

The Efficiency Of Ukraine's Stock Market*

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ABSTRACT. The article is devoted to the study of the efficiency of Ukraine's stock market based on the efficient market hypothesis (EMH) which assumes that the price of a financial instrument completely reflects all the information about a given asset. Depending on the variety of information, weak, semi-strong and strong forms of market efficiency are applied. The testing of market efficiency is based on verifying the hypothesis against actual statistical data. The study uses four statistical methods. The values of the stock index are used as source data, since the index can be interpreted as a hypothetical security (share), the price of which fluctuates all the time. This article demonstrates that Ukraine's stock market on the whole is a weak form of market efficiency. It explains the specific strategies for a market with a weak form of efficiency and offers recommendations on the continued development of Ukraine's stock market.

KEY WORDS. Efficient market hypothesis (EMH); weak, semi-strong and strong forms of market efficiency; stock market efficiency; historical, current, internal information; rational response; market prices of financial assets; equilibrium of asset prices; abnormal yield, rational behavior of market participants; regular speculative earning; stock index; autocorrelation; regression analysis; Ukraine's stock market.

One of the most noticeable recent trends in the development of the world financial system has been the increase in the share of emerging markets in the global capitalization and total liabilities under securities. At the same time the volatility of their stock markets has increased substantially. Judging from Asia's crisis of 1997-1998, the financial turmoil in these countries could profoundly affect the entire world economy.

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Although the size of Ukraine's stock market is not as large as those of emerging markets elsewhere (e.g., Russia, China, Brazil), it has an appreciable potential growth and there is mounting interest by international investors in the country's securities.

The efficiency of capital markets is among the principal problems of the financial sector's development. In the economics literature, three forms of efficiency are singled out: weak, semi-strong and strong. In most cases this issue was studied in relation to developed countries, while little attention was paid to emerging markets, including Ukraine. Thus, research into the question is warranted.

Among the body of work that focuses on the theoretical foundations of efficient stock markets as well as on the general issues of development of securities markets, such research should be singled out as by L. Bachelier, S. Bodi, G. Working, H. Jones, F. Zarba, A. Cowles, A. Kayne, M. Kendall, A. Markus, M. Miller, F. Fabozzi and E. Fama, Russian scholars O. Burenin, I. Ivanchenko, V. Malyugin, Y. Mirkin, V. Nalivaisky, B. Rubtsov and O. Khmyz, as well as Ukrainian scholars M. Nazarchuk, O. Mozhovy, and V. Sapran.

The first historically known work in this area was devoted to the application of probability models for describing the prices of financial assets at the Paris Stock Exchange and was written by L. Bachelier¹, who advanced the «hypothesis of the random walk» of asset prices. The results of his studies were published in French (the complete English translation appeared only in 1964), and therefore were not widely known.

Thirty years later the works of H. Working² and A. Cowles³ were much better known and studied the predictability of prices on the basis of the probability approach. Further studies in this area, specifically the works of A. Cowles and H. Jones⁴, related to the empirical verification of this hypothesis.

But the idea of a quantitative analysis of financial markets — based on probability statistical models and methods applied over a long period of time — did not have a large following. Among the

¹ Bachelier L. Theorie de le speculation // Annales de l'Ecole Normale Superiuer. 1900. V. 17. Pp. 21-86.

² Working H. A random-difference series for use in the analysis of time series // Journal of American Statistical Association. 1934. V. 29. P. 11—24.

³ Cowles A. Can stock market forecasters forecast // Econometrica. 1933. V. 1. P. 309—324.

⁴ Cowles A., Jones H. Some a posteriori probabilities in stock market action // Econometrica. 1937. V. 5 P. 280—294.

⁵ Rynok tsennykh bumah; Kolichestvennye metody analiza. [V. Maliugin. Securities Market. Quantitative Methods of Analysis. Manual. Moscow, Delo Publishers, 2003, pp.160-161].

⁶ Kendall M.G. The analysis of economic time series. Part I. Prices // Journal of the Royal Statistical Society. 1953. V. 96. P. 11—25.

financial analysts of the 1920s-1940s the dominant studies were technical and fundamental analyses to identify trends, cycles and the like in the dynamics of prices, and once they were revealed, the prices could be forecast. Therefore, at that time the traditional assumptions of the advocates of quantitative analysis of financial markets were at odds with the «random walk» of financial assets⁵.

The works of M. Kendall⁶ were of great importance for the adherents of quantitative methods of financial market analysis for substantiating more deeply the probability models and practically proving their adequacy. His studies proved that it was generally impossible to reveal any predictable picture about the behavior of stock prices. It seemed that their behavior was absolutely random. On any given day stock prices could go up or down with equal probability regardless of what had been the case in the days prior. This explains the assumption that stock prices are of a random and unpredictable nature. Arbitrary changes in stock prices are not yet proof of the market's irrationality. On the contrary, they are a required consequence of the reasonable behavior of investors who are in competition to gain the information before it becomes available to other market participants.

We should not confuse the arbitrary nature of price changes with the irrationality of prices. If prices are set rationally, only new information can make them change. Therefore, random walk would be the natural result of prices that always reflect all the current knowledge. Indeed, if changes in prices were predictable, it would prove the inefficiency of the securities market, since the capability of predicting prices would point to the fact that all available information had not been built into the stock market rates. So the thesis that securities reflect all the available information is called the efficient market hypothesis (EMH)⁷.

Kendall's study and modeling of the dynamics of behavior of financial asset prices launched the development of the efficient capital market theory. Related to this theory are certain model assumptions about the market (EMH) and one of its elements — rational expectation hypothesis (REH), which serve as the point of departure for constructing dynamic models of prices and returns on assets under conditions of uncertainty.

The efficient market hypothesis is one of the central ideas of modern finance theory⁸. The concepts «information» and «rational

⁷ *Printsipy investitsiy*. S.Bodi, A.Kayne, A.Markus. Principles of Investment. Translated from English. Moscow, Williams Publishing House, 2002, p. 984.

⁸ *Rynok tsennykh bumag i proizvodnykh finansovykh instrumentov*. [A.Burenin. Market of Securities and Derivative Financial Instruments. Manual. Moscow, S.Vavilov Scientific-Technical Society. 2002, p. 348].

response» of the market and its renewal are central to identifying efficient markets as well as the assumption about equal opportunities, identical goals and similar expectations of the market participants.

All the information can be divided into three groups: historical, current and insider. Historical information covers the status of the market in the past. First of all, it is the dynamics of the market value and volumes of trade in financial assets. The information is generally available and already known. Current information becomes generally available at the current moment in time. It is presented in the current press, in the speeches of civil servants, reports of companies, analytical forecasts, and the like. It is also called public information. Insider information is known to a narrow circle of persons owing to their official status or other circumstances. With the help of insider information an investor can gain significant profits. Therefore, in the western countries laws prohibit from using insider information on financial markets and control the actions of persons who may possess such information.

The rational behavior of market participants, who have equal opportunities, identical goals and similar expectations, results in a mechanism of price formation of assets on the market when prices, immediately, completely and correctly reflecting all the available and relevant information, achieve an equilibrium. Price equilibrium means that the market lacks «incorrectly» market-valuated assets: the market prices of assets correspond to their «true» values, while demand in assets corresponds to their offer. This excludes the possibility of regularly gaining riskless (speculative) profit at the cost of using arbitrary opportunities, i.e. the differences in prices for one and the same asset at one and the same moment in time.

A higher yield on such a market is possible only as a risk premium for incurring corresponding losses. Gaining «superprofits» without additional risks, i.e. «to best the market» is impossible, because such a possibility exists for any participant only if he violates the equal opportunities that benefit him as, for example, using information that is not known to other market participants. Therefore, a «market is efficient» if earning gains is tantamount to fair game. Attempts at «besting» the market by «unfair» means of violating rules of fair play can be successful only in an inefficient market. As a Greek proverb goes, an «inefficient» market is a special place where people can deceive one another⁹.

⁹ *Rynok tsennykh bumag: Kolichestvennyye metody analiza*. [V.Maliugin. Securities Market. Quantitative Methods of Analysis. Manual. Moscow, Delo Publishers, 2003, pp. 160— 161].

Speaking about market efficiency, economists usually have in mind the market's information efficiency in relation to and depending on certain information or, to be more precise, information flows, if allowance is made for the dynamic nature of a market's behavior. Such an interpretation of the EMH belongs to E. Fama¹⁰.

Fama¹¹ presented the EMH as a model of fair game. Apart from explaining the EMH as a fair game model, in his article he divided the EMH and its empirical embodiment into three forms of its expression: weak EMH form, semi-strong EMH form and strong EMH form relative to the parent information the market participants possess.

In the case of a weak EMH form, the current asset prices completely reflect all the market information about past asset transactions (historical information): dynamics of prices, yield rates, volumes of sales and other general-market information. This expression of the hypothesis assumes the inutility of analyzing trends. Data about past asset prices is generally available and can be acquired practically at no cost. Weak EMH form affirms: if such data bore trustworthy signals about future behavior, all investors would have been using it for some time. In the end, these signals lose their value as soon as they become widely known, since, for example, a signal about a sale immediately raises prices. A weak form of efficiency means that each investor, relying on historical prices, cannot gain excessive yields all the time¹².

The semi-strong form of efficiency considers that share prices respond promptly to the incoming information, i.e. current prices completely reflect all of the public (generally available) information. The semi-strong EMH includes the weak EMH form, because all the market information examined under a weak form of efficiency— such as yield rates and volumes of sales — is generally available. Public information includes such market information as earnings and declared dividends; price/earning coefficient (P/E); dividend yield; stock splits; fundamental data on the nomenclature of products of a corresponding company; quality of its management; structure of its accounts; information about the patents it holds; earning forecasts; methods of accounting; different economic and political news. The hypothesis foresees that investors who make decisions on the basis of new important information cannot gain yields

¹⁰ Fama E.F. «Efficient Capital Markets: A Review of Theory and Empirical Work,» The Journal of Finance, May 1970, PP. 383—417.

¹¹ Fama E.F., Miller M.H. The Theory of Finance. — The University of Chicago: Holt, Rinehart and Winston, Inc., 1972. — 346 p.

¹² This case means that such income exceeds (on the average) earnings from the «buy and hold» investment strategy.

higher than the average, because the prices for securities already reflect this new generally available information.

A strong EHM form means that prices completely reflect all the information from generally available and private sources¹³, i.e. no group of investors exists who would have a monopoly access to information affecting price formation.

After analyzing the possible existence of certain regularities in the change of asset prices, Kendall and Roberts (1959) failed to detect such regularities. One of the ways of detecting the trends in the change of asset prices is measuring the serial correlation of the rates of return on the securities market. Serial correlation means a trend in the existence of a certain relationship of share yields with the previous yield rates¹⁴.

In 1965 Fama, using 30 shares underlying the Dow Jones industrial index, tested the random walk model. According to the random walk model, the successive earning yields for certain shares lack the serial correlation, and the yield of securities is subordinate to some rules of probability distribution. Fama discovered that returns on equities of this sampling lacked normal distribution as well. Fama used the indicators of serial correlation and demand as instruments for studying market efficiency. On the basis of these criteria he determined that the American market corresponded to conditions typical of an efficient market.

During the past ten years the EMH was substantially refined. It was widely applied not only for the analysis of markets of developed countries, but also of developing countries.

As a rule, different statistical methods of returns on assets are offered to study the degree of a market's efficiency. In this study we use the stock index, since it can be interpreted as a hypothetical security (share) whose price always fluctuates and for which, in particular, the expected rate of return and variation can be determined. In other words, an index can be examined as a typical security.

For examining the degree of efficiency of Ukraine's stock market, we used the methods of regression analysis along with modern econometric models.

Of importance, in the majority of studies on the degree of market efficiency, it is believed that information alone affects price formation. Thereby the main law of market economy — the law of supply and demand — is leveled down. This is one of the fundamental

¹³ Generally available information affects asset prices before anyone can use it, while private information affects prices in the process of bidding.

¹⁴ *Printsipy investitsiy*. S.Bodi, A.Kayne, A.Markus. Principles of Investment. 4th edition. Translated from English. Moscow, Williams Publishing House, 2002, p.422.

flaws of some statistical methods used in research. In reality, when investors suddenly receive information, they do not have free funds to effect active transactions on the market. The process of establishing prices for stock market instruments takes much more than one hour as foreseen by some statistical methods that are usually applied for analyzing market efficiency.

For analyzing the efficiency of stock markets, the Russian scientists V. Nalivaitsky and I. Ivanchenko proposed a number of statistical methods, specifically the Irwin method. This method refers to the stage of preliminary analysis of time series of economic indicators and consists of checking the homogeneity of a series, i.e. detecting anomalous (abnormal) values. An anomalous level means individual values of time series levels that markedly affect the main time characteristics of a dynamics series: average level, average gain, average growth rate, average gain growth, and the like, as well as a corresponding model. The reasons for anomalous observations may be technical errors or factors that are of an objective nature but occur rarely or periodically.

To study the efficiency of Ukraine's stock market, we used the values of the PFTS index (PFTS — abbreviation of the Ukrainian *Persha Fondova Torhivvelna Systema*, the name of the First Securities Trading System — *Tr.*) in the period from January 1, 2000 to December 31, 2005¹⁷. In this case, the presence of anomalous levels of time series speaks of the violation of the law of demand and supply of securities as well as of the affect of extraneous forces as, for example, political on the objective laws of the stock market.

The Irwin method assumes the application of the following formula:

$$\lambda_t = \frac{|I_t - I_{t-1}|}{\sigma_I}, \quad t = 2, 3, \dots, n,$$

where I_t — PFTS index value at the moment in time t ,

σ_I — average quadratic deviation.

The computed values $\lambda_2, \lambda_3, \dots, \lambda_{n-1}$ are compared with the critical values of the Irwin criterion λ_α and, if they are higher than the tabular value, the corresponding value of series I_t is considered anomalous¹⁸.

¹⁷ The values of the PFTS index were taken from the Internet (site: www.pfts.com). In the period from November 22, 2004 to December 1, 2004, the PFTS index values were not computed (on the site their value was zero) and therefore were not included in the study.

¹⁸ *Ekonometrika. Pidruchnyk.* [S.Nakonechny, T.Tereshchenko, T.Romaniuk. Econometrics. Manual. 3rd edition, supplemented and revised. Kyiv. National University of Economics of Kyiv, 2004, p.520.

The PFTS dynamics index was studied separately for each year as well as simultaneously for the entire period under review. The Irwin method produced the following results: average quadratic deviation by the 2001 data was 5.73, maximum value of Irwin statistics — 0.58; respective values by 2002 data — 6.74 and 0.53; values by 2003 data — 7.25 and 2.14; 6; respective values by 200 data — 35.88 and 0.61; respective values by 200 data — 23.21 and 0.64. The only value of Irwin statistics that exceeded 1 and represented the presence of an anomalous value was received in 2003 (the value of Irwin statistics equaled 2.14). The anomalous value was registered on December 31, 2003. When applying the Irwin statistics for the entire period (2001–2005), we have an average quadratic deviation of 106.05 and a maximum Irwin statistics value of 0.26.

So for the PFTS index values we have the presence of an anomalous value only by the 2003 data, while the examination of all observations (2001–2005) did not reveal any anomalies.

From among the group of methods of non-parametric statistics, we applied the computation of statistics Z ¹⁹ for the analysis of market efficiency. The study was carried out to compute the daily increase in the PFTS index values for the period from January 1, 2000 to December 31, 2005²⁰. The entire period, similar to the previous study, was divided into five sub-periods. Computed for each of them were: n_1 — number of additional increases in the PFTS index; n_2 — number of negative increases in the PFTS index; R — number of series or groups of increases with the same symbols.

The values of Z are computed according to the following formula:

$$Z = \frac{R - \left(\frac{2n_1n_2}{n_1 + n_2} + 1 \right)}{\sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}}}.$$

¹⁹ *Spravochnik po neparametriceskoi statistike: Sovremenny podkhod* [R. Runion/ Handbook of Nonparametric Statistics. the Modern Approach. Translated rom English. Moscow, Finance and Statistics, 1982, p.72

²⁰ The values of the PFTS index were taken from the Internet (site: www.pfts.com). In the period from November 22, 2004 to December 1, 2004, the PFTS index values were not compute (on the site their value was zero) and therefore were not included in the study

The results are presented in Table 1.

Table 1. Date for computing Z statistics

Indicator	Year				
	2001	2002	2003	2004	2005
R	138	140	131	123	141
n_1	119	124	140	151	138
n_2	125	122	109	90	112
Z	1.94	2.05	0.96	1.27	2.10

Source: estimated by the author on the basis of daily PFTS index values

The critical value at the level of significance $\alpha=0,01$ is determined provisionally $|Z| \geq 2,58$. The computed values Z for each of the five time periods fall in the interval from -2.58 to $+2.58$. So we accepted the zero hypothesis that the sequence of additional and negative increases in the PFTS index for the period from January 1, 2001 to December 31, 2005 was random.

Relying on the computed values of Z statistics, we can assume that Ukraine's stock market is a weak form of efficiency.

For further verification of the EMH autocorrelation analysis was used.

The study was carried out to compute the daily increases in the PFTS index values for the period from January 1, 2000 to December 31, 2005²¹. Checking on the autocorrelation between elements of the time series, we can establish the presence or absence of linear relations in the time sequence of different PFTS index values taken with a certain lag.

It is believed that significant additional and negative correlation speaks of the presence of a trend in the index dynamics as a result of gradual establishment of new equilibrium prices after investors received unexpected information²².

The most widely known and applied test of checking the presence of autocorrelation is the Darbin-Watson test. The analyzed time in-

²¹ The values of the PFTS index were taken from the Internet (site: www.pfts.com). In the period from November 22, 2004 to December 1, 2004, the PFTS index values were not computed (on the site their value was zero) and therefore were not included in the study.

²² *Issledovaniye stepeni efektivnosti rossiyskogo fondovogo rynka*. [V.Nalivaisky, I.Ivanchenko. Study of the Degree of Efficiency of the Russian Stock Market. *Securities Market*, No.15 [250], pp.46-48].

terval was divided into five periods by years: 2001, 2002, 2003, 2004, and 2005. For each of the intervals 10 values of d -statistics were computed for increases in the PFTS index with shifts by 1, 2, ... 10 time periods (see Table 2).

Table 2. Values of d -statistics computed by the daily PFTS index values for the period from January 1, 2001 to December 31, 2005

Time lag value	Year				
	2001	2002	2003	2004	2005
	d	d	d	d	d
1	2.22	2.36	2.22	1.92	2.12
2	2.18	1.92	1.60	1.64	1.62
3	1.95	1.64	1.67	1.64	1.91
4	1.78	1.95	1.65	1.79	1.72
5	1.94	1.77	1.66	1.60	1.72
6	2.03	1.93	1.76	1.70	1.70
7	1.79	1.98	1.58	1.86	1.80
8	1.97	1.95	1.63	1.71	1.75
9	1.80	1.99	1.70	1.81	1.68
10	1.98	1.85	1.68	1.77	1.85

Source: estimated by the author on the basis of daily PFTS index values.

The values of d -statistics were computed according to the following formula:

$$d = \frac{\sum_{t=k+1}^T (e_t - e_{t-k})^2}{\sum_{t=1}^T e_t^2},$$

where e_t – daily increase in the PFTS index values,
 k – time lag values.

For the level of significance $\alpha=0.01$ and number of observations $T \approx 200$ the tabular values are $d_L = 1,664$; $d_U = 1,684$. The zero hypothesis about the absence of autocorrelation between elements of

the time series for the given case is accepted at the values of d -statistics within the limits from 1,684 to 2,316²³.

As we see in Table 2, not all of the computed values fit into the identified interval. For 2001 it is evident that the increases in the PFTS stock index are independent of one another. For 2002 we see an autocorrelation for values taken with lags of $k=1$ and $k=3$. For 2003 it is an autocorrelation with lags of $k=2, 4, 5, 7, 8$; as to the lags of $k=3$ and $k=10$, the value d appears in the zone of indefiniteness (it is difficult to make a conclusion on the presence or absence of autocorrelation). For 2004 autocorrelation is observed with lags of $k=2, 3, 5$. In 2005 autocorrelation is present only with a lag of $k=2$. So we can arrive at the conclusion that the increase in the stock index is random in time only for the year 2001.

We also used the regression analysis to check the degree of efficiency of Ukraine's stock market.

All useful information can be designated for the projection of prices and returns on assets in an arbitrary moment of time $t - J_t$, while only the information J_t^a ($J_t^a \subseteq J_t$) is available to the participants in the market. Relying on information J_t^a , the market participants will forecast the expected returns on assets. Let $E(R_{t+1}(J_t^a))$ be the expected returns on assets on the basis of information — J_t^a in the future period of $t+1$. The expected returns, as we know, include compensation for all systematic risks caused by market factors and ensure for investors normal returns. In this case, all the market participants are expected to process one and the same available information and behave as though they were using one and the same equilibrium model of assets evaluation.

In accordance with the rational expectations hypothesis relative to the returns on assets, we have:

$$R_{t+1} = E(R_{t+1}(J_t^a)) + \varepsilon_{t+1}^a, \quad t \geq 0. \quad (1)$$

Random value

$$\varepsilon_{t+1}^a = R_{t+1} - E(R_{t+1}(J_t^a)) \quad (2)$$

is interpreted within the framework of this model as an «unexpected» or «abnormal» yield (in case of negative symbol ε_{t+1}^a , there

²³ *Ekonometrika*. [I.Lukianenko, I.Krasnikova. Econometrics. Textbook. Kyiv. Znannia Society, 1998, pp.274, 487].

are corresponding losses) caused by new incoming information in the time interval between moments t and $t+1$.

If the market is efficient, $J_t^a \equiv J_t$, i.e. the market participants have at their disposal all the parent information immediately reflecting the asset prices. The «abnormal» earnings of investors should in this case equal zero and be unpredictable.

In the study we propose applying the following approach:

If $J_t^a \subset J_t$, not all of the parent information is reflected in the prices, i.e. the market is not efficient, and therefore preconditions appear to violate the terms formulated above. The objective of checking these terms is illustrated in the following model.

If we assume that $J_t^a \subset J_t$, the information, which is not used at the moment in time t and affects the prices (earnings) of assets, can be reflected with the assistance of values z_{it} . To check the terms of independence of forecast error ε_{t+1}^a from (2) of this information, the following regression-type model can be applied:

$$R_{t+1} = E(R_{t+1}(J_t^a)) + \sum_{i=1}^m \theta_i z_{it} + \varepsilon_{t+1}, \quad t \geq 0, \quad (3)$$

where $E(R_{t+1}(J_t^a))$ — returns on assets expected in accordance with the used information J_t^a ;

θ_i — model parameters (regression coefficients); z_{it} — values that may affect the price of (returns on) assets.

The forecast error on the basis of all possible information J_t in accordance with model (3), equals:

$$\varepsilon_{t+1} = R_{t+1} - E(R_{t+1}(J_t^a)) - \sum_{i=1}^m \theta_i z_{it}, \quad t \geq 0. \quad (4)$$

If the market is efficient relative to all the information J_t , the random value ε_{t+1} does not depend on information J_t and its mathematical expectation should equal zero.

The test of the efficient market hypothesis related to information J_t^a on the basis of model (3) is formulated as a problem of checking statistical hypotheses about the significance of regression coefficients:

$$H_0 : \theta_i = 0, \quad i = 1, 2, \dots, m, \quad H_1 : \theta_i \neq 0, \quad i = 1, 2, \dots, m.$$

If hypothesis H_0 is accepted for all $i=1,2,\dots,m$, it means that the market is efficient relative to information J_t^a and «abnormal» returns are not predictable on the basis of information J_t^a . If hypothesis H_0 deviates, not all the parent information is used for evaluating expected earnings. In this case, when using not only information J_t^a , but also all possible information, returns on assets can be forecast with the assistance of model (3). With (3) we have a model for forecasting «abnormal» earnings:

$$\varepsilon_{t+1}^a = R_{t+1} - E(R_{t+1}(J_t^a)) = \sum_{i=1}^m \theta_i z_{it} + \varepsilon_{t+1}, \quad t \geq 0, \quad (5)$$

i.e. ε_{t+1}^a depends on information J_t , which means that in this case the market cannot be considered efficient.

Subject to what is used as value of z_{it} depends the definite type of model (3), and, accordingly, the definite type of tests for verifying hypotheses H_0 i H_1 .

Let us rely on the following when checking the weak market efficiency form:

- 1) z_{it} – value of returns on some assets for the past periods;
- 2) z_{it} – value of forecast errors of returns on some assets for the past periods;
- 3) z_{it} – values of returns and forecast errors of returns of some assets.

If we assume that the expected returns by the available information are permanent, the following models of returns will correspond to the values of z_{it} under 1), 2) and 3):

- 1) autoregression model;
- 2) sliding (moving) average model;
- 3) autoregression-sliding average model.

We used value z_{it} as the value of increases in the PFTS index with lags up to the 10th level. Therefore, we suggest considering model (3) as an autoregression.

The models of PFTS index increases were constructed for each studied period (2001–2005) as

$$e_t = a_0 + a_1 e_{t-1} + a_2 e_{t-2} + \dots + a_{10} e_{t-10} + \varepsilon_t,$$

where e_t – daily increases in the values of the PFTS index,

ε_t – random model component

For the 2001 data the dependence is:

$$e_t = -0,05 - 0,14e_{t-1} - 0,13e_{t-2} - 0,02e_{t-3} + 0,07e_{t-4} + 0,02e_{t-5} - \\ - 0,01e_{t-6} + 0,08e_{t-7} - 0,006e_{t-8} + 0,08e_{t-9} - 0,005e_{t-10} + \varepsilon_t,$$

where the value of F -statistics is less than the critical ($F = 1,19 < F_{kp} = 2,54$)²⁵, and therefore the hypothesis about the inadequacy of the model is accepted.

For the 2002 data the dependence is:

$$e_t = 0,06 - 0,23e_{t-1} + 0,005e_{t-2} + 0,2e_{t-3} + 0,07e_{t-4} + 0,12e_{t-5} + \\ + 0,01e_{t-6} - 0,07e_{t-7} - 0,09e_{t-8} - 0,06e_{t-9} + 0,02e_{t-10} + \varepsilon_t,$$

since $F = 2,35 < F_{kp} = 2,54$, the hypothesis about the inadequacy of the model is accepted as well. That is, the change in the daily values of stock index increases does not have a linear dependence on the changes of its previous values, but occurs under the impact of different random factors.

For the 2003 data the dependence is:

$$e_t = 0,16 - 0,45e_{t-1} - 0,13e_{t-2} - 0,02e_{t-3} + 0,03e_{t-4} + 0,03e_{t-5} - \\ - 0,02e_{t-6} + 0,07e_{t-7} + 0,1e_{t-8} + 0,05e_{t-9} + 0,01e_{t-10} + \varepsilon_t,$$

in this case $F = 3,18 > F_{kp} = 2,54$, and, therefore, the obtained model is adequate and the change in the increases of the stock index depends linearly exactly on the changes of its previous values, as confirmed by previous results (Darbin-Watson test).

For the 2004 data the dependence is:

$$e_t = 0,49 - 0,04e_{t-1} + 0,11e_{t-2} + 0,12e_{t-3} + 0,02e_{t-4} + 0,12e_{t-5} + \\ + 0,05e_{t-6} - 0,02e_{t-7} - 0,03e_{t-8} + 0,05e_{t-9} - 0,002e_{t-10} + \varepsilon_t,$$

$F = 1,16 < F_{kp} = 2,54$, the relation is not statistically significant.

For the 2004 data the dependence is:

$$e_t = 0,15 - 0,11e_{t-1} + 0,11e_{t-2} + 0,04e_{t-3} + 0,09e_{t-4} + 0,12e_{t-5} + \\ + 0,04e_{t-6} - 0,06e_{t-7} + 0,02e_{t-8} + 0,05e_{t-9} - 0,04e_{t-10} + \varepsilon_t,$$

$F = 1,38 < F_{kp} = 2,54$, the relation is statistically significant.

²⁵ *Ekonometrika*. [I.Lukianenko, I.Krasnikova. Econometrics. Textbook. Kyiv. Znannia Society, 1998, p. 4983].

On the whole, it is possible to conclude the following: although according to the d -statistics throughout 2002–2004 there existed a correlation between the successive daily values of increases in the stock index, the regression dependence of linear relations between them was statistically insignificant for the data of 2002 and 2004, and therefore the change in the successive daily values of increases in the stock index occurred under the influence of random factors. But for the 2003 data such a relation was not random and a possible trend in the dynamics of the PFTS index exists.

Let us examine the graphic representation of the PFTS index dynamics in the period when autocorrelation with the largest number of lags was observed, namely in 2002, 2003 and 2004. Fig.1 presents: the PFTS index dynamics for 2002; linear regression computed on the basis of corresponding data, where t is the number of the day from January 1, 2002 to December 31, 2002; y – value of the stock index for a corresponding day; as well as the determination coefficient for the presented regression.

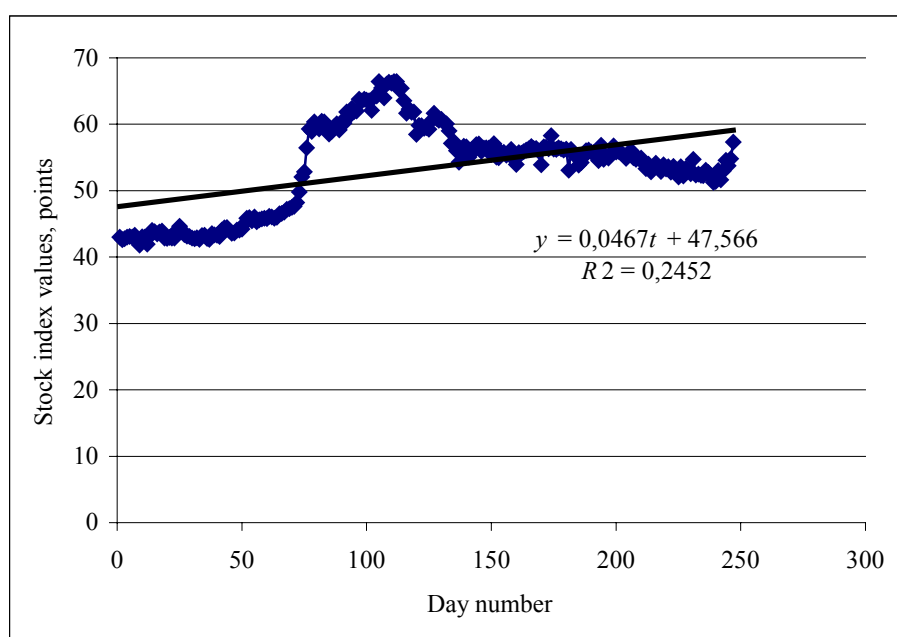


Fig.1. Dynamics of the PFTS index in 2002

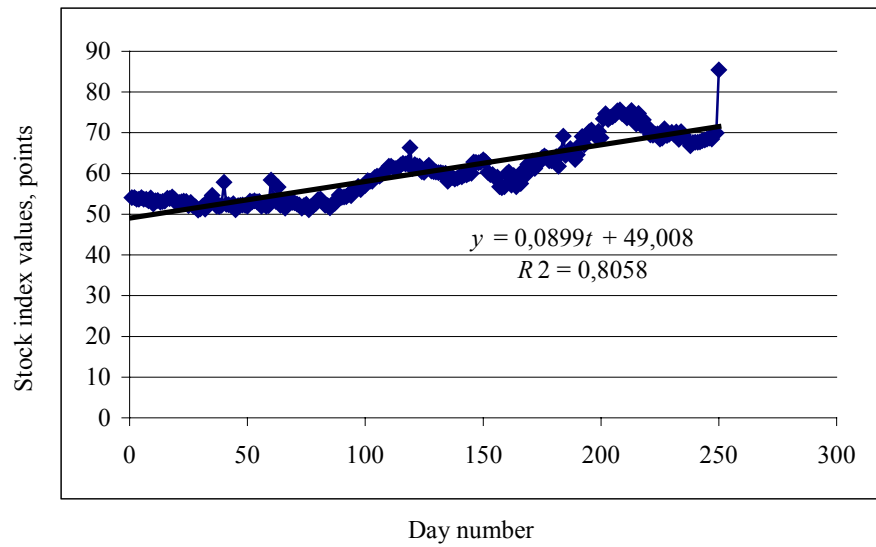


Fig.2. Dynamics of the PFTS index in 2003

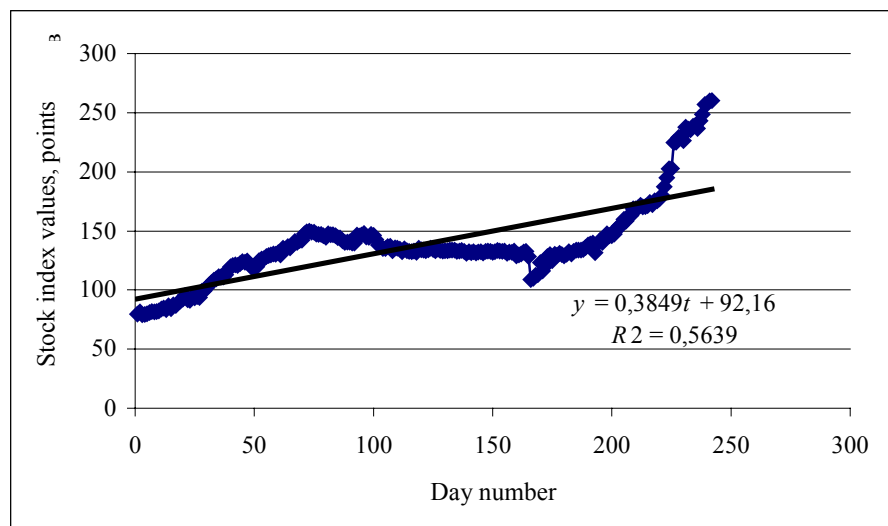


Fig.3. Dynamics of the PFTS index in 2004

If all analyses rely on generally available information about a company's profits and its position in the sector, it is difficult to expect that the evaluation of the company's prospects gained

by one of the analysts will be much more accurate than the evaluations of other analysts. Many well informed and handsomely financed companies conduct such studies of the market. Superb success can be achieved only by specialists with a unique insight.

Adherents of the EMH assume that active management of an investment portfolio is related to a lot of effort, most of which is expended in vain. That makes them arrive at the conclusion about the expedience of applying passive investment strategies that preclude attempts at «besting» the market. The purpose of a passive strategy is to form a well-diversified securities portfolio without trying to determine the understated or overstated financial assets. Passive management is usually characterized by a «buy and hold» strategy. Since the efficient market theory proceeds from the share prices being fixed at a «fair» level (given all the available information), frequent sales and purchases of shares are devoid of all sense, because the transactions result in substantial trade expenses, without increasing their expected efficiency.

But an excessively idealized faith in efficient markets may paralyze investors and create the impression of the futility of research. Such an extreme point of view seems to be absolutely unjustified. Real facts speak of the presence of enough anomalies that justify the search for securities with understated prices, and there is no doubt that this search is going on.

Rational portfolio management nonetheless plays a certain role, even if we deal with absolutely efficient markets. The basic principle of portfolio selection is diversification. Even when share prices are set «fairly,» each of them is at risk specific for a definite company, and this risk can be avoided by diversification. Rational selection of securities in, say, efficient markets foresees the formation of a thoroughly diversified portfolio. Moreover, such a portfolio should ensure the level of systematic risks caused to the investor. Even when he operates on an efficient market, the investor should select the «risk-rate of return» profile that seems best to him²⁶.

In defense of the EMH, we can say that the search for assets incorrectly evaluated by the market requires financial expenses. If this process proves costly, the detected deviations of the asset prices from their equilibrium values do not contradict the hypothesis. Besides, a higher profitability of such transactions should not be

²⁶ *Printsipy investitsiy*. S.Bodi, A.Kayne, A.Markus. Principles of Investment. 4th edition. Translated from English. Moscow, Williams Publishing House, 2002, pp. 414—418].

viewed as receipt of «superprofits,» since additional income is simply a compensation for the investor's efforts of collecting and processing additional information.

In describing the information efficiency of a market, we should also mention a market's operational promptness. How quickly do decisions on purchase and sale of securities reach the market? If a market is inefficient when it comes to promptness of response, there will always be some investors operating who enjoy an advantage over other bidders. That is, if a market is not operationally prompt, it will also not be informationally efficient.

The development of new technologies and the use of the internet have made world financial markets more accessible to investors. But at the same time such mobility has made it easier for dishonest investors to evade responsibility for offenses they commit on financial markets. The use of insider information is not an exception. Since at the present time Ukraine does not yet fully use its potential for attracting investment, we can say that the lack of legislation governing the use of insider information on the stock market negatively affects the country's investment attractiveness. Of course, the enactment of a law on insider information will not deal with all the problems an investor faces on Ukraine's securities market, but this problem has to be addressed to raise the country's status on the world financial market.

The need to establish a Central Depository in Ukraine will also correspond to global trends in the development of financial markets. The centralization of the clearing and depository infrastructure of stock markets in the financial centers recognized worldwide is moving along the way of setting up centralized depositories and specialized clearing centers to provide comprehensive services to all groups of participants: issuers, investors, professional participants, registrars and custodial depositories. The main purpose of the Central Depository is to radically simplify the accounting system structure on the stock market, making it more transparent and, as a result, reducing risks and enhancing the reliability of transactions in securities.

By ensuring the concentration of liquidity and considerably reducing risks when servicing securities agreements, the Central Depository is at the same time simplifying control over transactions in securities. In the medium-term outlook, it has to safeguard the interests of all the groups of participants in Ukraine's internal stock market. And for the economy as a whole, the Central Depository should become one of the principal mechanisms for concentrating the stock market within the country.

Finally, it should be pointed out that the successful development of Ukraine's stock market as well as its higher degree of efficiency can be achieved only when the high rates of reform, of the infrastructure included, will be retained.

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