period/ Quantile	**2006-2007**				
	α	γ_1	γ_2	γ_3	**Adj.** R^2
Services					
$\tau = 10\%$	0.001	0.84***	-2.41	0.02	0.09
$\tau = 25\%$	0.005***	0.65**	1.51	0.06***	0.07
$\tau = 50\%$	0.009***	0.63*	-1.14	0.31***	0.07
$\tau = 75\%$	0.018***	0.79**	-13.17	0.38***	0.09
$\tau = 90\%$	0.03***	2.06	-51.10	0.35***	0.10

Construction					
τ = 10%	0.000	1.68***	-37.94***	0.05	0.10
τ = 25%	0.004	2.12***	-54.74**	0.06	0.05
τ = 50%	0.016***	1.72**	-20.77	0.19**	0.05
τ = 75%	0.03***	2.28	-52.62	0.31*	0.06
τ = 90%	0.04***	1.71	-46.82	0.73***	0.13
Agriculture					
τ = 10%	0.0006	1.15***	-18.33**	0.03	0.12
τ = 25%	0.004***	0.89***	-11.74*	0.12***	0.09
τ = 50%	0.011***	0.89***	-13.61	0.12**	0.06
τ = 75%	0.017***	0.66*	-7.20	0.30***	0.05
τ = 90%	0.033***	0.20	13.04	0.34**	0.03
Oil					
τ = 10%	0.000	0.98***	-20.25**	0.08**	0.10
τ = 25%	0.003**	0.87***	-15.48	0.15**	0.07
τ = 50%	0.007***	0.89***	-16.22*	0.24***	0.08
τ = 75%	0.015***	1.26***	-28.05	0.23***	0.06
τ = 90%	0.023***	1.45**	-26.86	0.23	0.08
Pharmaceuticals					
τ = 10%	0.000	0.008**	0.10	0.001	0.05
τ = 25%	0.000	0.014***	0.14	0.01	0.07
τ = 50%	0.000	0.029***	-0.02	0.14***	0.09
τ = 75%	0.000	0.085***	-1.62**	0.47	0.11
τ = 90%	0.0002***	0.11***	-2.86***	0.96***	0.16
Financials					
τ = 10%	0.000	1.25***	-14.72***	0.000	0.16
τ = 25%	0.006***	1.04***	-13.19**	0.006	0.09
τ = 50%	0.012***	0.95***	-13.24	0.02	0.05
τ = 75%	0.019***	1.17***	-16.53	0.11	0.04
τ = 90%	0.03***	0.50*	3.82	0.21	0.03

2008-2009					2010-2011				
α	γ_1	γ_2	γ_3	Adj. R^2	α	γ_1	γ_2	γ_3	Adj. R^2

0.004***	0.55***	0.71*	0.05***	0.19	0.04***	0.42***	5.24***	0.01**	0.08
0.007***	0.58***	0.31	0.059***	0.17	0.06***	0.36***	5.44***	0.04	0.06
0.01***	0.57***	0.02	0.09	0.14	0.08***	0.44***	3.82***	0.18***	0.06
0.02***	0.31	2.01	0.35***	0.11	0.013***	0.36***	3.82***	0.28***	0.07
0.03***	0.08	8.5**	0.70***	0.09	0.018***	0.30*	3.37*	0.49***	0.09
0.000	1.29***	-7.46	0.005	0.19	0.0007	0.98***	-1.69	0.01	0.06
0.02	1.21***	-2.48	0.02	0.16	0.004***	0.69***	2.30	0.09***	0.03
0.012***	0.99***	-2.67	0.20***	0.10	0.016***	0.13	6.33**	0.21***	0.03
0.04***	0.74	3.33	0.30***	0.09	0.03***	0.24	1.37	0.38***	0.05
0.08***	0.17	15.85**	0.33*	0.09	0.059***	0.47	-5.00	0.45***	0.06
0.006***	0.46***	1.34***	0.036	0.24	0.004***	0.51***	3.13	0.19*	0.09
0.008***	0.48***	1.09***	0.08***	0.22	0.007***	0.36***	4.95***	0.038**	0.07
0.012***	0.54***	0.33	0.10**	0.21	0.01***	0.34***	4.44***	0.07**	0.05
0.015***	0.61***	-0.99	0.32**	0.19	0.017***	0.30**	3.59**	0.16**	0.03
0.029***	0.55*	-1.36	0.36**	0.14	0.025***	0.28	2.24	0.24**	0.04
0.003*	0.102	1.35	0.17**	0.07	0.001***	0.50***	8.27**	0.025	0.13
0.006***	0.20***	0.89*	0.22***	0.10	0.003***	0.40	13.72	0.06*	0.12
0.01***	0.32***	-0.10	0.30***	0.14	0.008***	0.15*	41.37***	0.09**	0.10
0.019***	0.26	0.77	0.36***	0.15	0.01***	0.24**	41.58***	0.20**	0.12
0.02***	0.49**	-2.30	0.77***	0.20	0.01***	0.33*	41.65***	0.44***	0.18
0.000	0.014*	0.295	0.000	0.07	0.000	0.0003*	0.99***	0.000	0.08
0.000	0.015***	0.519***	0.001	0.11	0.000	0.001*	1.02**	0.000	0.08
0.000	0.03***	0.40***	0.01	0.11	0.000***	0.003**	1.64***	0.001	0.07
0.0003	0.04*	0.29	0.50	0.13	0.0002***	0.001*	1.60***	0.008	0.05
0.002**	0.08*	-0.30	0.64***	0.12	0.0005	0.04*	5.31	0.87***	0.06
0.003***	0.74***	-0.03	0.003	0.30	0.001***	0.79***	2.21***	0.001	0.13
0.005***	0.74***	-0.41	0.07**	0.26	0.003***	0.67***	3.28***	0.0006	0.08
0.01***	0.544***	1.61	0.16***	0.22	0.009***	0.36***	6.18***	0.0005	0.04

0.018***	0.46	2.08	0.33***	0.20	0.017***	0.22	6.57***	0.10	0.03
0.03***	0.41	0.40	0.35***	0.18	0.02***	0.42	2.25	0.39*	0.03

Source: Authors' calculation; ***statistical significance at the 1% level **statistical significance at the 5% level, *statistical significance at the 10% level

In the case of Croatia, the results indicate the existence of herding behavior only for pre-crisis period, mainly for lower quantiles in the case of oil, financial, construction and agricultural sectors. For pharmaceutical, the results have identified herding behavior for upper quantiles. The herding behavior is more considerable for lower quantiles, where market participants mimicry the strategies of others investors, thus disregarding the information they hold.

Finally, in order to confirm that gregarious behavior could constitute the cause of the existence of long memory, we will use Hurst exponent, as a measure of multifractality. Because for the countries that we have analyzed, the stock market sector indices are not available, we will calculate the Hurst exponents for the market indices, namely: BET, SOFIX and CROBEX. The Table 4 presents the results for the existence of long memory.

Table 5. Hurst exponent for stock market indices

Indices	2006-2007	2008-2009	2010-2013
BET	0.66	0.63	0.63
SOFIX	0.68	0.72	0.66
CROBEX	0.72	0.69	0.70

Source: Authors' calculation

The value of the Hurst exponent is higher than 0.5 for all the market indices and for all the periods that we have examined, indicating the existence of the long-term dependencies with a persistent behavior, which could be an indication for the existence of a relation between gregarious behavior and long memory, but for more pertinent results we should build equally weighted indices at sector of activity level and apply more complex tests in order to detect a possible correlation between herding behavior and long memory. This assumption will be subject of future research.

5. Conclusions

This paper investigates the existence of gregarious behavior of investors for three European emerging stock markets: Romania, Bulgaria and Croatia based on daily data from January 2006-December 2013. After we have applied an adjusted CSSD model in order to relieve the presence of multicollinearity and improve the power of the model , the results obtained pointed out the existence of herding behavior of investors for all three periods that we have analyzed: pre-crisis, crisis and post-crisis. Interesting to note that manifestation period of herding behavior for these markets is slightly different, thus for Croatia the herding occur only for pre-crisis period, moreover in the case of Bulgaria it prevails during crisis period, and for Romania it exists especially during post-crisis period.

Furthermore, for a robust analysis that includes also the tails of the returns distributions, we have experienced quantile regression approach. The results obtained were mixed. In the case of Romania, for the post crisis period, the results provide evidence of herding behavior for financial, construction and pharmaceutical sectors. On the other hand, for oil sector the results pointed out the existence of herding before the crisis. The herding behavior was identified especially for lower tails of the quantile distributins. In the case of Bulgaria the results indicate the existence of gregarious behavior, both for lower and upper quantile, thus for the pre-crisis period the herding has an important influence on financial, pharmaceutical and oil sector, moreover for the crisis period the herding was identified for construction, agriculture, oil and pharmaceutical sectors, finally for post crisis period the results highlight the presence of herding for upper quantiles in the case of services and oil sectors. For Croatia, we find herding behavior both for lower quantiles (oil, financial, construction and agriculture sectors) and upper quantiles (pharmaceutical sector).

We can conclude that gregarious behavior of investors occurs both for lower and upper quantiles, due to their tendency to build homogeneous strategies as those of other market participants and thus tend towards a collective behavior that it manifest on the market, so ignoring their own beliefs they amplify the mass of investors' frenzy, which may lead to the emergence of speculative bubbles and to destabilization of financial markets.

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