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HERD BEHAVIOR IN INTERNATIONAL MARKET

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Abstract: According to literature, herding can be observed not only within single stock market, but also on international level. Poland has entrance to Euro Zone in perspective, so especially interesting is answer to the question whether herding is present on the stock markets of candidate countries to Euro Zone? Moreover, whether this tendency will be more noticeable in periods of higher volatility than during the periods of relative market stability, as suggested by psychological theories.

To find the measure of herd tendency we can refer both to neoclassical and behavioral theories. Basing on models grounded in rationality assumption, there is a need to assume informative efficiency of markets. Thus, it can be expected that aggregated changes in stock markets should be reflected in the process of prices formation. Behavioral literature pointed that if tendency of herding is present on international level, it can be assumed that markets 'in average' will behave in the similar way. Following this idea the size of deviation of the given series from the 'average' can be taken as the measure of herding activity in aggregated market. Methodology created by Christie, Huang and Chang, Cheng, Khoran will be used as a starting point for the consideration of this problem. To propose more perfect measure of herding, in the paper this approach will be developed by using alternative methodology for average and measure of deviations construction. Those improvements will cause that, theoretical models will come closer to reality and will take into account both sociological and behavioral tendencies present in investors activity.

Keywords: herding, international stock market, measure of herd behavior

INTRODUCTION

Herding is defined as activities of decision-makers that are caused by interpersonal interaction and rely on making decisions basing on observation of others participants of the given community and imitating their behavior [Szyszko 2009]. In financial markets such activity is present if in a group of investors some of them proceed as others and invest or not in the given asset in the given period of time (in case of financial markets this definition is rarely related to investments in a single and strictly defined time point) [Sias 2002].

It was shown that behavior of subjects is determined by individuals who from their point of view have relatively bigger stores of knowledge, which they personally do not own. The tendency of behavior imitation will be the larger, the smaller is precision and amount of available information. It is expected that herding does not appear if credibility of private information is bigger than quality of information coming from activity of others market players. The tendency of herding will be the bigger, the more difficult is to gain and process the information.

Literature shows, that herding is present in the international market. In research performed for Germany, Great Britain, United States of America, Mexico, Japan, Spain and France, Blasco and Ferreruela [2008] identified this tendency just in Spain market. Chang, Cheng and Khoran's [2000] study indicated on presence of meaningfully significant herd tendency in South Korea and Taiwan markets in period 1963-1997. Hwang and Salmon [2004] used daily stock returns and also found some circumstances that herding was present in South Korea market in period 1993-2002. In 2004, Demirer and Kutan [2004] applied CSSD (Cross-Sectional Standard Deviation) methodology to Chinese individual and sector markets and did not find any reason to say that behavior imitation tendency appears there.

Herding can be observed not only in stock market. Presence of this propensity was tested also in government stock market [Gleason et al., 2004], in future market for fuel oil and petroleum [Weiner et al., 2004], where symptoms of collective activity were identified.

Although the literature contains a number of examples of herd behavior presence tests on many different markets and for plenty of varying assets, there is noticeable shortage of papers, which investigate this phenomenon in global scale. The example of such work is Demirer, Gubo and Kutan's [2007] paper, where such research was performed on many stock markets grouped into six regions: developed markets (West Europe and USA), Asian, Central and East Europe, Latin America, Mid-East and Africa.

Literature suggests, that imitation of behavior is present not only inside of single stock market, but also this phenomenon can be observed on international level. Thus, it can be expected that the Euro Zone members (having relatively broader knowledge) determine the behaviour of candidate countries to this

international community, especially in periods of greater market volatility. Confirmation of such dependence will introduce new implications in the area of stock market behaviour modelling as allows to assume that in the markets of members of this international community important leading factors for candidate countries to Euro Zone exist and grants to make further use of theory of leading factors in analyses on international level.

Attempting to point herd tendency measure, we can refer both to neoclassical and behavioral theories. It can be expected that aggregated changes in the market will be reflected in the process of prices development. On the basis of behavioral literature, in case of herding presence in international market, it can be assumed that markets in average should behave in a similar way. Following this intuition, as a measure of herding activity in the aggregated market, the size of deviation of the given time series from 'average' can be considered. Such methodology was proposed by Christie, Huang [1995] and Chang, Cheng, Khoran [2000]. To create closer to reality measure of herd behavior, alternative approach in mean construction and deviation measure was used to develop those theories. Thanks to introduced extensions, statistics reflect behavioral tendencies in investors activity in the stock markets.

HERD BEHAVIOR MEASURE

Referring to behavioral literature, if herding is present in international market, it can be assumed that stock market indexes, which are considered to be representant of capital markets and are regarded to reflect aggregated changes in prices development, in average should behave in the similar way. This intuition suggests, that the value of deviation of the given return series from 'average' may be considered as herd measure in aggregated market.

Related literature refers to two measures of herd behavior. First was proposed by Christie and Huang [1995]. In it construction standard deviation is used – it's called Cross-Sectional Standard Deviation (CSSD). The second approach was introduced by Chan, Cheng and Khoran [2000]. This indicator based on absolute deviation from the mean – it's so-called Cross-Sectional Absolute Deviation (CSAD). Construction of CSSD and CSAD assumes that relation between average cross sectional and actual return of asset in interest is symmetric.

Researches depict that investor reactions on decreases and increases of rates in the markets are not the same. Behavioral economy proves that people in suspense have tendency to too quick jumps to conclusions, make decisions just basing on single facts. On the other hand, sometimes investor's reactions are delayed in respect to signals that came to them or downright ignored. On the basis of psychological tendencies, it seems to be reasonable to include in herding measure construction both propensity to overreactions and for ignoring information/ waiting for signals confirmation. Such phenomenon's take place on the level of activity of individual investors, but it can be expected that to some

extent, they will be reflected also in aggregated market. Owing to those facts asymmetric measures can be proposed: Mean Mixed Errors Undervaluation (MMEU) and Mean Mixed Errors Overvaluation (MMEO):

$$MMEU_t = \frac{1}{N}\left[\sum_{i=1}^{N}|R_{ti} - R_t|K_{ti} + \sum_{i=1}^{N}\sqrt{|R_{ti} - R_t|L_{ti}}\right] \tag{1.1}$$

$$MMEO_t = \frac{1}{N}\left[\sum_{i=1}^{N}\sqrt{|R_{ti} - R_t|K_{ti}} + \sum_{i=1}^{N}|R_{ti} - R_t|L_{ti}\right] \tag{1.2}$$

where:

$$K_{ti} = \begin{cases} 1 & if \quad R_{ti} > R_t \\ 0 & if \quad R_{ti} \le R_t \end{cases} \qquad L_{ti} = \begin{cases} 1 & if \quad R_{ti} \le R_t \\ 0 & if \quad R_{ti} > R_t \end{cases}$$

R_{ti} - daily return from market index for country i in period t,

R_t - daily average cross sectional return from market indexes for N countries in period t / indicator of market behavior.

The idea of those measures based on emphasizing (by using root square function) value of deviation of the given return series from aggregated market index in direction which is 'assumed' by measure.

MODELS DEFINITION

It is assumed that in normal conditions investors act in rational way, taking into account all available information when making decisions. Extreme conditions cause extreme emotions and reality shows that investors 'feel more comfortable' acting as other participants of market. This suggests, that it can be expected that herding should be clearly noticeable especially in periods when bigger uncertainty is in the market. On the basis of this presumption, 'normal' and 'extreme' periods can be distinguish in the market behavior. Periods with returns in first (extremely low) and in fourth (extremely high) quartile of distribution are considered as 'extreme'. Moreover, it can be expected that investors will modify the way of their behavior depending on the phase in which the market is.

To verify this hypothesis, model with zero-one variables marking market phases (D^U =1 if the return in day t is in the fourth quartile of distribution, 0 otherwise; D^L =1 if the return in day t is in the first quartile of distribution of market returns, 0 otherwise) can be proposed:

$$\mathrm{MMEU_t}\left[\mathrm{MMEO_t}\right] = \beta_0 + \beta_1^L D_{t1}^L + \beta_2^U D_{t2}^U + \varepsilon_t \tag{2}$$

This linear model allows to investigate the direction of changes in the market. According to classical theories of capital market, developed on rationality fundaments, estimated coefficients should be significantly positive as assets differ in the level of sensitivity. It is expected that herding will cause decrease of dispersion of returns around the mean. Thus, statistically significant and negative

value of at least one of estimated coefficients will indicate on presence of this tendency in the market.

Empirical researches show [Prosad et al., 2012] that relation between measure of herd behavior and market indicator may not be linear. Thus, following alternative nonlinear regression model can be proposed:

$$\mathrm{MMEU}_t[\mathrm{MMEO}_t] = \beta_0 + \beta_1|R_t| + \beta_2 R_t^2 + \varepsilon_t \tag{3}$$

where symbols description as in (1).

If collective behavior is not present in the stock market, relation between MMEU [MMEO] and R_t will be linear and positive. Statistically significant and negative coefficient β_2 implies presence of this tendency in the market.

According to behavioral literature, relation between dispersion measure and market returns may be asymmetric, so two separate models for extreme reactions can be proposed:

$$\mathrm{MMEU}_t^U\left[\mathrm{MMEO}_t^U\right] = \beta_0^U + \beta_1^U\left|R_t^U\right| + \beta_2^U\left(R_t^U\right)^2 + \varepsilon_t \quad \textit{if} \quad R_t > 0 \tag{4.1}$$

$$\mathrm{MMEU}_t^D\left[\mathrm{MMEO}_t^D\right] = \beta_0^D + \beta_1^D\left|R_t^D\right| + \beta_2^D\left(R_t^D\right)^2 + \varepsilon_t \quad \textit{if} \quad R_t < 0 \tag{4.2}$$

where symbols description as in (1).

EMPIRICAL ANALYSIS

Data and analysis period

The research was performed for period from 1st July 2006 to 1st July 2008[1]. July 2007[2] is consider to be the start point of global economic crisis. For analysis purposes two sub periods were determined: period before the crisis start: 1st July 2006 - 1st July 2007 and period after the crisis start: 2nd July 2007 - 1st July 2008. This allows to compare behavior of market in different economic conditions.

Herd tendencies measures presented in literature assume the equal realization each of the series in creation of the average R_t. If the research is performed within single market there are no objections to such approach. However, if the study concerns different countries, using weighted average market capitalization seems to be more appropriate way. Such approach find also methodological justification, as size of the market has very important impact on stock market behavior.

1 This article is part of larger study and that was main determinant of choosing such period of analysis.

2 Appointment of crisis start date is subjective task. In this article decision was made to take more or less a moment of bankruptcy of two hedging funds of Bear Stearns bank – the time when alarming information started appearing in the market.

Daily closing index prices coming from web-sites[3]: http://analytics.tradingeconomics.com, http://www.nasdaqomxbaltic.com/market, http://www.borzamalta.com.mt (for Lithuania and Malta respectively) were used in analysis and for calculation weighted average market capitalization index (R_t) for countries belonging to Euro Zone.

Information about markets capitalization was taken from web-site: http://databank.worldbank.org (annual data were converted into daily data using PROC EXPAND procedure (with options: OBSERVED=total and METHOD=join) available in SAS 9.1®).

Results of investigation

To verify presence of herd behavior in the aggregated market of candidate countries to Euro Zone, models (2), (3) and (4) were estimated. The research was performed both for S&P 500 (as American market still has great impact on world economy) and for weighted average index return of Euro Zone members as a markers of market phases.

Table 1. Regression coefficients for: $\mathrm{MMEU_t}\ [\mathrm{MMEO_t}] = \beta_0 + \beta_1^L D_{t1}^L + \beta_2^U D_{t2}^U + \varepsilon_t$

	1st July 2006 - 1st July 2007		2nd July 2007 - 1st July 2008	
Parameter	Estimates (p-value) #	Estimates (p-value) ##	Estimates (p-value) #	Estimates (p-value) ##
MMEO				
β_0	0.0526 (<.0001)*	0.0408 (<.0001)*	0.0609 (<.0001)*	0.0512 (<.0001)*
β_1^L	-0.0003 (0.0006)*	-0.0117 (0.9288)	-0.0023 (0.5047)	-0.0180 (0.0002)*
β_2^U	-0.0042 (0.0009)*	0.0222 (<.0001)*	0.0049 (0.0091)*	0.0440 (<.0001)*
MMEU				
β_0	0.0421 (<.0001)*	0.0432 (<.0001)*	0.0418 (<.0001)*	0.0474 (<.0001)*
β_1^L	0.0105 (0.0006)*	0.0322 (<.0001)*	0.0066 (0.0390)*	0.0423 (<.0001)*
β_2^U	-0.0002 (0.0064)*	-0.0099 (0.9004)	-0.0011 (0.0027)*	-0.0128 (0.5043)

for S&P 500 as marker of market phases; ## for weighted average index return of Euro Zone members as marker of market phases
* denotes significance at 5%

Source: Author's calculations, performed in SAS 9.1®

Estimated coefficients β_2^U of MMEU regression and β_1^L of MMEO regression are negative in each case. Also, for pre crisis time β_2^U is below zero in the model where S&P 500 as marker of market phases and MMEO as dependent

3 In the research were included all countries belonging to Euro Zone in the analyzed period and the members of European Union that candidate to this international community.

variable are used. Results of analysis do not allow to reject hypothesis about herding presence in the market.

Literature shows that all economies are very sensitive on the situation in USA. It is worth to notice that when American index as marker of market phases is used, estimator's values are closer to zero. Such results suggest that greater impact on behavior of countries that would like to enter to Euro Zone has behavior of members of Euro Zone than S&P 500 index, which is traditionally used for determination of tendencies in the world markets.

MMEO construction highlights issues of overestimation variability. Too strength reaction are characteristic for stressful periods: with higher variability, with very low returns and decreases in the market.

Contrastively MMEU construction highlights issues of underestimation variability. Such tendencies in investors behavior are characteristic especially for 'calm' periods and characterized by increasing trend.

Table 2. Regression coefficients for: $\mathrm{MMEU}_t[\mathrm{MMEO}_t] = \beta_0 + \beta_1|R_t| + \beta_2 R_t^2 + \varepsilon_t$

	1st July 2006 - 1st July 2007		2nd July 2007 - 1st July 2008	
Parameter	Estimates (p-value) #	Estimates (p-value) ##	Estimates (p-value) #	Estimates (p-value) ##
MMEO				
β_0	0.0343 (<.0001)*	0.0345 (<.0001)*	0.0525 (<.0001)*	0.0471 (<.0001)*
β_1	0.2397 (0.0414)*	0.2271 (0.0109)*	-0.0887 (0.4348)	-0.1815 (0.0125)*
β_2	13.0570 (0.0004)*	7.2686 (0.0088)*	5.6789 (0.0561)*	6.1352 (0.0013)*
MMEU				
β_0	0.0427 (<.0001)*	0.0396 (<.0001)*	0.0467 (<.0001)*	0.0412 (<.0001)*
β_1	-0.1149 (0.3236)	-0.2690 (0.0025)*	-0.1603 (0.1770)	-0.0853 (0.2527)
β_2	6.3826 (0.0784)*	13.5097 (<.0001)*	17.1034 (<.0001)*	10.7802 (<.0001)*

where symbols description as in Table 1

Source: as in Table 1

Results of $\mathrm{MMEU}_t[\mathrm{MMEO}_t] = \beta_0 + \beta_1|R_t| + \beta_2 R_t^2 + \varepsilon_t$ estimation suggest that herding is not present in the market as in each model β_2 coefficient is greater than zero. Also, it can be observed that R_t changes have more than proportional impact on the herding behavior measure.

Table 3. Regression coefficients for: $\mathrm{MMEU}_t^x \left[\mathrm{MMEO}_t^x\right] = \beta_0^x + \beta_1^x \left|R_t^x\right| + \beta_2^x \left(R_t^x\right)^2 + \varepsilon_t$, $x \in \{U, D\}$

	1st July 2006 - 1st July 2007		2nd July 2007 - 1st July 2008	
Parameter	Estimates (p-value) #	Estimates (p-value) ##	Estimates (p-value) #	Estimates (p-value) ##
MMEO where $R_t > 0$				
β_0	0.0352 (<.0001)*	0.0358 (<.0001)*	0.0450 (<.0001)*	0.0445 (<.0001)*
β_1	0.6468 (<.0001)*	0.4915 (<.0001)*	0.5346 (0.0006)*	0.2676 (0.0082)*
β_2	5.4493 (0.0799)	10.1682 (0.0152)*	1.4433 (0.5745)	1.5037 (0.7250)
MMEU where $R_t > 0$				
β_0	0.0411 (<.0001)*	0.0385 (<.0001)*	0.0532 (<.0001)*	0.0430 (<.0001)*
β_1	-0.6405 (<.0001)*	-0.6057 (<.0001)*	-0.7233 (<.0001)*	-0.5280 (<.0001)*
β_2	15.1782 (<.0001)*	18.2479 (<.0001)*	18.7647 (<.0001)*	18.0368 (<.0001)*
MMEO where $R_t < 0$				
β_0	0.0353 (<.0001)*	0.0344 (<.0001)*	0.0543 (<.0001)*	0.0461 (<.0001)*
β_1	-0.8458 (<.0001)*	-0.4980 (<.0001)*	-0.4979 (0.0008)*	-0.4708 (<.0001)*
β_2	-16.5644 (<.0001)*	-27.0667 (<.0001)*	-11.2251 (0.0021)*	-11.7262 (<.0001)*
MMEU where $R_t < 0$				
β_0	0.0416 (<.0001)*	0.0391 (<.0001)*	0.0470 (<.0001)*	0.0412 (<.0001)*
β_1	1.1762 (<.0001)*	0.5823 (<.0001)*	0.1664 (0.3292)	0.2392 (0.0238)*
β_2	-0.1154 (0.9776)	-15.9737 (0.0024)*	-3.7381 (0.1662)	-13.4507 (0.0023)*

where symbols description as in Table 1

Source: as in Table 1

Different conclusions provide analysis performed separately for decreasing and increasing periods in the market than those flowing from the results of estimation $\mathrm{MMEU}_t \left[\mathrm{MMEO}_t\right] = \beta_0 + \beta_1 |R_t| + \beta_2 R_t^2 + \varepsilon_t$.

Results for bull market allow to reject hypothesis about existence of herding in the market of candidate countries to Euro Zone. In periods characterized by $R_t < 0$ models for both MMEO and MMEU and for both markers of market phases indicate on herding presence in the analyzed market. This draws conclusions that decreasing trend itself invokes anxiety and increases stress among investors and thus increases probability that herd behavior appears in the stock market. Furthermore, received differences in the results for periods characterized by $R_t < 0$ and $R_t > 0$ confirm theory of behavioral finance about different reaction of

investors for increasing and decreasing trends in the market and show that this tendency is also noticeable on the aggregated level.

As in the first model (2), in most cases values of received estimators indicate relatively stronger (as to absolute values) reaction of herd behavior measures on the changes of weighted average of indexes returns of Euro Zone members than on changes of American index returns.

To complete empirical analysis, short summary of models diagnostic need to be added. All presented models are statistically significant (Pr > F: <.0001). Adjusted R square belongs to interval: [0.0200, 0.4779] for models estimated for pre crisis period and to: [0.0259, 0.3864] for crisis period. For both periods and both market indicators the worst fitted linear models are. Slightly better is model (3). Significantly the best fitted are nonlinear models estimated separately for periods characterized by $R_t < 0$ and $R_t > 0$.

SUMMARY AND CONCLUSIONS

In the paper attemption to create better than known until now measure of herd behavior on the basic of methodology of deviations from mean was made. Theory proposed by Christie, Huang and Chang, Cheng, Khoran was developed for alternative approach of average construction and deviation measure. Thanks to that, it includes predispositions of investors behavior and becomes more close to reality. Referring to literature, it seems that introduction of mentioned elements do not affect significantly the obtained results. One of the reasons may be dilution (by averaging) of the effect on aggregated level. For further methodology verification it is recommended to use data with higher frequency.

Moreover, in the paper the problem of herding presence on the markets of countries that would like to enter to Euro Zone in the period before economic crisis (1st July 2006 - 1st July 2007) and after it beginning (2nd July 2007 - 1st July 2008) was analyzed. Received results do not allow to answer unambiguously for in the introduction questions raised, however seem to be consistent with those described in literature. Even then the models do not indicate on presence of herd tendency among countries that would like to enter to Euro Zone unquestionably, but also do not allow to reject this hypothesis. Also, it should be emphasized that any market can not be fully free from herding effect – it with smaller or greater strength will be reflected in aggregated market.

Obtained results suggest that dependence between the behavior of countries that would like to enter Euro Zone and members of this international community exists. If in the aggregated market imitation tendencies are present, received results indicate that candidates to Euro Zone will copy the way of activity not only in periods of higher uncertainty. Also, it should be emphasized that it is more probable that countries that would like to enter to Euro Zone will be more

sensitive to changes appearing in the markets of members of Euro Zone than to those indicated by American index, which traditionally according to literature is used as marker of market behavior. This outcome supports availability heuristic defined in psychology. Also, this draws very important conclusion for modeling behavior of candidate countries to Euro Zone markets. It can be expected that important leading factors for countries that would like to enter this international structure can be found in markets of members of Euro Zone. Furthermore, it provides a clue for governments about directions in which information systems should be developed to provide appropriate level of information for investors.

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