Analysis of the stock market anomalies in the context of changing the information paradigm

Kostyantyn MALYSHENKO*, Vadim MALYSHENKO**, Elena Yu. PONOMAREVA***, Marina ANASHKINA****

Abstract

The present paper describes the results of a comprehensive research in the information efficiency of the Ukrainian stock market in the context of a financial paradigm transformation which causes a need to modify the EMH (efficient market hypothesis). The aim of the research is to identify the market inefficiencies (anomalies) that occur in the market and contradict the EMH provisions. The database used for the research is from both the world and the Ukrainian stock markets (from 2008 to 2013). Besides, the authors compiled their own event database on Ukrainian mass media data with clear formalization of the event evaluation, which excludes any judgmental approach. Both the standard statistical procedures and the authors' event analysis become the instruments for the analysis. To randomize the research, an event date was shifted by 1-5 days with the reference to the emissions by the moving average method. The research becomes the basis for a new information paradigm, and the fourth form of information efficiency was justified. These changes underlaid the evaluation methodology for the arisen anomalies being the result of explicit or implicit collusion at the stock market of Ukraine.

Keywords: anomalies of the stock market, information efficiency, event analysis, efficient market hypothesis (EMH), fractal market hypothesis (FMH), coherent market hypothesis (CMH)

---

* Kostyantyn MALYSHENKO is Senior Researcher at the National Research Institute for Vine and Wine Magarach; e-mail: malyshenko.cfu@bk.ru.
** Vadim MALYSHENKO is Senior Researcher at the National Research Institute for Vine and Wine Magarach.
*** Elena Yu. PONOMAREVA is Ph. D., Associate Professor at the Vernadsky Crimean Federal University.
**** Marina ANASHKINA is Assistant at the V. I. Vernadsky Crimean Federal University.

Introduction

This article includes an overview of the work of the authors conducting research in this field, the rationale for choosing the methods of conducting the study, the description of their conduct, the results obtained and their discussion. Stock market information efficiency (or just efficiency) is a multi-faceted criterion describing the changes in the prices for stock instruments under the impact of different events. Information efficiency is a must for a perfectly competitive market which is a goal to achieve for the economy of any country. In terms of financial theory, the investors in their decisions on the financial investments consider, first of all, their own priorities and preferences in risks and revenues, and secondly, they evaluate the returns on investment options on the markets, that is, they evaluate the true value of the financial assets.

The purpose of the research is to determine the anomalies in the stock markets that are in contradiction with the hypothesis of an effective market, as well as to develop on this basis an integral theory that meets the modern nature of the stock Markets. The peculiarity of this research is that it used the author's method of event analysis, based on traditional methods, applicable to the research of markets with strong information asymmetry and monopolization. About 65% of the countries are emerging or developing stock markets that are not integrated into the global financial market. The choice as a basis of research of the stock market of Ukraine is due to the fact that it is characterized by the isolation and actual monopolization of information from the largest participants, which inherent most of the markets related to development. In the stock market of Ukraine during 2008-2013, securities of 15 companies were in circulation (JSC "FSTS stock exchange"), fact which directly indicates its isolation and inaccessibility for a wide range of investors. Thus, this study is based on a small sample, but it fully covers the Ukrainian stock market, which allows taking into account its peculiarities.

In the context of a strong asymmetry of information on the stock market, existing theories of the organization and functioning of the market are not adapted to the prevailing conditions, accordingly, it is impossible to build a forecast of its movement. Existing methodologies will not produce reliable results. Forecasting the movement of markets is a topical problem, which has an acute practical significance, which in conditions of weak form of efficiency becomes almost impossible. Thus, there is a need for the formation of such a paradigm, which will be the basis of new methods of forecasting, complying with modern laws of market functioning.

The scientific community adheres to two opposing opinions on the question of the possibility of predicting stock market movements. The first party believes that the prediction is impossible, while the other party does not rule out such a possibility. The economics literature provides a systematic approach to the development and application of different theoretical strategies to stock market analysis, although there are a number of challenges connected, first of all, with the stock market functions on

attracting the population's capital. To illustrate this point of view, we can classify the most well-known theories, according to which the main criteria will be the possibility of forecasting prices on the one hand and rationality of the behaviour of market entities on the other. We will present the obtained results in the form of the following table (see table 1).

Table 1. Extended classification of pricing models for the securities market

		Forecast is possible	Forecast is not possible
Behaviour of market players	Rationally	The theory of „catastrophes" - (K. Ziman, 1974). The theory of the "Sturdy Foundation" - (E. Gildu, J. Williams, 1938). Hypothesis of coherent markets - (T. Vage, 1990).	The theory of "market efficiency" - (Y. Fama, 1965). Mathematical models of the theory of market efficiency (CAPM, APT) - (W. Sharp, 1964).
	Conditionally rational	Elliott Wave Theory - (R.N. Elliott, 1938). The theory of „Castle-in-the-Air Theory" - (J. Keynes, 1936). "Perspective theory" (D. Kahneman and A. Tversky, 1979).	The random walk theory (L. Bachelier, 1900, Cootner, Paul H. 1964). The theory of rational expectations - the concept of macroeconomics, originally developed (J. F. Muth, 1961 and developed by R. Lucas in the middle of the 1970s).
	Irrationally	The theory of „noise" (F. Black, 1986). The theory of „fashion and moods" (G. Simmel, 1900). The theory of reflexivity - (J. Soros, 1987). Theory of investor behavior (A. Schleifer, 2000).	The "chaos" theory - (A. Poincaré, 1905). The theory of „fractals" - (B. Man-delbrot, 1984).

Source: author's synthesis.

As can be seen from the table above, there are theories that have the features of two groups (both rational subjects and non-rational subjects — conditionally rational behaviour). These theories have a transitional character and historically they arose in response to attempts to explain events that did not fit into the framework of already constructed theories. The following theories are even more "pessimistic" - for example, the theory of random walk, which in principle negates the possibility of predictions.

The analysis found that all theories have some special points, anomalies, assumptions, and sometimes direct inconsistencies. This is explained by the fact that

the theories that seemed to be "working" ceased to be so. For example, over time, with the emergence of new circumstances, events, global changes and other things, the degree of price predictability decreases and a new concept is born. This general process is connected, first of all, with changes in the socio-economic formation itself, its evolution.

Currently, there is a need to work out the pricing model which could accurately reflect the situation on the stock market. This need is even more acute as in different periods of time any theory should be verified to this or that extent. Thus, the main tasks of the research are, first of all, to analyse the existing theories, secondly, to identify the discrepancies and similarities between them, and, thirdly, to develop the integral theory which could match a changing nature of the stock market in the context of the global economic instability.

Financial transactions are carried out by the financial market's agents through financial instruments. The results of the majority of the transactions are difficult to predict. Overall, it is impossible to predict other characteristics of transactions, for example, revenue and returns on investment. However, this is of high demand in practice. A way out is to accept particular agreements on the market which will use some scientific arguments for analysis. There are mainly three assumptions:

1. Hidden parameters (for example, psychology) are not taken into account;

2. In purely abstract terms, a market has infinite manifestations, which are different in all their details, at the same time very often one can find a manifestation from the past or in other place, which is similar to the analysed situation;

3. The financial instrument under analysis should be accompanied with some accumulated information (Malykhin, 2003).

Three articulated assumptions are the grounds to examine the financial markets with the academic model developing methods (mathematical, computerized, etc.) describing and reflecting real financial markets.

The aim of the research is to identify the market inefficiencies (anomalies) that contradict efficient market hypothesis (EMH).

A verified hypothesis: H_0 – Ukraine's stock market has no external (monopolistic) impacts; H_1 – Ukraine's stock market has external impacts.

As a result of this study, the evolutionary "Logistic information paradigm" is theoretically justified as the next stage in the development of the nonlinear information paradigm of the stock market. The difference from the actual paradigm lies in the disclosure of irrational reactions of market entities in the context of economic instability (volatility) based on the coherence (consistency) of their behaviour. This paradigm allows us to understand the multidirectional orientation of price dynamics and the influence of social and political events on the basis of investor behaviour; as a result, the theory of the "Informational Efficiency of the Stock Market" was modified by adapting the Efficient Market Hypothesis (EMH) to the characteristics of the emerging stock market in terms of its levels. Let us briefly

analyse the existing market theories and their models and see their advantages and drawbacks.

1. Literature review

The first theoretical assumptions underlying the efficient market hypothesis were made at the beginning of the XXth century. In his PhD thesis „The Theory of Speculation" published in Paris in 1900, Louis Bachelier, a French economist, proposed some ideas concerning the random fluctuations of the stock prices at the stock market. About half a century later, many economists addressed this issue.

EMH considers pricing to be a random walk (Francis *et al*., 2005) or a martingale process (Mandelbrot *et al*., 2004) and presupposes the prices to be normally distributed. Presently, the fact that the prices are not correlated and stationary, and there are different anomalies empirically verified results in hypothesis modelling and transition to price distribution in accordance with the family of Pareto-Levy distributions, which is looked upon by a number of scientists (Andreou *et al*., 2001; Likhutin, 2012) as a stage in the evolution of the theory and a sign of importance and relevance for further studies. At the same time, some academicians doubted the application of the Pareto-Levy distributions in modelling yields because in this case the invariant property of exponent is violated (this property defines the peaked value of probability density). Further studies showed that Student's t-distribution gives a better approximation of returns in comparison with the Pareto-Levy distributions.

Unfortunately, the latest national publications typically contain the examples of applying widely known techniques and instruments within an old non-linear paradigm. Mamedov and Lisovskaya (2014) showed that it is impossible to implement strong and moderate forms of market efficiency. They gave the examples of the markets that impact the market efficiency level and thus the possibility to identify the under-valued (or over-valued) assets. Kuznetsova (2015) conducted a theoretical research which enhances some EMH notions with due regard to the development of this theory. Adbullin and Farrakhetdinova (2015) looked at different aspects connected with EMH development and its further interpretations. Lukasevich (2016) described the examples of stock markets in Russia and the USA and demonstrated the chaos theory models being utilized as an instrument to evaluate the market efficiency in a Bloomberg data.

EMH is based on the fact that investors have a linear reaction to the information, which is not always the case with the reality. Fractal Market Hypothesis and Coherent Market Hypothesis are being developed as an alternative to EMH.

Fractal Market Hypothesis. In the 1970s, Benoit Mandelbrot (2004) proved that the distribution of financial asset returns differed from the normal distribution, for example, a diagram of probability density function had the highest peak and

heavy tails. Mandelbrot was the first to consider the market as a fractal structure through fractal theory.

Coherent Market Hypothesis. The coherent market hypothesis is based on the creation of nonlinear statistical models. This model was first created by T. Vaga in 1990 and is based on the Ising model of coherent molecular behaviour and the theory of social imitation of Callan and Shapiro.

Thus, we can articulate the key features of this hypothesis which are important for the analysis: a need in liquidity; investors with different investment horizons on the market; damages in fractal structure results in crisis on the market; prices reflect the information which is important for this investment horizon

2. Materials and methods

Today, an event study is the most widely used method to evaluate an impact of a particular event on a market behaviour.

The event study is enhanced for different national markets, as well as for other stock instruments in the papers of Wei (2006), Nageswara and Sreejith (2014), Thornton (2014), Brav and Lehavy (2003), Thornton (2014), Bradshaw (2004) and other. The stages of the event analysis are shown in Table 2:

Table 2. Stages of event analysis

Stages	Stage description
1	Identify the event and a period of securities quotations being affected by this event, that is, the event window.
2	Formulate a research hypothesis and divide the events into favorable - market responds positively, and unfavorable ones - market responds negatively (Okun, 2016).
3	Calculate abnormal returns. This is a difference between an actual yield and normal returns for this event window. Normal returns: $$AR_{it} = R_{it} - E(R_{it}) \qquad (1)$$ where AR_{it} is the abnormal returns, R_{it} is the actual returns, $E(R_{it})$ is the expected returns for the period t. The actual returns (Farrakhetdinova *et al.*, 2015) – this is not a negative number* (based on the formula) and for each day it is calculated as follows: $$R_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) \qquad (2)$$ P_{it} – price of the i-th security.
4	Excessive returns which are the difference between the actual returns and the normal returns are calculated. The excessive returns are the abnormal returns - a part of returns which is not expected on the market and therefore becomes an instrument to measure the changes in firm's value caused by the news. For each

	day of the event window, the abnormal returns are averaged for the companies in question.
5	Summing up the average excessive returns for each day, that is calculating CAR (Cumulative Average Residual), which shows average cumulative event impact for all companies in a chosen time interval.

Note: quotes cannot be negative.

Aswath Damodaran in his book "Investment Valuation. Tools and Techniques for Determining the Value of Any Asset" gives a precise description of the event study approach and points out possible methodological failures which very often occur when testing market efficiency:

1. „Funny" arguments are used to accept or to reject an investment strategy.
2. An investment strategy is tested with the same data and time period which were used to develop it.
3. Sampling is biased.
4. Negligence of market returns.
5. Negligence of risk.
6. A wrong correlation to identify a cause-effect relation.
7. Negligence of survival.
8. Negligence of transaction costs.
9. Negligence of barriers in implementation.

An event analysis has a number of difficult points which should be taken into account. They are as follows:

1. In the context of an imperfect system of information disclosure at the developing stock markets, there are no well-formed practices of releasing information about an announcement date of any event. Foreign analysts deal with a Calendar of Official Events for the events in every economy development area. Therefore, we can only see the events that took place and that were aired in the official and easily accessible mass media.
2. Companies are sampled. The whole market is of interest for the research, that's why the change in the stock index is used. These indices are based on the sampled companies, which makes the analysis easier, solves the problem with the number of companies in a sample, and eliminates any distortions which would inevitably occur, because for a significant time period some companies could cease to exist, for example, they could become bankrupt, merged, etc.
3. Then the analysis is reduced to the calculation of the excessive returns for particular firms closer to the announcement date in comparison with the market returns. Therefore it is necessary to identify the event window, and an analyst should do it on his/her own. Thus, an event and changes in price are correlated in a subjective manner. However, the events do not happen in sequence and do not wait for the response of the market to the first event, then to the next event, and so on. You can't apply the above mentioned features to

accept the returns period before the announcement date of the event – because these dates are not set.

The difference of the above approach is that the excess yield is not defined in the classical form (as the difference between the observed and the expected). The excess return is determined only on the basis of the coefficient of information elasticity.

In terms of event fundamental-technical analysis, methodological approaches (methodology) to evaluate the information efficiency of the stock market have been developed:

Procedure to apply event fundamental-technical analysis (modified type of classic event analysis, Figure 1):

Stage 1. Evaluation of information availability in terms of history, event window and information sources;

Stage 2. Collection of historical information and compilation of event base;

Stage 3. Identification and description of special moments connected with the registration of this or that event.

Stage 4. Analysis of event profile of a day;

Stage 5. Analysis of event factor of a day;

Stage 6. Analysis of information elasticity.

We included the following indices of stock market monopoly power:

- Index of information asymmetry;
- Rate of stock index concentration;
- Index of stock market monopoly power.

The diagram gives the formulas to calculate these indices, their possible values and interpretations (Figure 2).
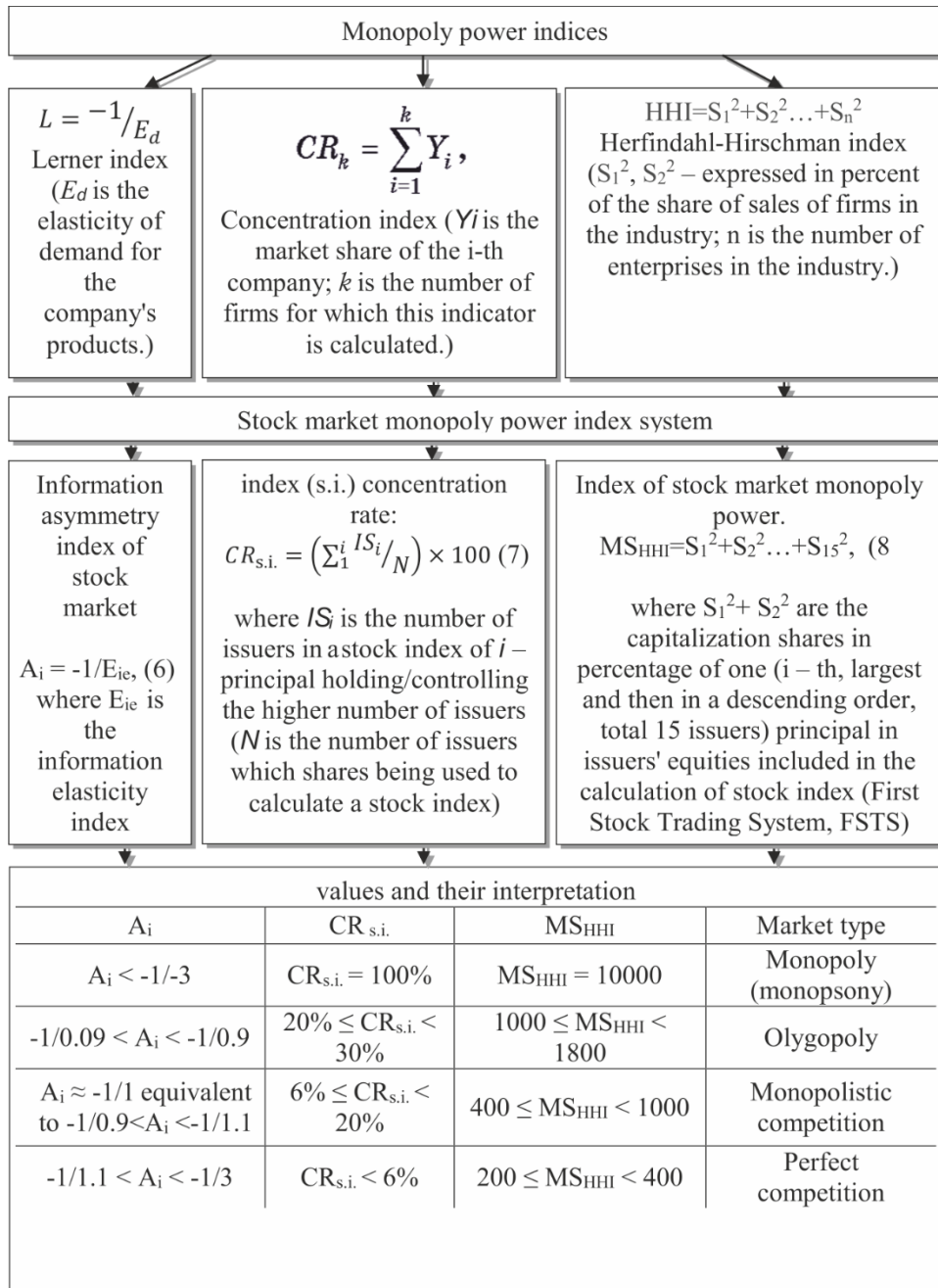
Criteria boundaries of the information asymmetry index are based on information elasticity indices (Figure 3). The boundaries for other indicators are defined in accordance with the theoretical evaluations of the market which are typical for the microeconomic analysis.

Figure 1. Stages in event analysis based on the evaluation of information efficiency

STAGES IN EVENT ANALYSIS BASED EVALUATION OF INFORMATION EFFICIENCY

Stage	Description
Stage 1. Evaluation of information availability in terms of history, research horizon and information sources;	1. Impact from the information availability; 2. Choice of event window; 3. Choice of uniform information sources.
Stage 2. Collection of historical information and compilation of event base	1. Collection of news and messages from different sources; 2. Preliminary analysis with coding in accordance with the event classification at hand; 3. Data on national currency exchange rate and stock index.
Stage 3. Identification and description of special moments connected with the registration of this or that event.	1. Type of event to be used for an event profile of a day See Appendix, Fig. A.1.). 2. Weight of the event; 3. Area of event impact; 4. Classify by other developed criteria and assign them the appropriate weight.
Stage 4. Analysis of event profile of a day	Classified events are assigned their weight in accordance with different characteristics, and an event profile of a day is calculated by the formula: $$IvP = \sum_{0}^{n} W_e \times W_t \times W_d \times W_i \times W_p \times W_s \times W_l, \text{ event-units;} \qquad (3)$$ where: W_e is the weight of event kind (from 1 to 6 depending on a tkind of an event, except for rumors and expectations with the weight depending on the area of the event); W_t is the weight of the type of the event (from 1 to 3); W_d is the weight of impact duration (from 1 to 2); W_i is the weight of impact type (from - 1 to 1); W_p is the weight of place (from 1 to 2); W_s is the weight of impact strength (from 1 to 3); W_l is the weight of analysis level (from 1 to 3); n is the number of events (See Appendix, Table A.1.).
Stage 5. Analysis of event-factor of a day	Event-factor of a day differs from event profile of a day in the preserved impact from the previous days: $IF_i = IvP_i + IvP_{i2}/4 + (IvP_{i-1} + IvP_{i2}/2)/2,;$ (4) where IF is the event-factor of a day, in EU; IvP is the event profile, in EU; i is the event date in the period in question.
Stage 6. Analysis of information elasticity	It is calculated by the following formula ; $$E_{ip} = \frac{\Delta I \text{ or } \Delta P}{\overline{\Delta IF_i}} \qquad (5)$$ where EIe is the index of information elasticity;Δ I or ΔP is the change in stock index or security quotation expressed in %; $\overline{\Delta IF_i}$ – the average change in the event factor of the i day.

Source: Malyshenko *et al*., 2018.

Figure 2. Stock market monopoly power index system

Monopoly power indices		
$L = {-1}/{E_d}$ Lerner index (E_d is the elasticity of demand for the company's products.)	$CR_k = \sum_{i=1}^{k} Y_i,$ Concentration index (Yi is the market share of the i-th company; k is the number of firms for which this indicator is calculated.)	HHI=S_1^2+S_2^2…+S_n^2 Herfindahl-Hirschman index (S_1^2, S_2^2 – expressed in percent of the share of sales of firms in the industry; n is the number of enterprises in the industry.)

Stock market monopoly power index system		
Information asymmetry index of stock market $A_i = -1/E_{ie}$, (6) where E_{ie} is the information elasticity index	index (s.i.) concentration rate: $CR_{s.i.} = \left(\sum_1^i {IS_i}/{N}\right) \times 100$ (7) where IS_i is the number of issuers in a stock index of i – principal holding/controlling the higher number of issuers (N is the number of issuers which shares being used to calculate a stock index)	Index of stock market monopoly power. MS_{HHI}=S_1^2+S_2^2…+S_{15}^2, (8) where S_1^2+ S_2^2 are the capitalization shares in percentage of one (i – th, largest and then in a descending order, total 15 issuers) principal in issuers' equities included in the calculation of stock index (First Stock Trading System, FSTS)

values and their interpretation			
A_i	CR s.i.	MS_{HHI}	Market type
$A_i < -1/-3$	$CR_{s.i.}$ = 100%	MS_{HHI} = 10000	Monopoly (monopsony)
$-1/0.09 < A_i < -1/0.9$	20% ≤ $CR_{s.i.}$ < 30%	1000 ≤ MS_{HHI} < 1800	Olygopoly
$A_i ≈ -1/1$ equivalent to $-1/0.9<A_i <-1/1.1$	6% ≤ $CR_{s.i.}$ < 20%	400 ≤ MS_{HHI} < 1000	Monopolistic competition
$-1/1.1 < A_i < -1/3$	$CR_{s.i.}$ < 6%	200 ≤ MS_{HHI} < 400	Perfect competition

Source: own representation.

The Information asymmetry index is specifically given in fractions to make it easier to identify the sources of criterion values (as reverse values of the information elasticity index). The Index of stock market monopoly power is calculated in the same way as the Herfindahl-Hirschman index, although capitalization shares of one (i - th, the biggest one and the others in descending order) principal in percentage are used. Besides, these shares are not squared - the number of equities used in calculating a stock index in Ukraine in comparison with the developed market countries is not high (for example, our FSTS includes only 15 issuers), while the number of the large principals is even less. It is reasonable to have an algorithm to describe the control of stock market monopoly power with the proposed indicators (Figure 3).

According to this algorithm, the first stage of control is to calculate our control indicators and, first of all, the information asymmetry index (A_i). This is the first stage - it gives the information on the dates with the information asymmetry, that is, it shows whether the anomaly in market response can generally be observed. Then the issuers (principals) included in the stock index with the equity quotations being the reason for the changes are identified. After that the changes in national currency exchange rate are evaluated, which can indirectly signal about one important event being missed, and the adequate adjustment is made. The next stage is to calculate stock index concentration rate ($CR_{s,i}$) and stock market monopoly power index MS_{HHI} with the previously defined formulas. The latter two indices can be calculated for all principals, however, our approach helps, first of all, to identify the suspicious principals and to check their possibilities in their extra-market impact.

3. Results

Thus, all significant events were registered with similar parameters, including the rare ones. Here the most important point is the requirement to event registrar's qualification (if the events are not registered automatically, which is quite possible with the development level of information technologies). Therefore, a clear task and appropriate qualifications given in the Annex (general classification of the events and formal requirements to event type evaluation (Figure A.1, Table A.1) (a bearish and bullish event) by their impact, see the Annex) weaken the requirements to these procedures as the approach is highly formalized in details.

Information about an event was taken from different resources:

News resources of information agencies. Until recently the news was mainly published in traditional media: radio, television, teletype, and it was quite difficult to see the general picture of the news. The Internet has changed the process of news collection, and tags and indexing helped to process the news automatically.

Figure. 3. Algorithm of evaluation and control of stock market monopoly power
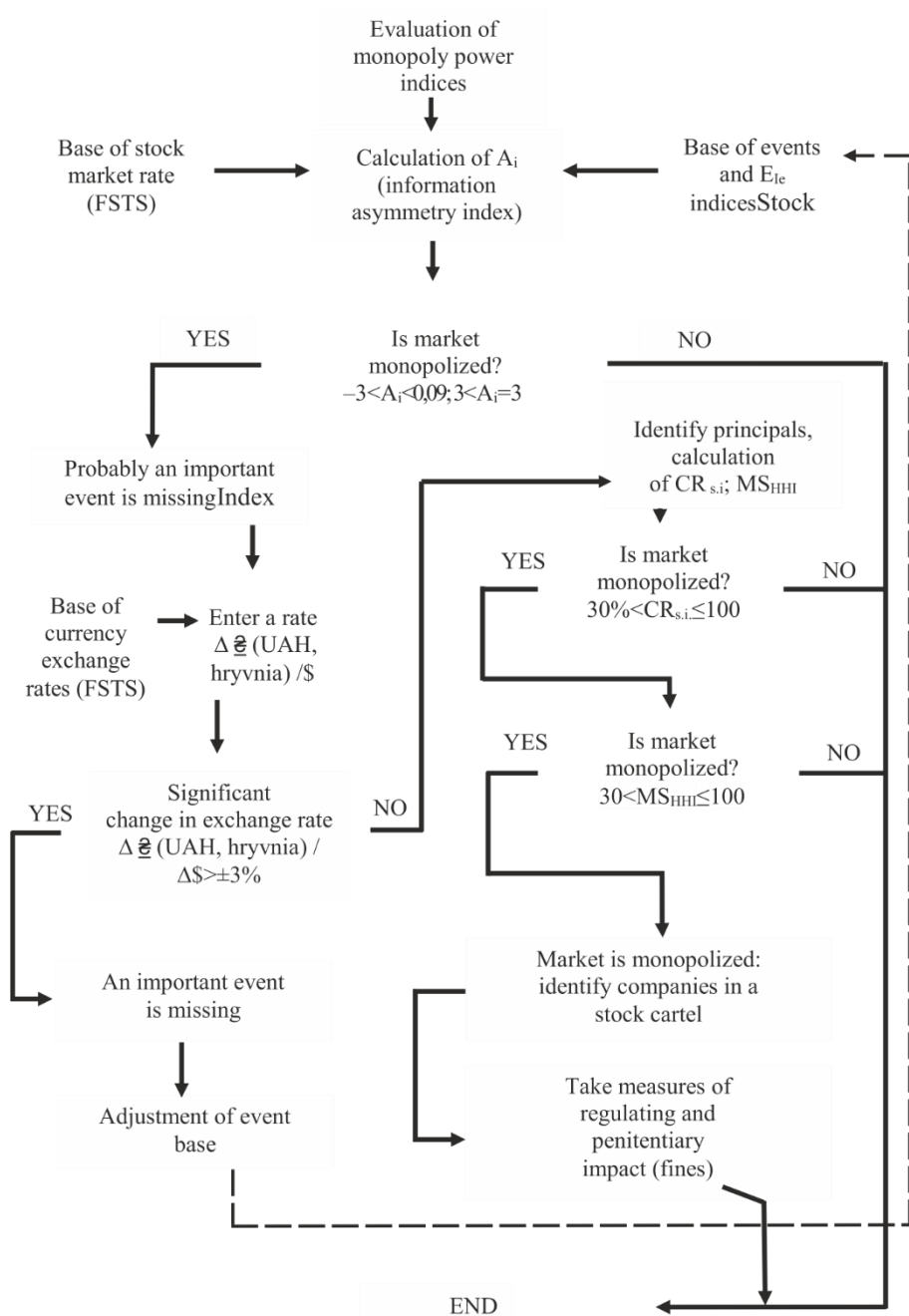

Source: own representation.

Information from the primary sources is a raw material, which the journalists use in preparing the news. It can be taken from the primary sources, for example, from SEC reports (The United States Securities and Exchange Commission, https://www.sec.gov/reports), court documents, reports of different governmental agencies, companies' resources, companies' reports, previews, macroeconomic statistics, etc. Information elasticity evaluation controls the level of monopoly power when carrying out the transactions at the stock market. The main tasks of this control are to identify the drawbacks and negligence in resource usage; to cover the caused damages; to hold the guilty people accountable for administrative and material deeds; to take measures to prevent further violations of financial discipline.

The choice of the period for the study is not accidental. This period accounts for the rapid growth of the stock market in Ukraine. Since the beginning of 2007, the stock market of Ukraine, classified by the international agency S&P as the so-called frontier markets, has shown staggering growth rates (42%), being on this indicator on the leading positions in the world. And this is despite the fact that in 2006 the growth of the local stock index was 77%. In subsequent years, the positive dynamics and the upward trend in trading volume continued.

In 2012, the trading volume on the securities market amounted to UAH 2530.87 billion. (Fig. 4.), whereas in 2009 this figure was UAH 1,067.26 billion. (an increase of 137%) The decrease in trading volume in 2013 was due to a decrease in securities transactions in the over-the-counter market to UAH 1213.54 billion due to the introduction from January 1, 2013 of a special tax on operations for the alienation of securities and operations with derivatives.

Figure 4. The volume of trading on the securities market in 2009 - 2013, billion UAH
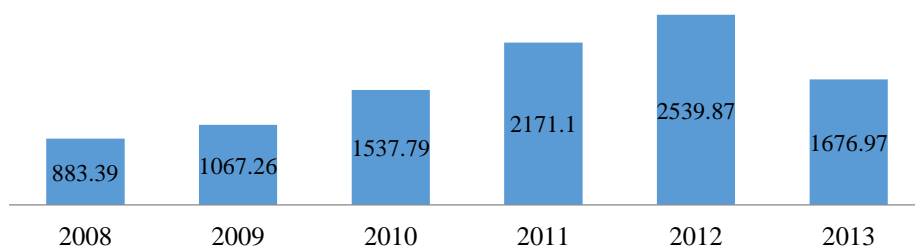
Source: Annual Report National Commission on Securities and Stock Market (2013).

At the same time, the growth rate of the stock market in 2013 was faster than GDP, in particular, the volume of trading on the securities market exceeded this figure by UAH 222 billion. (Figure 5.). First of all, it testifies to the rapid development of the stock market and the development of the state's economy as a whole.

Figure. 5. Comparative data of trading volumes on the securities market and GDP, billion UAH.
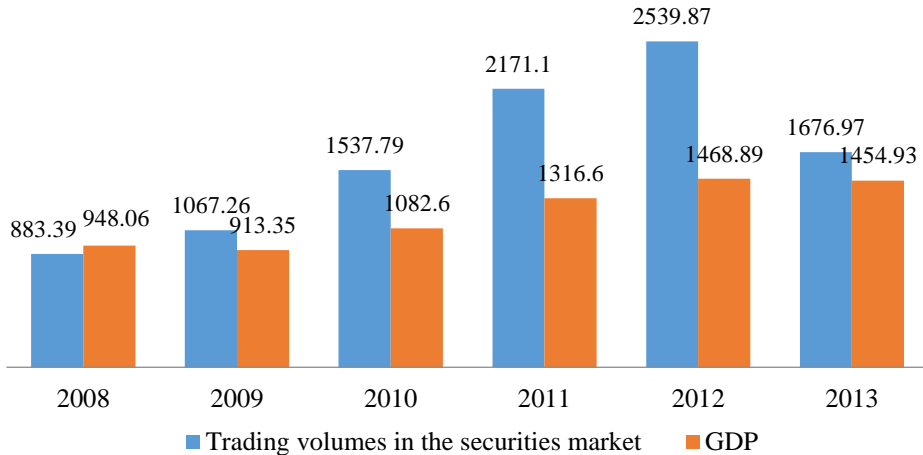
Source: Annual Report National Commission on Securities and Stock Market (2013).

Table 3. The ratio of capitalization of listed companies to GDP in 2009 - 2012%

Country	International organization	2008	2009	2010	2011	2012
USA	-	82,5	108,5	108,9	104,3	114,9
Brazil	BRICS	35,7	72	72,1	49,6	54,6
Russia		23,9	70,5	67,5	42,9	43,4
India		52,7	86,6	95,9	54,9	68,6
China		61,8	100,3	80,3	46,3	44,9
France	Europe	52,7	75,3	75,6	56,6	69,8
Germany		30,6	39,3	43,5	32,9	43,4
Italy		22,6	15	15,6	19,7	23,8
Great Britain		69,9	128,1	137,7	118,7	122,2
Poland		17,0	31,4	40,5	29,9	36,3
Armenia	CIS	1,5	1,6	0,3	0,4	1,3
Kazakhstan		23,3	50	41	23	11,5
Ukraine		9,0	12,6	15,9	13,7	19,7

Source: Annual Report National Commission on Securities and Stock Market (2013).

The key indicator of the development of the stock market and the financial system of the country is the share of listed companies' capitalization in the country's GDP. As the data in Table 3 shows, the share capital is most developed in the USA and the UK, while in Ukraine this figure is still small.

In 2013, most stock market indicators showed a positive trend. Thus, the Ukrainian stock market develops in parallel with the global securities markets; confirmation of this is the main indicator of the stock market - an index that makes it possible to assess the general situation on the stock market (the dynamics of the Ukrainian and world stock market stock indices are given in Figure 6).

Figure 6. Dynamics of domestic and global stock market indices during 2013 (FFTS, the First Stock Trading System (ПФТС) and UB, Ukrainian Exchange (УБ)
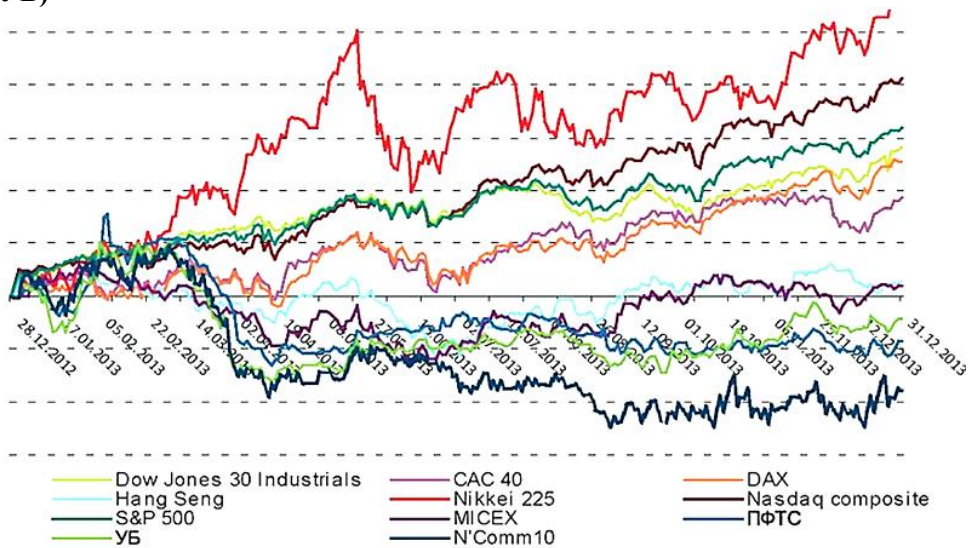
Source: Annual Report National Commission on Securities and Stock Market (2013).

Not all analysts recommend investors to invest in the shares of Ukrainian enterprises. Although the growth potential of quotations of individual securities is huge, the imperfection of legislation, low market liquidity and political instability put investments in the shares of Ukrainian enterprises among the high-risk investments. Such an abnormal growth of the stock market, outpacing GDP growth in the presence of manifestations of information asymmetry (caused by imperfect legislation and as a result of insider trading and market manipulations) made this phenomenon extremely interesting for in-depth analysis.

Let us give an example of how our algorithm (Fig. 3) experimentally works on particular data. First of all, we chose the dates, when the market showed its monopoly reactions. To do this, we used the data from the Table (Fig. 3) with the boundary values of Ai and compared them with the exchange rate dynamics and information elasticity index (Table 4).

Table 4 illustrates that there are 10 cases of monopoly power manifestations on Ukraine stock market for the period under analysis. In the first 5 cases the market

appeared to become monopsonic – buyers rather than sellers held the market power. These dates were connected with the quotation crashes at the FSTS - in fact, the buyers left the markets and imposed their prices. Along with that, these dates showed no extraordinary events - the situations were triggered by the overall panic. For example, the hryvnia exchange rate (by National Bank of Ukraine) which must have responded to a possible missed value, had no significant changes on the specified dates (within fluctuations, that is up to ±3%). However, for control purposes the lower part of the Table with the monopoly power manifestations is of interest.

Table 4. Information asymmetry index, Ai (an excerpt)

Number of a case (anomaly)	Dates[1]	Stock market monopoly power indices			
		E_{Ie}** *	$-0.33<=A_i<0.33$	$\Delta \underline{e}/\Delta\$>\pm10\%$	Market structure
882	02.03.2011	-45.0	0.022	0.0327	Monopoly (monopsony)
1315	16.05.2012	-41.7	0.024	0.0000	
1309	10.05.2012	-33.5	0.029	0.0025	
1695	31.05.2013	-5.3	0.189	0.0000	
1236	27.02.2012	-4.4	0.227	-0.0025	Monopoly
1386	27.12.2008	14.3	-0.069	0.0000	
239	22.08.2011	12.7	-0.078	0.0063	
1053	21.11.2011	3.4	-0.294	0.0000	
1238	29.02.2012	3.9	-0.256	0.0000	
1141	27.07.2012	17.9	-0.056	0.0000	

* Calculated on the basis of: Database "Event Database of the Information Efficiency of the Ukrainian Stock Market 2008-2013" (2015).

These dates showed a growth in quotations with no information about any significant events (although the events themselves occurred after the quotations had changed). This indirectly supports the fact that some issuers had had the information about them beforehand and thus introduced measures were backed up by their monopoly power. To confirm or to reject the suspicions, let's calculate the following monopoly power indices mentioned above: stock index (s.i.) concentration rate: $CR_{s.i.}$ and stock market monopoly power index MS_{HHI}. According to our algorithm, we will start the calculations of these indices with finding the principals. This action should be started with finding the issuers, which helps to find an index. Table 3 gives the results with the quotations based on the specified data. In addition, this Table contains the

---

[1] See also: Malyshenko, K. Malyshenko, V. Zhytnyi, P. and Shilova, L. (2017), Event Analysis on the Stock Markets and its Adaptation to Developing Markets, *International Journal of Economic Perspectives*, 11(2), pp. 458-474; Malyshenko, K. A. (2017), Studying the stock market of Ukraine with the use of the event analysis, *Economic and Social Changes: Facts, Trends, Forecast*, 10(1), pp. 235-253 (doi: 10.15838/esc/2017.1.49.13).

information about the structure of the shareholders. As it can be seen from the Table, a very frequently mentioned shareholder is Metinvest International S.A. with its owner Rinat Akhmetov who is the biggest owner of different assets in Ukraine. This company is mentioned three times in the Table, thus the value of our index $CR_{s.i.}$ is 20 % $(3/15 \times 100)$, which is within the range characterizing a stock market as an oligopoly (formula 7 Figure 2).

The formula includes the principal who both owns and controls the biggest number of the companies. Therefore, we find real owners of other companies-shareholders of FSTS blue chips (Table 5). In Table 3 it is shown that R. Akhmetov is a real owner of Energy Company of Ukraine and DTEK controlling two more issuer-companies with the quotations being included in calculating FSTS index, that is, Tsentrenergo and Zapadenergo. Then $CR_{s.i.}$ is 33.33 % $(3+2/15 \times 100)$, which refers to a monopoly because it is within the range from 30 to 100%. Thus, the stock index concentration rate signals the violation of the fair competition principles, which can give a monopolist (Akhmetov) some power via his impact on the stock index.

The next indicator – stock market monopoly power index MS_{HHI} must answer the question of how strong this impact is. Formula 9 in Figure 2 sees the stock market monopoly power index (MS_{HHI}) as a sum of capitalization shares in percentage from the largest to the smallest principal in issuers' equities included in the stock index (in our case FSTS).

Let us find this index with the data from the Table 6: $MS_{HHI} = 39.74^2 + 03.27^2 + 0.42^2 + 0.76^2 + 7.88^2 + 5.79^2 + 13.79^2 + 7.15^2 + 7.65^2 + 5.26^2 + 0.63^2 + 0.24^2 + 0.26^2 + 5.5^2 + 1.72^2 = 2047.54$. Thus, a found stock market monopoly power index shows extra-market impact on it. Besides, the value of R. Akhmetov previously defined as a monopolist was changed because, in fact, it is the Privat Group (I. Kolomoyskyi) that is a monopolist holding blocking shares of Ukrnafta. These indices should accompany each other - for example, the asymmetry index reveals anomalies, while the other indices identify the possible reasons for them, that is a possibility of extra-market impact. These indices cannot contradict each other, because they are calculated in sequence.

The next stage is to check the companies which are likely to be involved into a stock cartel, that is, to find the companies which act in explicit or implicit collusion to influence the market. We will check these relations with the help of correlations of accruals of the equity prices of the first-level listing issuers (which are used to find the stock index) (Table 6).

Correlation being the easiest and the most representational was chosen to be an instrument to check. The information to find this correlation is taken from the above Table 4 with the data on index accruals in information elasticity index based anomalies on particular dates. The correlation gives the following results: some companies from the list have the correlation equal to one or close to one. These are the groups (let us call them 'stock cartels'):

1. Ukrnafta; Alchevsk Iron and Steel Works, PJSC; Raiffeizen Bank Aval; Ukrtelecom (with a reverse correlation); Avdiivka Coke and Chemical Plant; Forum Bank (with a reverse correlation);
2. Ukrsotsbank; Yenakiyeve Iron and Steel Works, PJSC; Motor Sich; Tsentrenergo; Ukrtelecom; Yasinovsk Coke and Chemical Plant; Bogdan Motors.

Thus, two groups of companies with a very high correlation (positive and negative) have been found. These companies are partly principals as defined above, although their owners are mainly different.

4. Discussions

We cannot say for sure that these companies have directly or indirectly entered into a cartel agreement, although one can observe the connection with the changes in quotations - this fact should be taken into account when calculating the stock market index. The research hypothesis verification showed that the Ukraine stock market had external impacts. The problem of extra-market impact identification with the help of the proposed method becomes formal and can justify the regulatory decisions.

Our analysis helped to identify the anomalies or the features of extra-market impact – investors behave as monopolic enterprises, thus implicitly adjusting their market behaviour. How can this behaviour of market agents be explained?

There are several papers devoted to the analysis of the information efficiency of the stock market of Ukraine. Dragota and Tilica (2014) have tested the predictability of returns based on past records (as a proxy for the weak-form efficiency) for the market index of 20 East European former communist countries (including Ukraine), for the period January 2008-December 2010, a period of financial crisis for most of these countries. Various methods for testing were used (unit root tests, runs test, variance ratio test, filter rules test and the January Effect). The results have shown that there are serious doubts concerning the stock market efficiency for all the countries in the analysed period.

In addition, there is a study by Graham Smith (2012) on the topic of information effectiveness of the European emerging stock markets. The martingale hypothesis is tested for 15 European emerging stock markets (including Ukraine). Rolling window variance ratio tests based on returns and signs and with wild bootstrapped p-values are used with daily data over the period beginning in February 2000 and ending in December 2009. The fixed-length rolling sub-period window captures changes in efficiency and it is used to identify events which coincide with departures from weak-form efficiency and to rank markets according to relative efficiency. Overall, return predictability varies widely. The least efficient are the Ukrainian, Maltese and Estonian stock markets.

Table 5. Change in issuers' quotations with the equities being used for FSTS index (Ukraine stock market)

№	Issuers	27.12.2008			22.08.2011			21.11.2011			29.02.2012			27.07.2012			Shareholder structure: (FF – Free-float)
		26.12	27.12	Δ%	19.08	22.08	Δ%	18.11	21.11	Δ%	28.02	29.02	Δ%	26.07	27.07	Δ%	
1	Ukrnafta	713.8	627.8	13.7	565.0	621.0	9.91	420.0	400.0	4.76	339.0	349.7	3.16	168.5	169.0	0.29	1. Neftegaz 50%; 2. Privat Group 41.8%; 3. FF 8.20%.
2	Ukrsotsbank	0.30	0.32	6.7	0.27	0.28	3.7	0.18	0.16	-11.1	0.18	0.18	0	0.16	0.17	6.25	1. Unicredit Bank Austria AG 37.353%; 2. Ferrotrade 35.5811%; 3. UC S.p.A 26.479%
3	Yenakiyeve Iron and Steel Works	83.06	79.0	5.14	72.14	72.26	1.63	63.50	56.00	-11.81	70.20	69.70	0.72	37.45	38.01	1.49	1. Metinvest International S.A. 3034%; 2. Metinvest B.V. 55.29%; 3. FF 14.37%.
4	Alchevsk Iron and Steel Works	0.150	0.145	3.45	0.13	0.13	0	0.11	0.10	-9.09	0.13	0.13	0	0.06	0.06	0	1. Industrial Union of Donbass 96.13%; 2. FF 3.87%.
5	Azovstal	1.82	1.70	7.06	1.53	1.58	3.27	1.50	1.41	-6.0	1.41	1.44	2.13	0.93	0.94	1.07	1. Metinvest International S.A. 21.55%; 2. Metinvest B.V. 74.09%; 3. FF 4.36%.
6	Raiffeisen Bank Aval	0.26	0.24	8.33	0.22	0.23	4.54	0.14	0.13	-7.14	0.13	0.13	0	0.10	0.10	0	1. Raiffeisen International Bank Holding AG 96.36%; 2. FF 3.64%.
7	Motor Sich	2603.6	2460.0	5.84	2214.0	2265.0	2.30	2486.0	2367.0	4.78	2405.0	2480.0	1.04	2173.0	2204.0	1.43	1. Management 46.28%; 2. V. Boguslaev 14.98%; 3. Bartens Alliance Ltd. 9.7%; 4. Bank FiK 5.7%; 5. FF 23.34%.
8	Tsentrenergo	10.98	10.28	6.89	9.25	9.55	3.24	8.35	7.80	-6.58	8.51	8.59	0.94	6.90	6.94	0.58	1. Energy Company of Ukraine 78.28%; 2. FF 21.72%.
9	Ukrtelecom	0.53	0.49	8.16	0.44	0.46	4.55	0.48	0.47	-2.08	0.42	0.41	-2.38	0.25	0.26	4.00	1. State Property Fund of Ukraine 92.79%; 2. FF 7.21%.
10	Zapadenergo	310.35	303.12	2.39	272.8	270.0	-1.03	259.2	289.8	0.23	233.0	244.7	5.02	297.0	220.4	3.09	1. Energy Company of Ukraine 70.10%; 2. 11.45%; 3. ADR 10.64%; 4. FF 7.81%.
11	Avdiivka Coke and Chemical Plant	8.55	8.11	5.43	7.44	7.91	6.59	7.04	6.58	-6.54	5.70	5.74	0.71	3.82	3.84	0.53	1. Metinvest B.V. 90.9%; 2. Illich Steel and Iron Works 5.9%; 3. FF 3.20%.
12	Yasinovsk Coke and Chemical Plant	–	–	–	–	–	–	1.82	1.59	-12.64	1.46	1.36	-6.85	1.04	1.02	-1.92	1. Donetsksteel Metallurgic Plant, PSC 75.9%; 2. Investrazvitie, OOO 9.04%; 3. FF 15.06%
13	Bogdan Motors	0.25	0.24	4.17	0.22	0.22	0	0.22	0.23	4.55	0.20	0.20	0	0.14	0.14	0	1. SV Motors 12.6%; 2. Ukrainskii Avtoholding, OOO – 18.91%; 3. Bogdan Capital –13.64%; 4. Bogdan, LMK – 10.93%.
14	Forum Bank	2.64	2.56	3.13	2.3	2.3	2.04	1.70	1.69	-0.58	1.57	1.57	0	1.60	1.63	2.19	1. Yernamio consulting LTD 98.68 %$; 2. FF 1.32 %.
15	Frunze Sumy NPO	5.75	5.44	5.7	4.9	5	2.04	4.99	4.99	0	3.79	3.79	0	2.00	2.00	0	1. Energeticheskii Standard Financial Production Group, 50%

Source: own calculations

Table 6. Correlations of changes in security quotations (first-level listing) at emission dates (anomalies)

№	Issuer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	b	Ukrnafta	Ukrsotsbank	Yenakiyeve Iron and Steel Works	Alchevsk Iron and Steel Works	Azovstal	Raiffeisen Bank Aval	Monor Sich	Tsentrenergo	Ukrtelecom	Zapadenergo	Avdiivka Coke and Chemical Plant	Yasinovsk Coke and Chemical Plant	Bogdan Motors	Forum Bank	Frunze Sumy NPO
1	Ukrnafta	1	0.255	0.371	-0.618**	0.042	0.840**	0.255	0.371	-0.618**	0.042	0.840**	0.255	0.371	-0.618	0.042
2	Ukrsotsbank	0.255	1	0.985**	0.464**	0.179	0.155	1.000**	0.985**	0.464	0.179	0.155	1.000**	0.985**	0.464	0.179
3	Yenakiyeve Iron and Steel Works	0.371	0.985**	1	0.348	0.097	0.314	0.985**	1.000**	0.348	0.097	0.314	0.985**	1.000**	0.348	0.097
4	Alchevsk Iron and Steel Works	-0.618**	0.464	0.348	1	0.482	-0.537**	0.464	0.348	1.000**	0.482	-0.537**	0.464	0.348	1.000**	0.482
5	Azovstal	0.042	0.179	0.097	0.482	1	-0.174	0.179	0.097	0.482	1.000**	-0.174	0.179	0.097	0.482	1.000**
6	Raiffeisen Bank Aval	0.840**	0.155	0.314	-0.537**	-0.174	1	0.155	0.314	-0.537**	-0.174	1.000**	0.155	0.314	-0.537**	-0.174
7	Monor Sich	0.255	1.000**	0.985**	0.464	0.179	0.155	1	0.985**	0.464	0.179	0.155	1.000**	0.985**	0.464	0.179
8	Tsentrenergo	0.371	0.985**	1.000**	0.348	0.097	0.314	0.985**	1	0.348	0.097	0.314	0.985**	1.000**	0.348	0.097
9	Ukrtelecom	-0.618**	0.464	0.348	1.000**	0.482	-0.537**	0.464	0.348	1	0.482	-0.537**	0.464	0.348	1.000**	0.482
10	Zapadenergo	0.042	0.179	0.097	0.482	1.000**	-0.174	0.179	0.097	0.482	1	-0.174	0.179	0.097	0.482	1.000**
11	Avdiivka Coke and Chemical Plant	0.840**	0.155	0.314	-0.537**	-0.174	1.000**	0.155	0.314	-0.537**	-0.174	1	0.155	0.314	-0.537**	-0.174
12	Yasinovsk Coke and Chemical Plant	0.255	1.000**	0.985**	0.464	0.179	0.155	1.000**	0.985**	0.464	0.179	0.155	1	0.985**	0.464	0.179
13	Bogdan Motors	0.371	0.985**	1.000**	0.348	0.097	0.314	0.985**	1.000**	0.348	0.097	0.314	0.985**	1	0.348	0.097
14	Forum Bank	-0.618**	0.464	0.348	1.000**	0.482	-0.537**	0.464	0.348	1.000**	0.482	-0.537**	0.464	0.348	1	0.482
15	Frunze Sumy NPO	0.042	0.179	0.097	0.482	1.000**	-0.174	0.179	0.097	0.482	1.000**	-0.174	0.179	0.097	0.482	1

** - significant level of correlation

Source: own calculations

Operational efficiency assessment is devoted the study of Malyshenko (2014). The analysis is carried out on the basis of statistical methods with reference values obtained for the key events associated with the development of the Ukrainian stock market over the last period.

The study of anomalies in the Ukrainian stock market is reflected in a number of works. For example, Caporale and Gil-Alana (2013) examine the dynamics of stock prices in Ukraine by estimating the degree of persistence of the PFTS stock market index. Using long memory techniques, the authors show that the log prices series is I(d) with d slightly above 1, implying that returns are characterized by a small degree of long memory and thus are predictable using historical data. Moreover, their volatility, measured as the absolute and squared returns, also displays long memory. Finally, the paper examines if the time dependence is affected by the day of the week; the results indicate that Mondays and Fridays are characterized by higher dependency, consistently with the literature on anomalies in stock market prices.

In addition, anomalies were studied by Depenchuk and Compton (2010). These researchers examine the market returns of the Ukrainian stock and bond markets to determine whether they exhibit calendar anomalies including the January effect, weekend effect, and turn-of-the-month (TOM) effect. Ukraine provides an opportunity to examine the efficiency of an emerging market, adding to the extensive body of research on calendar anomalies. Regression analysis is used to examine the relationship between January returns vs. non-January returns, Monday returns vs. non-Monday returns, and TOM returns vs. non-TOM returns. Non-parametric t-tests and Wilcoxon signed rank tests are also used to examine TOM returns vs. the rest of the month returns. There is no evidence of a January effect or a weekend effect in the Ukrainian stock and bond markets.

An evaluation of the impact of events on the Ukrainian stock indexes was carried out in their work Sveshnikov and Bocharnikov (2009). In this article, they propose the model for the forecast of various financial indexes: stock markets indexes; currency exchange rates; crediting rates. These researchers have made the supposition that political, economical, financial and other events are preconditions for the formation of the future psychological sentiments of players. Therefore, for forecasting financial indexes they estimate the influence of all topical events on the future inclination of players to buy or sell. The proposed model calculates the composite influence of events on the basis of estimations of influence direction, influence force, influence time, events importance and confidence to the information about events. They have used this model for forecasting indexes of various economical natures: the Ukrainian stock index (PFTS); the exchange rate EUR/USD; the crediting rate KievPrime 1M and quotations of Eurobonds Ukraine 2015.

Another noteworthy work is the study of anomalies. Caporale *et al*., (2016). The purpose of this paper is to provide some new empirical evidence on the weekend effect in Ukrainian futures prices. The analysis uses various statistical techniques

(average analysis, Student's t-test, dummy variables, and fractional integration) to test for the presence of this anomaly, and then a trading simulation approach to establish whether it can be exploited to make extra profits. The statistical evidence points to abnormal positive returns on Fridays, and a trading strategy based on this anomaly is shown to generate annual profits of up to 25 per cent. The implication is that the Ukrainian stock market is inefficient.

In this regard there is a need to develop a forth form of EMH with the market agents acting as monopolists in one direction with no account of information about the fundamental events.

Thus, we believe the stock market mechanism has four types of releasing information:

1. Overall informed trade (the mechanism works with all information contained in historical prices, security returns and in the major part of new relevant information, as well as with unified information structure including the traditional weak form of market efficiency and information about the current events with their impact on pricing);

2. Professionally informed trade (situations when some part of available information becomes unavailable to some operators due to particular circumstances);

3. Partially informed trade (at any stock market there are groups of operators who hold a kind of monopoly on particular types of information);

4. Uninformed trade (with the uninformed trade the prices reflect soft information (secondary data, assumptions, rumors, predictions and abilities of an operator to predict) which significantly impacts the pricing of the stock assets). In this case the changes in stock prices are not driven only by the fundamental factors. Robert Shiller (1981) believes that the stock market overreacts to the events because the investors stick to their preferences, emotions in planning and performing transactions and ignore the fundamental factors.

Today there are theories on pricing at the stock markets with a number of disadvantages and biases. A lack of an all-encompassing theory which matches the modern stage of market development in the context of global economic instability and the changing nature of the markets does not help to identify the efficient approaches to predict the stock market prices. These changes underlaid the evaluation methodology for the arising anomalies. The algorithm given here is verified on an event database compiled by the authors from Ukrainian mass media data. The database is characterized by a clear formalization of event evaluation. The research helped to identify a group of companies with a high correlation index.

Conclusions

Theoretical research findings arisen from the development of a new paradigm and a fourth form of market efficiency should be taken into account in further studies since these findings account for the factors of external impact on the market structure

and match its modern evolution stage. A new information paradigm can be the basis for further development of modern methodologies to predict the movements on the market.

However, there are some features that will be solved in the following studies: 1. Labor intensity calculation of the coefficient of information elasticity. This problem is supposed to be solved with the help of its formalization and the calculation of the specified coefficient in the automatic mode (an attempt to solve this problem has already been undertaken by the author in a general form based on the evaluation of the sentiment generated by a set of event messages, see for more: Malyshenko *et al.*, (2018):

2. The second problem of the study is the classification of events. So the same event can be classified as political and social (for example, an increase in the retirement age). To solve this problem, a more accurate system of signs is needed, for example, from sources that gave information about the event in the media;

3. The proposed logistic paradigm requires its further development in terms of consistency with the Andrew Lo (2004) market adaptability theory (See Appendix, Table A.2.).

The proposed methodology of stock anomaly evaluation can be applied in studies aimed to examine the insider and manipulative impact on the market and its resistance to external impacts to identify the market efficiency, and so on.

References:

Abdullin, A. R. and Farrakhetdinova, A. R. (2015), Efficient market hypothesis in the context of finance theory, *Economic System Management: E-Academic Journal*, 40 (retrieved from http://www.uecs.ru/finansi-i-kredit/item/3473-2015-04-30-07-50-47).

Adebiyi, A. A. Ayo, C. K. and Otokiti, S. O. (2009), Stock price prediction using hybridized market indicators, In. *Proceedings of International Conference on Artificial Intelligence and Pattern Recognition*, pp. 362-367.

Akbalik, M. and Tunay, K. B. (2016), An Analysis of Ramadan Effect by GJR-GARCH Model: Case of Borsa Istanbul, *Oeconomia copernicana*, 7(4), pp. 593-612.

Andreou, E. Pittis, N. and Spanos, A. (2001), On Modelling Speculative Prices: The Empirical Literature, *Journal of Economic Surveys*, 15(2), pp. 187-220.

National Commission on Securities and Stock Market (2013), *Annual Report National Commission on Securities and Stock Market for 2013 Movement of Ukrainian Securities Market to World Standards for Economic Growth of the State*, pp. 13-15 (retrieved from http: //www.nssmc.gov.ua/fund/analytics).

Anupam, D. and Probal, D. (2015), Measuring long-run security price performance: a review, *Investment Management and Financial Innovations*, 12(2), pp. 26-32.

Arendas, P. (2017), *The CEE Banking Stocks, the Financial Crisis and the Halloween Effect,* Proceedings of the 9th International Conference on Currency, Banking and International Finance Pages, pp. 9-16.

Balaban, E. Ozgen, T. and Karidis, S. (2018), Intraday and interday distribution of stock returns and their asymmetric conditional volatility: Firm-level evidence, *Physica a-statistical mechanics and its applications*, 503, pp. 905-915.

Barberis, N. Huang, M. and Santos, T. (2001), Prospect theory and asset prices, *Quarterly Journal of Economics*, 116(1), pp. 1-53.

Batyrbekova, N. (2015), Using Elliott wave theory predictions as inputs in equilibrium portfolio models with views, *Review of Business and Economics Studies*, 2, pp. 33-45.

Bilenko, V.A. and Maksyshko, N.K. (2017), *Real estate market reflection analysis on the basis of coherent market hypothesis*, World scientific expanse, Collection of scientific articles, pp. 196-201.

Borisov, A.Yu. (2017), Behavioral finances as a new stage of finance science development, *Economics and Entrepreneurship*, 8(4), pp. 144-147.

Bradshaw, M.T. (2004), How do analysts use their earnings forecasts in generating stock recommendations?, *The Accounting Review*, 1(79), pp. 25–50.

Brav, A. and Lehavy, R. (2003), An Empirical Analysis of Analysts' Target Prices: Short-term Informativeness and Long-term Dynamics, *The Journal of Finance*, 5(58), pp. 1933–1968.

Calvet, L. E., and A. J. Fisher (2007), Multifrequency News and Stock Returns, *Journal of Financial Economics*, 86(1), pp. 178-212.

Calvet, L.E. and Fisher, A.J. (2008), *Multifractal Volatility: Theory, Forecasting and Pricing*, Elsevier – Academic Press.

Caporale, G.M. and Gil-Alana, L.A. (2013), Long memory in the Ukranian stock market, *Investment Management and Financial Innovations*, 10(2), pp. 123-131.

Caporale, G.M., Gil-Alana, L.A. and Plastun, A. (2016), The weekend effect: an exploitable anomaly in the Ukrainian stock market?, *Journal of Economic Studies*, 43(6), pp. 954-965).

Caporale, G.M. and Plastun, A. (2015), Price gaps: Another market anomaly?, *Investment Analysts Journal,* 46(4), pp. 279-293.

Chen, P. (2002), Microfoundations of macroeconomic fluctuations and the laws of probability theory: the principle of large numbers versus rational expectations arbitrage, *Journal of Economic Behavior & Organization*, 49(3), pp. 327-344.

Chen, T.F. Sun, L. Wei, K.C.J. and Xie, F.X. (2018), The profitability effect: Insights from international equity markets, *European financial management*, 24(4), pp. 545-580.

de Souza, M.J.S. Ramos, D.G.F. Pena, M.G. Sobreiro, V.A. Kimura, H. (2018), Do small caps generate above average returns in the Brazilian stock market?*, Review of Development Finance,* 8(1), pp. 18-24.

Depenchuk, I.O. Compton, W.S. and Kunkel, R.A. (2010), Ukrainian financial markets: an examination of calendar anomalies, *Managerial Finance*, 36(6), pp. 502-510.

Doan, M.P. Alexeev, V. and Brooks, R. (2016), Concurrent momentum and contrarian strategies in the Australian stock market, *Australian Journal of Management,* 41(1), pp. 77-106.

Dragota, V. and Tilica, E.V. (2014), Market efficiency of the Post Communist East European stock markets, *Central European Journal of Operations research*, 22(2), pp. 307-337.

Faizan, A. Said, M.A. Kausar, S. (2018), Past and Future of Derivative/Future Market: Substantiation of Calendar Anomalies, *FWU journal of social sciences*, 12(1), pp. 31-41.

Farrakhetdinova, A.R. Kuleshova, V.P. and Balykbaeva, R.S. (2015), Financial market efficiency hypothesis: analysis of consistency, *Bulletin of BRAU*, 2, pp. 133-138.

Francis, J. Schipper, K. and Vincent, L. (2002), Earnings announcements and competing information, *Journal of Accounting and Economics*, 3(33), pp. 313-342.

Fromlet, H. (2001), Behavioral finance-theory and practical application, *Business economics*, 36(3), pp. 63-69.

Golmohammadi, K. and Zaiane, O.R. (2017), *Sentiment Analysis on Twitter to Improve Time Series Contextual Anomaly Detection for Detecting Stock Market Manipulation Big Data analytics and knowledge discovery*, Dawak 2017 Book series: Lecture Notes in Computer Science, 10440, pp. 327-342.

Guillotin-Plantard, N. and Schott, R. (2006), *Dynamic random walk, Theory and applications*, Amsterdam: Elsevier B.V.

Harris, R.D.F. (2004), The rational expectations hypothesis and the cross-section of bond yields, *Applied financial economics*, 14(2), pp. 105-112.

Pruden, H.O. (2005), Catastrophe theory and technical analysis applied to a cal tech experiment on irrational exuberance, *Managerial finance*, 31(5), pp. 38-59.

Hirshleifer, D. and Hong, T.S. (2003), Herd behaviour and cascading in capital markets: a review and synthesis, *European financial management*, 9(1), pp. 25-66.

Ho, J. (2006), *A comprehensive model for assessing information value: toward a theory for valuing information technology investment*, Dissertation of PhD, State University of New York at Albany.

Ivković, Z. and Jegadeesh, N. (2004), The timing and value of forecast and recommendation revisions, *Journal of Financial Economics*, 3(73), pp. 433-463.

Jacobs, H. (2015), What explains the dynamics of 100 anomalies?, *Journal of banking & finance*, 57, pp. 65-85.

Jarrow, R. (2018), An equilibrium capital asset pricing model in markets with price jumps and price bubbles, *Quarterly Journal of Finance*, 8(2), 1850005.

Joshipura, N. and Joshipura, M. (2017), Beta Anomaly and Comparative Analysis of Beta Arbitrage Strategies, *NMIMS Management Review,* 33, pp. 57-72.
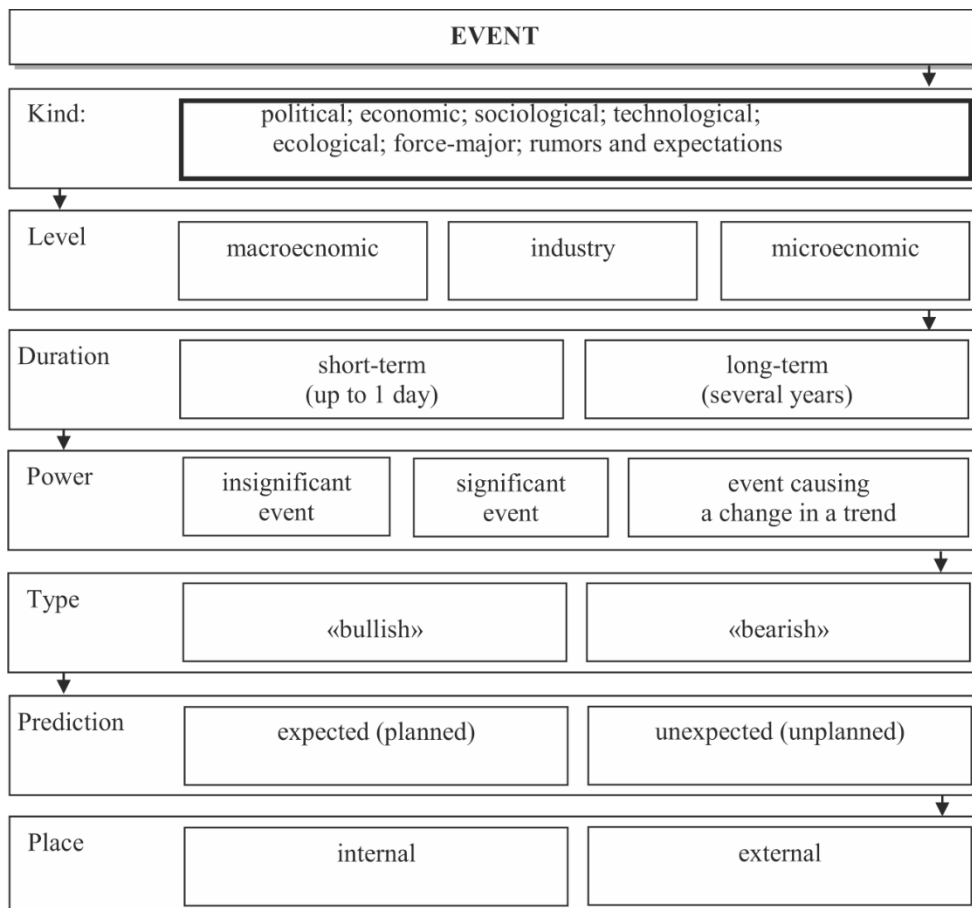
Kuznetsova, L.G. (2015). Information efficiency of modern financial markets: notion clarifications, *Finance and Loans Journal*, 37(661), pp. 2-9.

Laguna, J.I. Gargallo, P. and Salvador, M. (2012), *Sequential Bayesian analysis of Calendar anomalies in the Spanish Stock Market,* 1st International Work-Conference on Time Series (ITISE) Granada, pp. 1181-1192.

Likhutin, P.N. (2012), Evolution of key investment theories and their connection with the approaches too security price analysis, *Bulletin of NGUEU*, 3, pp. 68-77.

Lo, A. (2004), The Adaptive Markets Hypothesis: Market Efficiency from an Evolutionary Perspective", *Journal of Portfolio Management*, 30, pp. 15-29.

Loh, R. K. and Stulz, R.M. (2011), When are analyst recommendation changes influential?, *Review of Financial Studies*, 2(24), pp. 593–627.

Lukasevich, I. (2016), Analysis of stock market efficiency with Bloomberg system. Risk: Resources, Information, Supply, *Competition*, 2, pp. 98-102.

Lux, T. (2008), The Markov-Switching Multifractal Model of Asset Returns: GMM Estimation and Linear Forecasting of Volatility, *Journal of Business and Economic Statistics*, 26, pp. 194- 210.

Malykhin, V.I. (2003), *Financial Mathematics*, 2nd Ed., Moscow: UNITI-DANA.

Malyshenko, K. A. Malyshenko, V. A. Ponomareva, E. Y. and Anashkina, M.V. (2018), Change of Financial Behavior Paradigm of the Stock Market Subjects, *Journal of Advanced Research in Law and Economics*, 9(2(32)), pp. 570-580 (DOI: 10.14505/jarle.v9.2(32).21).

Malyshenko, K. Malyshenko, V. Zhytnyi, P. and Shilova, L. (2018), Event Analysis on the Stock Markets and its Adaptation to Developing Markets, *International Journal of Economic Perspectives*, 11(2), pp. 458-474.

Malyshenko, K.A. Malyshenko, V.A. and Anashkina, M.V. (2018), *Methodical Approaches to Forecasting Dynamics of the Stock Market based on „Text-Mining",* Proceedings of the 32nd International Business Information Management Association Conference - Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, 15-16 November 2018, Seville, Spain, pp. 1030-1044.

Malyshenko, K.A. (2014), Operational efficiency of stock market in Ukraine, *Actual Problems of Economics*, 158(8), pp. 325-333.

Mamedov, T.S.O. and Lisovskaya, I.A. (2014), Efficiency market hypothesis as one of the basic notions of financial management, *Innovation Technologies of Management and Law*, 3(10), pp. 122-126.

Mandelbrot, B. B. and Hudson, R. L. (2004), *The (Mis)behavior of Markets: A Fractal View of Risk, Ruin, and Reward*, New York, NY: Basic Books.

Matsuk, Z. and Deari, F. (2016), Ukrainian Exchange Returns: The Day-of-the-Week Effect New trends in finance and accounting, *Springer Proceedings in Business and Economics*, pp. 197-208.

Murphy, D. D. (2011), *Technical Analysis of the Financial Markets: A Comprehensive Guide to Trading Methods and Applications*, Moscow: Al'pina Pablisher Publ.

Musnadi, S. Faisal, Abd. and Majid, M. S. (2018), Overreaction and underreaction anomalies in the Indonesian stock market: a sectoral analysis, *International Journal of Ethics and Systems*, 34(4), pp. 442-457

Nageswara, S.V.D.R. and Sreejith, U. (2014), Event study methodology: a critical review, *The Macrotheme Review*, 3, pp. 40-53.

Okun, S. A. (2016), Overview of theories in financial asset pricing, *Financial Analytics: Challenges and Solutions*, 20, pp. 2-17.

Park, S.H. Han, I. Lee, J. and Kim, B. (2018), Information Asymmetry and the Accrual Anomaly Asia-Pacific, *Journal of Financial Studies*, 47(4), pp. 571-597.

Petrov, S. Yashina, N. Kashina, O. and Pronchatova-Rubtsova, N. (2017), *Forecasting of Crisis Phenomena in Emerging Financial Market: Real-Time Monitoring of Demand and Supply Anomalies in the Stock Exchange European financial systems*, 2017 Proceedings of the 14th International Scientific Conference, PT, pp. 150-158.

Pizzutilo, F. and Roncone, V. (2017), Red sky at night or in the morning, to the equity market neither a delight nor a warning: the weather effect re-examined using intraday stock data, *European Journal of Finance,* 23(14), pp. 1280-1310.

Ramnath, S.R.S. and Shane, P. (2008), The financial analyst forecasting literature: A taxonomy with suggestions for further research, *International Journal of Forecasting*, 1(24), pp. 34–75.

Prechter, R. and Frost. A. (2006), *Elliott wave principle. The key to understanding the market,* New Classics Library.

Rodriguez, J. (2004), *Essays in behavioral finance*, Dissertation of Ph.D. University of Houston.

Sasikirono, N. and Meidiaswati, H. (2017), *Holiday Effect in the Indonesian Stock Market*, Proceedings of the 2017 International Conference on Organizational innovation (ICOI 2017), Advances in Intelligent Systems Research, 131, pp. 109-112.

Shleifer, A. (2000), *Inefficient Markets: An Introduction to Behavioral Finance,* Oxford: Oxford University Press.

Simmel, G. (1900), *Philosophie des Geldes*, Leipzig: Duncker & Humblot,

Smith, G. (2012), The changing and relative efficiency of European emerging stock markets, *European Journal Of Finance*, 18(8), pp. 689-708.

Sornette, D. (2009), Why stock markets crash: critical events in complex financial systems, 448, Princeton University Press.

Sveshnikov, S. and Bocharnikov, V. (2009), Forecasting financial indexes with model of composite events influence, *Journal of Applied Economic Sciences*, 4(3), pp. 425-440.

Tang, G.Y.N. and Zhang, H. M. (2014), Stock return reversal and continuance anomaly: new evidence from Hong Kong, *Applied economics*, 46(12), pp. 1335-1349.

Thornton, D. L. (2014), The identification of the response of interest rates to monetary policy actions using market-based measures of monetary policy shocks, *Oxford Economic Papers*, 66(1), pp. 67-87.

Thornton, D. L. (2014), The identification of the response of interest rates to monetary policy actions using market-based measures of monetary policy shocks, *Oxford Economic Papers*, 66(1), pp. 67-87.

Tran, Q. T. (2017), Dividend capture on the ex-dividend day: evidence from Vietnamese stock market, *Asian Academy of Management Journal of Accounting and Finance* Volume, 13(2), pp. 69-94.

Urquhart, A. and McGroarty, F. (2014), Calendar effects, market conditions and the Adaptive Market Hypothesis: Evidence from long-run U.S., *International review of financial analysis*, 35, pp. 154-166.

Vanden, J. M. (2000), *Essays in financial economics*, Dissertation of PhD. University of California, Berkeley.

Vesperoni, E. R. (2002), Essays on financial markets in emerging economies, Dissertation of PhD. University of Maryland College Park.

Vidal-Garcia, J. Vidal, M. and Nguyen, D. K. (2016), Do liquidity and idiosyncratic risk matter? Evidence from the European mutual fund market, *Review of Quantitative Finance and Accounting*, 47(2), pp. 213-247.

Wang, Y. (2006), *Measuring private information in the financial assets market: evidence and implications from S&P 500 futures prices*, Dissertation of PhD. State university of New York at Buffalo.

Wei, R. (2006), *An empirical investigation of operational risk in the United States financial sectors,* Dissertation of PhD. University of Pennsylvania.

Winkelried, D. and Iberico, L. A. (2018), Calendar effects in Latin American stock markets, *Empirical Economics,* 54(3), pp. 1215-1235.

Xu, Y. D. (2016), Aversion of information ambiguity and momentum effect in China's stock market, *China Finance Review International*, 6 (2), pp. 125-149.

Yang, A. S. (2016), Calendar trading of Taiwan stock market: A study of holidays on trading detachment and interruptions, *Emerging Markets Review,* 28, pp. 140-154.

Zaremba, A. (2016), Investor sentiment, limits on arbitrage, and the performance of cross-country stock market anomalies, *Journal of Behavioral and Experimental Finance*, 9, pp. 136-163.

Zhang, Y. (2003), *Time-varying volatilities, capm betas, and factor loadings: a high-frequency data perspective*, PhD Dissertation, Duke University.

Appendix

Figure A.1. Event typology of fundamental analysis

EVENT		
Kind:	political; economic; sociological; technological; ecological; force-major; rumors and expectations	
Level	macroecnomic | industry | microecnomic	
Duration	short-term (up to 1 day) | long-term (several years)	
Power	insignificant event | significant event | event causing a change in a trend	
Type	«bullish» | «bearish»	
Prediction	expected (planned) | unexpected (unplanned)	
Place	internal | external	

Source: own represenation.

Table A.1. Classification of event type and its impact on national currency exchange rate and stock index

Kind	Event	Currency exchange rate	Δ index
1	2	3	4
political	- president election and/or parliamentary election. Correlation between the national currency exchange rate and presidency program and the real situation after the election. Improvement – exchange rate and quotations are rising;	↑	↑
	- announced economy strategy: support of the national manufacturers;	↑	↑
	- approval of the protectionist laws (for example, an increase of entry fees);	↑	↑
	- approval of the free trade laws (for example, cancellation of import quotas).	↓	↓
	- trade negotiations - positive (negative) result for the country:	↑(↓)	↑(↓)
force-major	Natural disasters, wars; revolutions; unexpected governmental prohibitive measures causing:		
	- manufacturing decrease among national companies (disruptions of supplies, damages of equipment, etc.);	↓	↓
	- manufacturing decrease among the companies from countries - competitors;	↑	↑
	- government allowances to cover the losses of the national companies;	↑	↑
	- government tenders for recovery measures of the national companies;	↑	↑
	- insurance payments to the national companies (according to the legislation and agreements).	↑	↑
economic	- evolution of gross domestic product (GDP). GDP grows with national currency exchange rate;	↑	↑
	- changes of the main interest rates. The growth of the main interest rate results in strong national currency exchange rate;	↑	↓
	- deficit (proficit) of trade and payment balance. The growth of the deficit (proficit) decreases (strengthens) national currency exchange rate;	↓(↑)	↓(↑)
	- data about money supply. Money supply increase determines a fall in exchange rate;	↓(↑)	↓(↑)
	- inflationary indicators: consumer price index and wholesale index. Inflation growth decreases national currency exchange rate;	↓	↓
	- entry of information about employment and unemployment in the country;	↓	↓
	- announcement of the industrial production index. Has an impact similar to GDP. Index growth strengthens national currency exchange rate;	↑	↑
	- announcement of the industrial product price index. There is an inverse dependence, that is, the index grows with national currency exchange rate;	↑	↓
	- announcement of the retail index. Index growth strengthens currency exchange rate;	↑	↑
	- announcement of the retail sale amount. There is a direct dependence, that is, the increase in retail values strengthens the national currency exchange rate;	↑	↑
	- announcement of residential construction indicator. Index growth strengthens national currency exchange rate;	↑	↑
	- information about manufacturing order increase. The number of orders grows with the national currency exchange rate;	↑	↑

	- stock indices (DJIA, S &P500, FTSE 100, Nikkei 225, etc.). The situation is biased. On the one hand, the growth of these indices can be determined by strengthening of national currency exchange rate. On the other hand, the indices themselves can impact the currency exchange rates;	↓ (↑)	↓ (↑)
	- dynamics in floating the government bonds (T-bonds, T-bills). Typically, a growing demand for the government securities is accompanied with the growth of the national currency exchange rate.	↑	↑
sociological	- data publications about different surveys: positive (negative) results naturally increase (decrease) the national currency exchange rate and thus the stock prices;	↑	↑
	- announcement of different rating agencies;	↑ (↓)	↑ (↓)
	- performances of analysts from public organizations, funds; the speeches can be positive (negative);	↑ (↓)	↑ (↓)
	- approval of the programs for social development, social protection, etc.;	↓	↓
	- an increase of a retirement age.	↑	↑
technological	- technological and technical news is looked upon, first of all, as a way to impact:		
	1) the manufacturing costs of the national companies – costs growth/reduction;	↓ (↑)	↓ (↑)
	2) a demand for the domestic goods – growth (reduction);	↑ (↓)	↑ (↓)
	3) output of the innovative products unfamiliar to the national companies;	↓	↓
	4) growth in interindustry competition causing capital flow abroad;	↓	↓
	5) growth of import (export) of the innovative products;	↓ (↑)	↓ (↑)
	6) discovery of new local (foreign) mineral deposits .	↑ (↓)	↑ (↓)
ecological	- ecological news is looked upon, first of all, as a way to impact:		
	1) the manufacturing costs of the national companies – costs growth, for example, due to filters (reduction);	↓ (↑)	↓ (↑)
	2) a demand for the domestic goods – growth (reduction);	↑ (↓)	↑ (↓)
	3) output of new eco-friendly products by the national companies;	↑	↑
	4) an increase of ecological wastes;	↓	↓
	5) reduction in emissions of harmful substances, radiation poisoning;	↑	↑
	6) investments by the Kyoto Protocol;	↑	↑
	7) usage of alternative energy sources, reduction in prices on energy supply.	↑	↑
rumors and expectations	The rumors can be connected with the sections mentioned above and therefore will be connected with all areas of the society, its challenges, for example:		
	- health deterioration (resignation) of the president or other influential person of the country;	↓	↓
	- companies' merger (depending on the merger terms);	↓(↑)	↓(↑)
	- additional emissions of the government securities, securities of the leading companies;	↑	↓
	- dividend growth;	↑	↑
	- an increase in prices, inflation expectations;	↑	↑
	- „fears" of economic and political matters on the whole;	↑	↓

| | | | | ↓ | ↑ |
| - „positive rumors and expectations". | | | | | |

Source: compiled on the basis of: Cookson, C., Tett, G., Cook, C. (2009), Changing the Hypothesis: Why 'Adaptive' Trumps 'Efficient', *Financial Times*, vol. 27, p.11; Goonatilake R., Susantha, H. (2007), The Volatility of the Stock Market and News International Research *Journal of Finance and Economics*, 11.

Table A.2. – Factors for information paradigm*

Factors for		information paradigm		
		LINEAR PARADIGM	**NON-LINEAR PARADIGM**	**LOGISTIC PARADIGM**
Type of analysis	Fundamental	Based on linear reactions – stock prices change adequately in accordance with the events within EMH (Fama *et al*., 1969)	Based on non-linear reactions – stock prices do not change adequately with the events in accordance with Fractal Theory (B. Malderbrot), one can observe coherent reactions (Vage, 1991)	Based on non-linear reactions – stock prices do not change adequately with the events of a reverse dynamics (different vector directions in market fluctuations and fundamental shifts) (Shiller, 1981)
	Technical	New technical analysis – diagrams manually prepared (Ch. Dow), that is, it is quite slow which compensates - emotional effects	Mathematical technical analysis – diagrams are software-based (R. Elliot, T.DeMark, 1994 etc).	Powerful computer-based mathematical technical analysis provides any available information (including rumors) and power instruments for analysis (Black, 1986)
Market agents		Agents are the professionals at the market (middlemen, dealers, brokers) who act rationally with regard to the fundamental news and simple technical analysis	Agents are the professionals and non-professionals (represented by the middlemen,for example brokers, и they can intrude into the process via telecommunication means) at the market who do not always act rationally with regard to a huge volume of the fundamental news and software-based technical analysis and try to „outgame" the market (that is, to outperform in trends) and to predict the dynamics.	Agents are both the professionals and non-professionals at the market who apply the Internet instruments. This allows a lot of non-professionals to trade in a remote mode, nearly from any place of the world. They sometimes act irrationally in response to fakes („noise" trade based on rumors) and change the trading strategy (from bearish to bullish and visa versa, very often it is against the trend)

Source: based on Malyshenko, K.A., Malyshenko, V.A., Ponomareva, E.Y., Anashkina, M.V. (2018), Change of financial behaviour paradigm of the stock market subjects, *Journal of Advanced Research in Law and Economics,* 9(2), pp. 570-580.