THE OVERREACTION HYPOTHESIS: THE CASE OF UKRAINIAN STOCK MARKET

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Abstract

This paper examines the short-term price reactions after one-day abnormal price changes on the Ukrainian stock market. The original method of abnormal returns calculation is examined. We find significant evidence of overreactions using the daily data over the period 2008-2012. Our analysis confirms the hypothesis that after an abnormal price movement the size of contrarian price movement is usually higher then after normal (typical) daily fluctuation. Comparing Ukrainian data with the figures from US stock market it is concluded that the Ukrainian stock market is less efficient which gives rise to opportunities for extra profits obtained from trading based on contrarian strategies. Based on results of the research we also recommend some rules of trading on short-term market overreactions.

Keywords: Efficient Market Hypothesis; Overreaction Hypothesis; Abnormal Returns; Contrarian Strategy; Stock Market

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1 Introduction

The hypothesis that provided an analytical framework for understanding asset prices and their behavior is the efficient market hypothesis (EMH) (Fama, 1965and Beechey et al. 2000). According to Jensen (1978) there is no other proposition in economics which has more solid empirical evidence supporting it.

EMH points to the fact that all participants of financial markets are rational economic subjects and have equal access to information. As the result it is impossible to get additional profits, since all important information is already included in price (Fama, 1965). This means that it is impossible to identify undervalued assets and/or overvalued assets. Price of the asset does not depend on its price in the previous periods. That is why, according to EMH, the study of past price changes of the asset does not indicate the future direction of price movements.

However, a number of recent studies furnish evidence in favor of a certain level of predictability in price movements. As examples that can be mentioned are well known market anomalies: firm anomalies (size, closed-end mutual funds, neglect, institutional holdings etc), seasonal anomalies (January, weekend, time of day. end of month, seasonal, holidays etc.), accounting anomalies (Price/Earnings ratio, earnings surprises, dividend yield, earnings momentum etc.) and event anomalies (analysts' recommendations, insider trading. listings etc) (Levy, 2002).

Another important example of market inefficiency is market overreactions. Market overreactions were identified by De Bondt and Thaler (1985) who showed that investors overvalue the recent information and undervalue past information. The result of this is the following anomaly: Portfolios with the worst (best) dynamics during a three-year period prefer to show the best (worst) results over the next three years, the so-called overreaction hypothesis.

A special case of the overreaction hypothesis is short-term price reactions after one-day abnormal price changes. There is empirical evidence from different financial markets that after one-day abnormal price changes the size of contrarian price movement is higher than after normal (typical) daily fluctuations (Atkins and Dyl, 1990, Bremer and Sweeney, 1991, 1996, Cox and Peterson, 1994, and Choi, H.-S. and Jayaraman, N. 2009).

Despite a considerable amount of research already conducted on the overreaction theory, there are still a number of unsolved areas. For example, usually a single stock market is normally the only object of research. In our opinion it is important to research the overreaction hypothesis on different types of financial markets. In addition, the Ukrainian stock

market has never been the subject of overreaction hypothesis testing.

This paper aims to expand the overreaction knowledge by examining the existence of such anomaly in Ukrainian stock market and testing the overreaction hypothesis on different financial markets. The purpose of this study is therefore to confirm /reject the presence of abnormal counter-reactions after one-day abnormal price changes on different financial markets.

To confirm/reject the fact that the size of counter-reaction that occur after abnormal price fluctuations differs from the size of typical countermovement (countermovement after usual, standard day, without any overreactions) we use t-statistics. The excess of calculated t-test values over its critical value indicates that the presented data sets belong to different general populations. This, in turn, confirms the overreaction hypothesis.

We analyze data not only from Ukrainian stock market, but also from the US stock market (Dow Jones Index), FOREX (EURUSD) and commodity markets (gold, oil). This allows, on the basis of common methodology, to test overreaction theory on different types of markets. This approach also gives a possibility to compare results from different financial markets.

The remainder of this paper is organized as follows: A review of the existing literature on overreaction hypothesis and reasons for overreactions. A section that provides the methodology followed in the study. Next follows a section that presents the results and key findings of the study. Last there a section on the conclusions and summary of the paper.

2 Literature review

Despite some contradictory of EMH hypothesis (for example, asset prices have fundamental basis, existence of market anomalies), the law of random walk is confirmed both on practical and theoretical levels. To demonstrate this we have simulated the price dynamics (Figure 1) using the random generator of price changes with 50% chance. In Fig. 2, we present a fragment of graph, illustrated changes in prices of gold (day interval).

Figure 1. Graph of randomly generated values (probability 0.5)
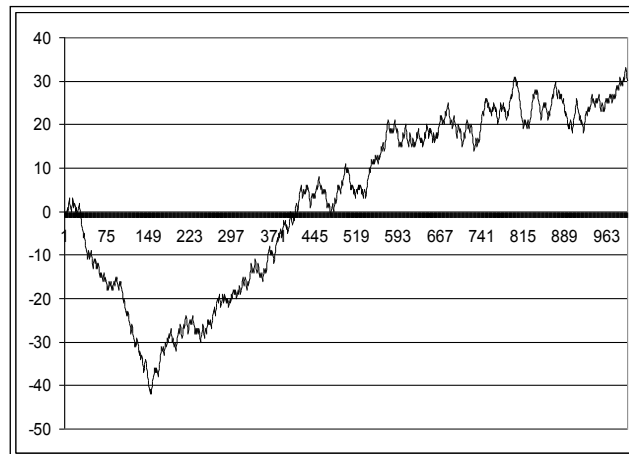

Figure 2. Fragment of gold prices chart (day interval)

Source: Archive of quotations MetaQuotes

Kothari and Warner (2006) conducted a study of scientific publications in favor of EMH. According to their results, there are more than 500 publications in top economic journals to testify in favor of the rational behavior of investors and their adequate and efficient response to new information. Nevertheless, empirical data from financial markets show that assumptions underlying the EMH do not always correspond to reality. The same applies to the main provisions of the efficient market hypothesis.

Discrepancies between the real life and EMH are observed in practice and in theory. Ball R. (2009) notes that the list of EMH inconsistencies is quite long and includes both market over- and under-reactions to certain information, volatility explosions and seasonal yield bursts, yield dependence on different variables such as market capitalization, dividend rate, and market factors.

2.1 Overreaction

Researchers pay much attention to the overreactions in the financial markets - significant deviations in price changes on assets from their average (typical) values during certain period of time. In Fig. 1 and 2 we showed graphs of randomly generated values and dynamics of real prices and concluded that they are quite similar. There are however situations in the market which cannot be simulated by random generation. For example, random generation will fail to display the picture, which took place in 2008-2010 in the U.S. stock market (Fig. 3). This is a typical case of overreaction.

Figure 3. Dynamics of Dow Jones Industrial Average Index during 2000-2013
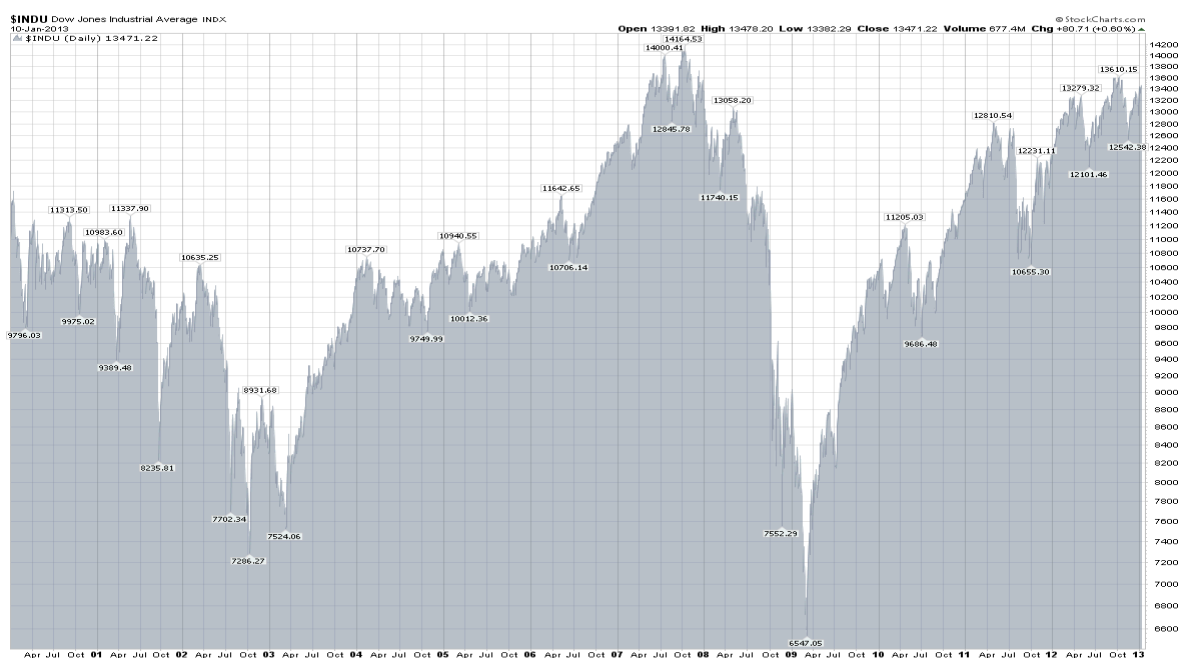

Fig. 3 describes an example of a long-term market overreaction. It is however also true that overreactions may occur on shorter time intervals.

There are two hypotheses to explain the abnormal price movements:

• Overreaction Hypothesis - according to this hypothesis, investors overreact in a given period, but the next period they act in opposite direction, i.e. if the price has increased one day, then the next day it will fall and vice versa;

• Under-reaction Hypothesis - investors underreact at event during the period of its appearance, however the next period they adjust actions - which means in case of some positive news price may not respond or even decrease, however the next day it will increase (Stefanescu et al. (2012)).

The overreaction hypothesis was first identified by De Bondt and Thaler (1985). De Bondt-Thaler's

(DT) idea was based on Kahneman-Tversky's (1982) research who showed that investors overvalue the recent information and undervalue the past information.

The main conclusions of DT's research were that portfolios with the worst/best dynamics during three-year period prefer to show the best/worst results over the next three years. Such results were obtained by analyzing the investment portfolios on the New York Stock Exchange.

According to DT, profits can be obtained using the following trading strategy of buy assets that have lost in value and selling those that have grown in value. Defining parameters of this trading strategy, DT got the following results:

• Portfolios with results, worse than average during previous 3 years, showed a return over the next

36 months that exceeded the average market average on 19.6%.

• Portfolios with profits over-average during next 36 months, earn 5% less than the average market rate of return. [6]

Overreactions are associated with irrational behavior of investors who overreact on certain news, perceiving them too optimistic (pessimistic). This leads to significant deviations in prices of the asset from its fundamental value (price). Such overreaction leads to correction of prices in subsequent periods.

Interesting fact, mentioned by DT, is asymmetry of overreaction. The size of overreaction is bigger for undervalued stocks than for overvalued stocks. Another result of the DT's work is confirmation of the "January effect" - overreactions occur mostly in January.

After DT's (1985) publication, scientists from different countries conducted similar studies in terms of different time periods, markets and countries. Here are some examples of such researches.

• Brown-Harlow (1988) analyzed New York Stock Exchange data for the period from 1946 to 1983 and reached similar to DT conclusions.

• Zarowin (1989) showed the presence of short-term market overreactions.

• Atkins and Dyl (1990) investigated the behavior of common shares on the New York Stock Exchange after significant price changes in one trading day and found overreaction presence, especially in the case of falling prices.

• Ferri and C. Min (1996) confirmed the overreaction hypothesis on S&P 500 data for the period 1962-1991.

• Larson and Madura (2003) analyzed New York Stock Exchange data for the period from 1988 to 1998 and showed the presence of overreaction effect.

• Clements et al. (2007) also testified in favor of the overreaction hypothesis. Analysis of data during 1983-2007 showed that manifestations of overreaction effect become even more obvious nowadays.

Overreaction hypothesis was confirmed in different international stock markets, including Spain (Alonso and Rubio (1990)), Canada (Kryzanowsky and Zhang (1992)), Australian (Brailsford (1992)), (Clare and Thomas (1995)), Japanese (Chang et al. (1995)), Hong-Kong (Akhigbe et al. 1998)), Brazilian (DaCosta and Newton (1994), Richards (1997)), New Zealand (Bowman and Iverson (1998)), Chinese (Wang et al. (2004)), Greek (Anthoniou et. al., 2005), Turkish (Gülin Vardar & Berna Okan, 2008) and Taiwan (Lin (1988)).

Most of the researchers, as a research object, use stock markets (see the example above), however overreaction hypothesis was tested in other markets. In particular, the gold market (Cutler, Poterba, and Summers (1991)), option market (Poteshman (2001)).

The efficiency of the overreaction hypothesis was proved not only on theoretical and empirical level, but also in the sphere of real trading. For example, Jegadeesh (1993) developed a trading strategy based on the main provisions of the overreaction hypothesis. Strategy algorithm is quite simple and consists in opening transactions in direction, opposite to the previous movement. As the period of analysis Jegadeesh used month. So, after price on certain asset within a month increases, it should be sold and short position is held during the month.

Contrary actions are performed in case of price decreasing. Profitability of such strategy according to Jegadeesh is 2% per month. A similar strategy but with a period of a week, was developed by Lehmann (1990). The result was 2% return in a week. Such results indirectly evidence that overreaction hypothesis is not just a hypothetical construction, but is actually working and effective.

2.2 Reasons for overreactions

Despite a large number of scientific researches devoted to the problem of overreactions, there is no consensus about its causes. According to EMH, overreactions should not exist because they create opportunities to obtain extra profits.

However, current evidence is in favor of the overreaction hypothesis. Summarizing existing theories we can list the reasons for these overreactions as Psychological, Technical, Fundamental and other.

2.3 Psychological overreactions

Psychological overreactions are normally associated with the following:

• Overreaction to new information - Instead of comparing new information with existing information and taking rational decisions, investors act under emotions and the herd effect. (Griffin and Tversky (1992), Madura and Richie (2004)).

• Existence of "noise" traders - Irrational investors take investment decisions on fragmentary information and current price fluctuations. According to Aiyagari and Gertler (1999), one of the most common behavioral signs of noise traders is their attempt to sell, if current prices fall and buy if prices increase. Thus, their activity increases the price fluctuations in the markets.

Developing the idea of presence in the market different investors, Hong and Stein (1999) note the existence of two types of investors: those ones who trade on inside and private information ("newswatchers", investors who use fundamental analysis are the basis for investment decisions), the other ones take decisions based on past prices analysis and extrapolation its results on the future ("momentum traders", investors who use technical analysis as a base for decision-making).

Depending on dominating type of investor in the market, overreaction or under-reaction may occur. For example, technical analysts react to price fluctuations

very quickly, that leads to the overreactions, if they dominate in the market. Conversely, investors who use fundamental analysis are oriented over a longer time horizons. They respond to new information slowly. This can lead to under-reaction of the market for particular new information.

• The representativeness effect – If a particular market or market sector is growing rapidly for some time, it forms a positive image among investors. Accordingly, investors begin to prefer assets of this sector. In turn it leads to increase in demand and therefore price growth. Barberis, Shleifer and Vishny (1998) explain representativeness effect by the fact that investors often ignore the laws of chance and behave as if the events, that took place recently, are typical. However, they are very slow to change their previous views and beliefs in response to the emergence of new information.

• Psychological characteristics of investor's behavior, such as panic and the effect of the crowd - Typical human psychological flaws can explain why "rational" investors buy assets higher than their fundamental value and sell below their fair value.

• Overconfidence and biased attitude - Investors often overestimate their ability to analyze the market situation. In this regard, they underestimated the likelihood of errors in the prediction of a certain event. Usually it is associated with a certain experience which caused the illusion of market understanding.

Daniel et al. (1998) also names a biased attitude as a psychological feature. If some information confirms the predictions of investor, it strengthens his belief in own rightness. In addition, the investor's confidence decreases very slowly even if information begins to refute their predictions. In other words, there is a tendency to consider random success as own achievement and to think that mistakes are caused totally by the external factors, independent from investor.

2.4 Technical reasons

An important group of factors that can lead to the emergence of market overreactions are technical reasons, i.e. factors associated with the use of technical analysis by investors in making decisions. Technical analysis methodology is based on the previous price fluctuations in forecasts of future prices. It is widely believed that the current movement in the price of assets can generate specific trading signals from various technical indicators that will lead to massive operations/trading in the current movement direction and will strengthen it causing overreaction.

Another important technical factor is price behavior when it approaches "level" (term from technical analysis that characterizes certain price values which act as some sort of a barrier to the next movement, since interest of the market is generally concentrated in these price zones). "Level"

breakthrough usually leads to massive operations in direction of current price movement.

One of the most important technical factors leading to overreactions is the execution of so-called "stop-losses" ("stops"). These are orders to close open positions when a certain level of losses is achieved (see Duran and Caginalp (2007)). Execution of stops means opening positions in the direction of current movement (forced closure of the short positions means opening of the long positions and vice versa). Stops execution acts as a movement catalyst or accelerator, and leads to increase in the scale of basic movement and loss of control over its size. The most typical example of overreaction caused by stops execution is the collapse of U.S. stock indexes in 1987 (Black Monday), when Dow Jones index lost 22.6%.

Analyzing the role of technical factors, Aiyagari-Gertler (1999) proposed an explanation for the emergence of overreactions called the margin-call theory. Its meaning is very close to previously analyzed stops execution. The bottom line of their idea is: to open a position on particular asset investors need cash collateral - margin. To increase clients' operations, increase their trading opportunities, brokers usually provide traders with the so-called leverage (some sort of a loan).

For example, with a $ 10,000 account trader can open positions on hundreds of thousands dollars. When position is opened certain amount of margin is needed and is reserved on the trade account. The consequence of this practice is an opportunity to make bigger profits, but bigger risks and losses too. At the same time, brokers, do not want to risk their own money (acting as a creditor of client's operations they share risks). So they limit the risks of the client using the margin-call mechanism.

Positions are closed when margin requirements reach certain level of equity (when trade account is insufficient to cover existing losses plus a certain level of margin). In case of large and unexpected movement in the markets margin-call mechanism often comes into action, closing the most unprofitable position of the client to release the margin. Closure of unprofitable positions means, that opposite positions are opened, i.e. positions in the direction of current movement, thus increasing its scale.

Margin-call theory has the right to life, especially in case of super-movements (as in 1929 or 1987 years), though there are doubts that in the case of "normal" overreactions this factor can be dominant.

2.5 Fundamental reasons

One more important group of factors is the fundamental ones such as the so-called "price-ratio hypothesis", proposed by Dreman (1982). According to this hypothesis, companies with low P/E ratio are undervalued. However, usually there are few investors who wish to buy stocks of these companies. It happens because past negative still strong in the memory of

investors. Nevertheless, when negative news on such companies end and positive news become dominant, the demand for shares increases dramatically. That leads to abnormal movements. Opposite situation is observed for overvalued shares.

2.6 Other reasons

Other reasons include the lack of liquidity in the market. Even small numbers and amounts of transactions can lead to significant price fluctuations (Jegadeesh-Titman (1992)).

Based on the analysis of the causes of market overreactions, the question arises that if an overreaction is not the result of achieving a new level of fair price, but rather a combination of psychological, technical and other non-rational factors, in this case at the end of overreaction, should prices correct to adjust equilibrium level? If it is so, the result should be that the size of countermovement in prices should exceed the size of countermovement for standard (normal, usual) periods.

Bremer and Sweeney (1991) proved the fact that after a very strong negative price movement positive price movement occurs. Their size exceeds ordinary movements. Analysis of negative daily changes which in size exceeded 10% showed that the next day price increased on average by 1.77%.

This phenomenon can be explained by:

• Fixation of profits - traders who open positions in the direction of the abnormal movement on the next day (realizing the fact that the potential of the movement is exhausted), close their positions to fix profits. To do this they have to open opposite positions and that initiates the movement in the opposite direction to the previous abnormal movement direction;

• Technical factors - after abnormally strong movements some technical indicators (especially oscillators) generate signals for transactions in a direction opposite to the previous abnormal movement;

• Market (rational) factors - investors reassess information and understand the fact of the previous movement abnormality, with further actions to return to its equilibrium level.

3 Research methodology

In this paper t-statistics is used to confirm/reject the fact that the size of counter-reaction that occurs after abnormal price fluctuations differs from the size of typical counter-movements (countermovement after usual, standard day, without any overreactions). The excess of the calculated t-test values over its critical value will indicate that presented data sets belong to different general populations. In practical terms this will mean that the size of countermovement that occurs after abnormal movements statistically differs from the normal countermovement. This, in turn, confirms the overreaction theory.

One of the conditions for the use of the t-test is the normality of the distribution of the analyzed data. Note that our sample is quite large in size (from a few hundreds to several thousands values). This allows us to use the central limit theorem and concludes compliance data to normal distribution (for details see Mendenhall et al. (2003)).

However, in order to confirm above-mentioned logical assumptions, we will analyze the "normality" of our data using specially designed criterion.

Normal distribution, so-called Gaussian distribution, is the probability distribution, under which the resulting value is affected by a large number of random factors.

Central Limit Theorem: If a random variable is exposed to an infinite number of infinitely small random factors, it is normally distributed.

Random variable is a variable which value results from the measurement of a quantity that is subject to variations due to chance (i.e. randomness, in a mathematical sense).

There are many factors that affect the movement of market prices and their influence is very different. So the price movement assumes the character of random fluctuations (usually for a limited period of time). Thus, financial assets prices can be regarded as random variables.

In order to check data, we used the Pearson criterion. We randomly selected 100 consecutive ranges of prices for the period 2006-2008 (Table 1) and calculated values of test statistics. If test statistics does not exceed the critical value of chi-square distribution, the value is normally distributed.

Table 1. "Normality" of EUR/USD data

	2006	2007	2008
Number of values	100		
Average	80.14	73.62	145.19
Standard deviation	28.37	24.5	51.67
Confidence probability	0.95		
Test statistics	6.1	9.37	9.12
Chi-square distribution (hi(p=0.95, f=7))	14.1		
Conclusion	Data is normally distributed		

Thus, daily ranges of financial assets prices changes are normally distributed. So the data is relevant to use Student's t-test.

The next important thing is data sample formation. The principal moment here is the interpretation of overreaction.

We will analyze short-term overreactions, so the period of analysis will be 1 day (one trading session). Typical price parameters that characterize the behavior of prices during one day are: maximum price, minimum price, open and close price.

In most studies to measure the size of price movement the difference between the open and close price is used. This is the final size of price changes over one day - daily return.

However, we believe this approach is not adequate enough and does not reflect real events fully. There are a lot of overreactions (when price during one day deviates strongly) with small price between open and close prices. So, we propose to consider daily return as the size of the fluctuations in price during the day, i.e. the difference between the maximum and minimum prices during the day.

It should be noted that in most cases, to calculate the size of overreaction and daily return relative values are used. An alternative to this approach is calculation of the movement size in absolute values.

Anyway, as the use of relative values let us avoid the impact of changes in absolute size of daily ranges due to the price changes (for example, when prices grow the absolute size of fluctuations also increases) we consider relative values more correct and adequate.

So the formula for calculating the daily return will be:

$$R_i = \frac{(High_i - Low_i)}{Low_i} \times 100\% \quad (1)$$

where R_i - daily return % for day *i*;

$High_i$ - maximum price for day *i*;

Low_i - minimum price for day *i*.

The next important step is to define the criteria for overreaction. Which daily return is normal, and which is abnormal (overreaction period)? We offer 3 variants for the overreactions defined.

1) If current daily return exceeds the average plus one standard deviation then this day is concerned to be a day of overreaction

$$R_i > (\overline{R}_n + \delta_n) \quad (2)$$

where $\overline{R}_n$ - average size of daily returns for period *n*.

$$\overline{R}_n = \sum_{i=1}^{n} R_i / n \quad (3)$$

δ_n - standard deviation of daily returns for period *n*

$$\delta_n = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (R_i - \overline{R})^2} \quad (4)$$

2) if current daily return exceeds the average plus two standard deviations then this day is concerned to be a day of overreaction

$$R_i > (\overline{R}_n + 2 \times \delta_n) \quad (5)$$

3) if current daily return exceeds the average plus three standard deviations then this day is concerned to be a day of overreaction

$$R_i > (\overline{R}_n + 3 \times \delta_n) \quad (6)$$

Period of averaging will be determined during the data analysis.

Thus, if the size of daily return of the test period exceeds the given parameters, it is considered abnormal. Accordingly this day is the day of overreaction and the next day should be the day of abnormal counter-reaction (at least this hypothesis will be checked).

The next step is to determine the size of counterreaction. We suggest determining it as the relative difference between the open price the next day and the maximum deviation from it in the direction opposite to the price movement on the overreaction day.

If price increased, during the overreaction, then the formula for counterreaction size calculation is:

$$cR_{i+1} = 100\% \times \frac{(Open_{i+1} - Low_{i+1})}{Open_{i+1}} \quad (7)$$

where cR_{i+1} - counterreaction size

$Open_{i+1}$ - open price of the day next to day of.

If price decreased, during the overreaction, then the formula for counterreaction size calculation is:

$$cR_{i+1} = 100\% \times \frac{(High_{i+1} - Open_{i+1})}{Open_{i+1}} \quad (8)$$

The result of calculations will be formation of two data sets:

Set 1. Size of counterreactions after normal price fluctuations

Set 2. Size of counterreactions after abnormal price fluctuations

The aim of research is to test these two data sets for their conformity to the same general population. If they match, overreactions hypothesis is not confirmed. Otherwise, if these arrays belong to various general populations, the overreaction hypothesis is confirmed and the fact that abnormal price movements generate abnormal countermovement is also proved. Checking for compliance will be done using Student's t-test.

The null hypothesis in this case is: two sets belong to the same general population. If t-critical exceeds t-calculated, the null hypothesis is accepted otherwise – it is rejected (that means that data sets belong to different general populations).

The algorithm of our methodology is as follows:

Figure 4. The algorithm of our methodology

Daily return count
$$R_i = \frac{(High_i - Low_i)}{Low_i} \times 100\%$$

Average daily return count
$$\bar{R}_n = \sum_{i=1}^{n} R_i / n$$

Standard deviation of daily return count
$$\delta_n = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(R_i - \bar{R})^2}$$

Overreaction determination
$$R_i > (\bar{R}_n + \delta_n)$$
$$R_i > (\bar{R}_n + 2 \times \delta_n)$$
$$R_i > (\bar{R}_n + 3 \times \delta_n)$$

Type of overreaction determination
price increased
price decreased

$$cR_{i+1} = 100\% \times \frac{(Open_{i+1} - Low_{i+1})}{Open_{i+1}}$$

Size of counterreaction count

$$R_{i+1} = 100\% \times \frac{(High_{i+1} - Open_{i+1})}{Open_{i+1}}$$

overreaction confirmed

overreaction is absent

Data set of counterreactions after overreactions

Data set of counterreactions after normal days

T-test

$$t_{cr} > t_p$$

$$t_{cr} < t_p$$

Null hypothesis accepted

Null hypothesis rejected

Countermovements after overreactions do not differ from countermovements after normal days

Countermovements after overreactions differ from countermovements after normal days

Overreaction hypothesis is not confirmed

Overreaction hypothesis is confirmed

4 Findings

As objects of analysis we choose the following financial assets:

- Dow-Jones index (developed stock market);
- Currency pair EURUSD (FOREX);
- Gold (commodities);
- Oil (commodities);
- UX index (leading Ukrainian stock market index - emerging stock market).

Test results for these assets are presented in Appendices 1-5. Results are rather sensitive to the parameters of testing (period of averaging and criterion of normality – the number of standard deviations that should be added to the mean). That is why they are mixed.

Interesting result of analysis is conclusion that increased size of abnormal movement does not necessary lead to increased size of countermovement.

Let's discuss results of analysis in details (case of Dow-Jones index for the period 1987-2012). We choose Dow-Jones index because US stock market is the biggest and developed in the world. Plus it has the biggest number of participants and the highest level of exchange culture in general.

The number of abnormal returns detections during 1987-2012 is presented in Table 2.

Table 2. The number of abnormal returns detections in Dow-Jones index during 1987-2012

n	5		10		20		30	
Indicator	Number	%	Number	%	Number	%	Number	%
Overall	6458	100	6454	100	6444	100	6434	100
Number of abnormal returns (criterion - mean+sigma)	1297	20	1183	18	1123	17	1070	17
Number of abnormal returns (criterion - mean+2*sigma)	587	9%	474	7	379	6	371	6
Number of abnormal returns (criterion - mean+3*sigma)	290	4%	194	3	159	2	145	2

As we can see, both parameters (period of averaging and number of standard deviation added to mean) make impact on the number of detected anomalies. It should be mentioned that change of averaging period causes relatively small deviations of the number of detected anomalies (difference between number for the period=5 and period=30 is less than 10%). So period of averaging is not so important from the position of number of detected anomalies. That is why selection of averaging period may be depended on other factors that interest researcher.

Opposite situation is observed for the parameter that concerns the number of standard deviations should be added to mean to detect the anomaly.

Each additional standard deviation significantly decreases the number of observed abnormal returns (the size of decrease is 50% for each additional sigma). It creates strong restrictions for the practical use of this parameter. 2-4% of overall data sample (the number of abnormal returns in case of 3 sigmas) are not enough to create a representative population and to make reasonable conclusions.

Based on data from Tables A.1-A.4 we selected the next set of parameters: period of averaging = 30, the number of sigmas = 1. This selection is caused by the following reasons:

1) Results for different types of market are close to each other with this combination of parameters;

2) Small periods of averaging cause serious fluctuations in values of means and standard deviations that increases the level of "noise" in data and results;

3) Increased number of sigmas significantly reduces the number of detected anomalies;

4) The quality of results is the highest for this set of parameters (difference between normal countermovements and countermovements after abnormal returns).

Results of analysis for this set of parameters are presented in Table 3.

The results of empirical tests evidence are in favor of the statistically significant difference between the size of countermovements after "normal" returns and the size of countmovements after abnormal returns. The only exception among analyzed types of financial markets is foreign exchange market (case of EURUSD). In case of FOREX difference between the size of countermovements after "normal" returns and the size of countermovements after abnormal returns is statistically insignificant (means are 0,5 and 0,52 accordingly). So for the FOREX null hypothesis is accepted. These results are consistent with EMH. So it is impossible to get extra profits from trading on foreign exchange market using the contrarian trading strategy based on short-term overreactions.

For other types of financial markets (stock and commodities) difference between means (let's call it "delta") is nearly 10% and it is statistically significant (t-criterion is bigger than t-critical). Nevertheless "delta" is different for each type of markets and assets. Maximum difference between "normal" average and "abnormal" was observed in Ukrainian stock market (1.07% vs 1.79%). "Delta" exceeds 50%. This gives huge opportunities for

speculative transactions based on contrarian trading strategy.

Table 3. Results of null hypothesis testing for different types of financial markets and assets (period of averaging=30, number of sigmas=1)

Type of financial market	Commodities market				Stock market				Foreign exchange market	
Type of asset	Gold		Oil		UX index		Dow-Jones index		EURUSD	
Indicator	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	726	3583	693	3816	142	790	1070	5364	952	5164
Mean	0,73%	0,66%	1,64%	1,50%	1,79%	1,07%	1,09%	0,92%	0,52%	0,50%
Standard deviation	0,72%	0,71%	1,48%	1,42%	2,11%	1,14%	1,12%	0,77%	0,44%	0,43%
t-criterion	2,74		2,49		4,10		4,72		1,12	
t-critical (p=0.95)	1,96									
Null hypothesis	rejected		rejected		rejected		rejected		accepted	

US stock market demonstrates the second biggest "delta". Average size of delta for Dow-Jones index is less than 20%. Anyway this difference is statistically significant that gives opportunities for successful trading on overreaction.

Thou, stock markets are the most sensitive to overreactions and further countermovements among other types of financial markets.

For commodities markets "delta" equals 10% on average and is statistically significant. This let us make a conclusion that countermovements after "normal" and "abnormal" returns are different. Also we should point out that the size of countermovement after "abnormal" returns for Oil is the biggest after Ukrainian stock market.

In general, results evidence in favor of less efficiency of the Ukrainian stock market (comparing with US stock market or other types of financial markets) and it's high speculative potential (size of countermovements in Ukrainian stock market is almost 2 times bigger than in US stock market).

These facts allow extra profit obtaining from the trading on Ukrainian stock market.

Based on results of research we can recommend the following rules of trading on short-term market overreactions:

1) detection of anomaly (abnormal return) – as a criterion can act exceeding of current range of fluctuation over certain value (according to our results this value is mean with a period of averaging 30 plus 1 standard deviation);

2) in case of detection of anomaly the next day position opposite to previous abnormal movement should be opened;

3) after reaching the target price (average size of countermovement for certain type of asset or market) open position should be closed.

Of course these rules are common and should be specified in the process of backtesting of strategy based on them.

5 Conclusions

In general results of research on the stock and commodities markets are consistent with the overreaction hypothesis. Results for FOREX are consistent with EMH. The results are rather sensitive to the set of parameters of testing. That is why they should be interpreted with the reference to the set of used parameters. Nevertheless, results of analysis evidence in favor of temporary inefficiencies in activities on stock and commodities markets.

We find significant evidence of overreactions in Ukrainian stock market using the daily data over the period 2008-2012. Results show that the size of contrarian price movements in Ukrainian stock market is higher than in US market. Comparing results from Ukrainian stock market with other financial markets we conclude that there is a high speculative potential on the Ukrainian stock market and also that the Ukrainian stock market is less efficient. Low level of market efficiency gives opportunities for extra profits.

Based on results of research we recommend some rules of trading on short-term market overreactions. Our study also makes some contribution to the overreaction hypothesis literature. First, we provide evidence of abnormal counter-reactions after the overreactions on Ukrainian stock market. These results are consistent with overreaction hypothesis. Second, we find practical implication to the overreaction hypothesis on the Ukrainian stock market - rules of trading on short-term market overreactions. Third, analysis of different financial markets with the same methodology let us make

complex conclusions about the presence of short-term market overreactions in modern financial markets and to highlight markets immune or exposed to overreactions.

6 Summary

This paper investigates whether counter-movements after days with abnormal returns are larger than countermovement after "normal" days.

Our results, based on daily data from US stock market, FOREX, commodities and Ukrainian stock market, indicate the following:

Firstly, the behavior of the stocks and commodities markets is consistent with the overreaction hypothesis and evidence in favor of temporary inefficiencies in activities on stock and commodities markets.

Secondly, the results for FOREX are consistent with EMH.

Thirdly, the results are rather sensitive to the set of parameters of testing. That is why they should be interpreted with the reference to the set of used parameters.

Fourthly the size of contrarian price movements in Ukrainian stock market is higher than in the US market. Comparing results from Ukrainian stock market with other financial markets we come to conclusion about the less market efficiency of the Ukrainian stock market. Low level of market efficiency gives opportunities for extra profits.

Finally, the important conclusion of this research is the high speculative potential of the Ukrainian stock market. Results of this paper can be a good base for construction a contrarian trading strategy based on short-term overreactions analysis. Basics of such strategy were proposed in this paper.

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Appendix A

Table A.1. Test results for Dow Jones Industrial Average Index for the period 1987-2012

1 sigma

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	1297	5161	1183	5271	1123	5321	1070	5364
Mean	0,97%	0,95%	1,00%	0,94%	1,06%	0,93%	1,09%	0,92%
Standard deviation	0,97%	0,80%	1,01%	0,80%	1,08%	0,78%	1,12%	0,77%
t-criterion	0,859571855		2,033267584		4,230763317		4,722439164	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		rejected		rejected		rejected	

2 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	587	5871	474	5980	379	6065	371	6063
Mean	1,01%	0,95%	1,07%	0,94%	1,14%	0,94%	1,20%	0,94%
Standard deviation	1,14%	0,81%	1,26%	0,80%	1,39%	0,79%	1,41%	0,79%
t-criterion	1,414756929		2,282117763		2,764405498		3,545822771	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		rejected		rejected		rejected	

3 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	290	6168	194	6260	159	6285	145	6289
Mean	1,07%	0,95%	1,10%	0,95%	1,29%	0,94%	1,52%	0,94%
Standard deviation	1,39%	0,81%	1,57%	0,81%	1,84%	0,80%	1,99%	0,79%
t-criterion	1,477631306		1,384190797		2,367443946		3,482152514	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		rejected		rejected	

Table A.2. Test results for the UX index for the period 2009-2012

1 sigma

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	180	777	164	788	154	788	142	790
Mean	1,43%	1,14%	1,54%	1,13%	1,71%	1,08%	1,79%	1,07%
Standard deviation	1,94%	1,29%	1,95%	1,30%	2,05%	1,23%	2,11%	1,14%
t-criterion	2,036494236		2,725513425		3,762167756		4,096163334	
t-critical (p=0.95)	1,96							
Null hypothesis	rejected		rejected		rejected		rejected	

2 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	73	884	85	867	72	870	66	866
Mean	1,39%	1,17%	1,67%	1,15%	2,02%	1,12%	2,04%	1,11%
Standard deviation	1,77%	1,40%	2,22%	1,34%	2,36%	1,29%	2,06%	1,27%
t-criterion	1,051742909		2,128155584		3,2381263		3,650673714	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		rejected		rejected		rejected	

3 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	31	926	43	909	35	907	27	905
Mean	1,46%	1,18%	1,41%	1,19%	1,78%	1,17%	2,39%	1,14%
Standard deviation	1,98%	1,40%	1,91%	1,42%	2,20%	1,37%	2,28%	1,31%
t-criterion	0,789177573		0,756710393		1,648250598		2,843550605	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		rejected	

Table A.3. Test results for the currency pair EURUSD for the period 1989-2012

1 sigma

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	1267	4875	1074	5062	1006	5120	952	5164
Mean	0,97%	0,95%	0,50%	0,51%	0,50%	0,51%	0,52%	0,50%
Standard deviation	0,97%	0,80%	0,42%	0,43%	0,43%	0,43%	0,44%	0,43%
t-criterion	0,849572618		-0,860344841		-0,310513198		1,120110619	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		accepted	

2 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	629	5513	454	5682	374	5752	334	5782
Mean	1,01%	0,95%	0,49%	0,51%	0,52%	0,50%	0,55%	0,50%
Standard deviation	1,14%	0,81%	0,43%	0,43%	0,43%	0,43%	0,44%	0,43%
t-criterion	1,464495703		-0,766391672		0,625074255		1,921197517	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		accepted	

3 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	355	5787	206	5930	144	5982	126	5990
Mean	0,97%	0,95%	0,54%	0,50%	0,59%	0,50%	0,64%	0,50%
Standard deviation	0,97%	0,80%	0,47%	0,43%	0,45%	0,43%	0,47%	0,43%
t-criterion	0,449703612		1,08240839		2,208156707		3,263013086	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		rejected		rejected	

Table A.4. Test results for gold for the period 1996-2012

1 sigma

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	886	3448	807	3522	745	3574	726	3583
Mean	0,65%	0,67%	0,68%	0,67%	0,72%	0,66%	0,73%	0,66%
Standard deviation	0,64%	0,72%	0,66%	0,72%	0,69%	0,71%	0,72%	0,71%
t-criterion	-1,334982129		0,686034132		2,191599044		2,742147192	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		rejected		rejected	

2 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	398	3936	315	4014	271	4048	255	4054
Mean	0,62%	0,67%	0,63%	0,67%	0,68%	0,67%	0,74%	0,67%
Standard deviation	0,58%	0,72%	0,61%	0,71%	0,70%	0,71%	0,79%	0,70%
t-criterion	-1,815892765		-1,388517607		0,210430638		1,481041542	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		accepted	

3 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	189	4145	105	4224	59	4260	55	4254
Mean	0,54%	0,68%	0,62%	0,67%	0,81%	0,67%	0,87%	0,67%
Standard deviation	0,51%	0,71%	0,62%	0,71%	0,95%	0,70%	0,97%	0,70%
t-criterion	-3,77366079		-0,849613628		1,184316079		1,515310007	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		accepted	

Table A.5. Test results for oil for the period 1995-2012

1 sigma

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	909	3625	776	3753	716	3803	693	3816
Mean	1,51%	1,52%	1,56%	1,51%	1,59%	1,51%	1,64%	1,50%
Standard deviation	1,39%	1,44%	1,47%	1,42%	1,46%	1,42%	1,48%	1,42%
t-criterion	-0,100474427		1,027787923		1,593035355		2,493366194	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		accepted		rejected	

2 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	430	4104	333	4196	260	4259	233	4276
Mean	1,50%	1,52%	1,58%	1,51%	1,73%	1,51%	1,79%	1,51%
Standard deviation	1,36%	1,44%	1,47%	1,43%	1,55%	1,42%	1,64%	1,42%
t-criterion	-0,327743331		0,771770513		2,298565501		2,68803689	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		rejected		rejected	

3 sigmas

	5		10		20		30	
	abnormal	normal	abnormal	normal	abnormal	normal	abnormal	normal
Number of matches	208	4326	138	4391	111	4408	107	4402
Mean	1,52%	1,52%	1,46%	1,52%	1,85%	1,51%	1,93%	1,51%
Standard deviation	1,19%	1,44%	1,30%	1,43%	1,56%	1,42%	1,57%	1,43%
t-criterion	0,000530744		-0,525812924		2,258133103		2,725251584	
t-critical (p=0.95)	1,96							
Null hypothesis	accepted		accepted		rejected		rejected	