

Possibilities of preventing manipulative transactions on the stock market in the conditions of new industrialization

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Abstract — The term “manipulative trade” does not reflect current challenges and requires constant adaptation. The article proposes to focus on detailing and suppressing a certain list of manipulative practices, based on the damage they cause. The object of the research is the manipulative transactions in the stock market, and the subject of the research is the methods of identifying manipulative transactions in the Russian stock market. The purpose of this study is the development of specific proposals and the selection of statistical methods relevant for the Russian stock market in the conditions of new industrialization to improve the current system of state control aimed at identifying various types and methods of manipulative trading in the stock market. The practical relevance of the study consists in the creation and testing in real conditions of the Russian stock market of a statistical machine algorithm based on the k-nearest neighbor algorithm, which can identify non-standard trading operations. The article presents statistical information reflecting the dynamics of the individual properties of the Russian stock market.

Keywords— *manipulative transaction, stock market, market abuse, financial technology, new industrialization, k-nearest neighbor algorithm, regulation*

I. INTRODUCTION

The relevance of studying the research topic is based primarily on the increasing frequency of complaints from various stock market participants on the widespread incidents of violations of effective pricing on the domestic stock market, as well as on fundamental technological changes that have recently restructured the structure of most developed financial institutions around the world. The struggle of state bodies with manipulative trading on the stock market is in many respects punctual, with a different low rate of identifying and stopping market abuses, which violate equality of stock market participants in terms of investment decision-making

opportunities and undermine the overall attractiveness of the Russian stock market for investors.

Despite the importance of the problem of manipulative practices for the entire financial sector of the country, a large proportion of existing research is of an applied legal nature and dates from the work of the past decades, which do not reflect the current actual digital challenges and changes, and also are based on translations of even earlier studies by foreign authors that do not take into account Russian specifics. To a large extent, issues related to automated quantitative methods for identifying abuses on the stock market are not touched upon by most researchers studying the identification of manipulative trading.

II. SCIENTIFIC CONCEPTS DEFINING MANIPULATIVE TRADING IN THE STOCK MARKET

The main function of the stock market, also relevant to the era of the new industrialization, is to attract investments in the economy. Fair pricing, availability of publicly available information about the market and equality of participants in the process of asset price formation are required. As a result, the efficiency of the stock market is proportional to its ability to fairly evaluate the assets included in it at any given time, which follows from the market efficiency hypothesis. The hypothesis about the effectiveness of most stock markets is also confirmed by comparing the profitability of professional analysts and managers of active funds against the average market profitability of the US stock market, which so far, with rare exceptions, over the past twenty years is on the side of broad market share indices, which largely confirms the general hypothesis [1]. On the other hand, it is currently widely recognized that abuses by unfair participants are one of the biggest threats to financial markets. One of the main forms is

presented in the form of manipulative securities trading on the stock market.

From an economic point of view, contrary to the properties of an effective market, the core of manipulations is a temporary distortion of pricing, which means the setting of artificial prices for financial instruments, which leads to a redistribution of capital to a small number of participants. This, in turn, leads to economic imbalances and prejudices fair market participants and undermines confidence in financial institutions. Based on the considered literary sources, the definition of manipulative trade, which is found in both scientific and law enforcement discourse [2], is formulated in a rather abstract way, which confirms the complexity and ambiguity of the practice in question.

In our opinion, the reason for the lack of an objective definition of manipulation in the market is that the most necessary criterion for creating manipulations is the subjective aspect. There are several common signs characteristic of market manipulations: the commission of a specific action or omission; the intention of the subject; causality and connectedness of events of agent actions with consequences for a certain market instrument; the presence of the fact of artificial prices. Among Russian scientists who worked on the theoretical aspects of manipulative actions in the stock market, V.N. Berzona, A.N. Burenina, A.P. Ivanova, I.S. Menshikov, Ya.M. Mirkina, B.B. Rubtsov, most of whose scientific works were devoted mainly to the regulatory aspect. Particularly difficult in defining manipulative trade is the classification of manipulations into three main categories: information-based, action-based and trade-based. Action-based manipulation is based on actions that change the actual or perceived value of an asset, information-based manipulation is done by issuing false information or spreading false rumors, and trading-based manipulation is based solely on buying and selling securities without any publicly observable actions or the dissemination of false information.

In our work, we will focus exclusively on a narrow understanding of manipulative transactions, trade based manipulations, since the other two types are more social, mixed and applied, which is based in most cases on fraud, cybercrime, social engineering and does not require applied interventions to related transactions. Let us consider and formalize the traditional methods of manipulation, as well as new methods that have appeared relatively recently (Tab. I).

TABLE I. CLASSIFICATION OF TYPES OF MANIPULATIVE TRADE¹

Classical types	New types
Corner, compression, running ahead, "boiler house" tactics, pumping and dropping, supply manipulation, price stabilization, the impact on the closing and opening prices, the original distortion	Pinging, spoofing, electronic front running, mass misinformation

Traditional market manipulations are usually carried out with the help of a person, and are aimed at distorting the natural prices of certain financial instruments or transactions in favor of the manipulative side. These traditional market distortion attempts can manifest themselves in various forms,

listed in the relevant part of the Table I. In contrast to the traditional manipulation of the stock market, new illegal practices in the market usually pass through electronic communications, information systems and algorithmic platforms to unfairly distort information and prices associated with financial instruments or transactions [4]. By their nature, they use algorithms that influence exclusively the interaction between machine robotic trading platforms, or participants that are directly connected with digital programs. Despite the fact that the manipulation of the new generation, as a rule, has the same goal as its traditional counterparts, it can be much more efficient due to the unprecedented velocity and connectedness of digital markets [5].

Pinging and spoofing are two new methods of market manipulation that use new financial technologies in the market to distort the process of displaying market prices on financial markets. The essence of Electronic front running is very similar to the traditional old equivalent. However, Electronic front running works to manipulate the market, executing transactions before a known price change in the future, making a profit as soon as a change is made. Unlike its past counterpart, which controlled traders through intermediaries, Electronic front running works using new high-tech mechanisms that allow manipulators to receive information about order flows a little earlier. Mass Misinformation is a new method of manipulating the cybernetic market, which is the use of mechanisms of new media technologies and new financial technologies in order to interrupt and distort financial markets on an unprecedented scale, spreading incorrect data, news and erroneous information on market. With mass disinformation schemes, parties can manipulate the market through fake regulatory documents, fictitious news messages, and erroneous data and hacker attacks. It is useful to clarify that market manipulation cannot be comprehensively classified as fraud. This is due to the fact that fraud is by definition an illegal act, based on an intention based on deception. If there is no objectively bad action, the question of intent is not enough to establish fraud. Therefore, trade manipulation cannot be reduced to fraudulent practices.

Obviously, not every manipulative activity is equally harmful for financial markets [6]. Diverse behavior requires a diversified set of rules. Therefore, it is important to adapt the regulation of market manipulations not to a single concept, but to each specific adverse effect, in connection with which you should completely abandon the above attempts to define the concept of manipulative trading for the following reasons: firstly, the term "manipulation" is not, apparently, exclusively negative. In a certain sense, it is a neutral word describing some kind of activity affecting others. However, the specific action must be illegal in order to fit the description [7]. Secondly, the external boundaries of market manipulation prohibitions should be changed depending on which behavior is harmful. Due to the fact that market damage is mandatory in the legal definitions of various manipulative offenses, the external limits of prohibitions on market manipulation should be clarified. Because any particular phenomenon must be clearly delineated in order to be effective in order to detect and stop such trade, as well as in maintaining the overall efficiency of the financial market. Third, different behaviors also require

¹ Compiled by the authors: [3]

separate prohibitions and classifications, since market manipulation takes different forms. This leads to confusion of concepts and inadequate regulation. If a single concept gives way to specific prohibitions for certain market abuses, the regulation of the stock market will become simpler and more effective [8]. Fourth, the manipulative schemes and practices do not stand still, each time new methods and methods of manipulation arise, and they are being improved and masked by everyone already known under the influence of technical progress.

It is worth noting that the general definition of manipulative trade and the state control resulting from it is extremely difficult to adapt and change to the new challenges of today, based solely on abstract models that do not reflect the current changes in the financial markets in recent decades. For this reason, the main tasks at the moment are to identify, classify and analyze new types of manipulations in order to limit the negative impact on ensuring the efficiency of the stock market and attracting investment in the domestic economy.

III. METHODS FOR IDENTIFYING MANIPULATIVE TRADING IN THE STOCK MARKET

Counteraction to the classical methods of manipulative trade, as well as new illegal practices, is not in place and is constantly adapting, including to the digital challenges described above. At present, most researchers distinguish three generations of methods that are used to identify manipulative trade in the stock market (Tab. II) ².

TABLE II. CLASSIFICATION OF METHODS FOR IDENTIFYING MANIPULATIVE TRADING

I generation of methods	II generation of methods	III generation of methods
Automated and manual, correlation analysis, regression analysis, canonical analysis, methods for comparing averages, frequency analysis, descriptive analysis	Dispersion analysis, cross tabulation, correspondence analysis, discriminant analysis, factor analysis, decision trees, k-nearest neighbor algorithm, multidimensional scaling, cluster analysis	Multiple discriminant analysis, logistic regression artificial neural networks, machine-vector method, time series methods

The first generation of detection methods concerns only raw market data. In case of a non-standard deviation from the specified normal range or permissible interval in this model, an alert appears in case of the necessary quantitative change for custom indicators and coefficients. The essence of these methods is quite transparent, as a result they are easy to calibrate and apply for any market, interval and instrument. The second classification group of methods can be used to characterize models that use statistical information from a specific market to make forecasts. The principle of operation consists in detecting statistically significant deviations from the calculated "forecast" one step ahead, using time series models for forecasting future volume.

With the help of the third group of methods, reflected in the classification, we can consider variations of numerical algorithms, as well as non-parametric methods.

The main feature of the presented methods is a phased mechanism for calculating numerical values by means of a specific algorithm, then filtering and clearing the results and, finally, the use of graphical and formal analysis. The ability to classify heterogeneous phenomena, as well as the possibility of independent work, represents the above methods among the best. However, the main disadvantages of these approaches are the need for constant and accurate calibration for a specific algorithm. Let us consider the main ones.

Logistic regression (LR) is a statistical model used to predict the probability of an event occurring by fitting data to a logistic curve. Linear (LDA) and quadratic (QDA) discriminant analysis are statistical and machine research methods used to find linear combinations of features that best separate two or more classes of objects or events. LDA and QDA are often preferable to logistic regression, in the case of a larger number of variable values, and also are more stable. An artificial neural network (ANN) is a system of simple processors (artificial neurons) connected and interacting with each other. Such processors are usually quite simple (especially in comparison with processors used in personal computers). Decision Tree (DTC) is a decision support tool used in statistics and data analysis for predictive models. The structure of the tree is "leaves" and "branches". At the edges (branches) of the decision tree, the attributes are recorded on which the objective function depends, in the leaves the values of the objective function are recorded, and in the remaining nodes there are attributes by which the cases differ.

K-nearest neighbor algorithm (KNN) is a metric algorithm for automatic classification of objects or regression. The algorithm may be applicable to samples with a large number of features. This algorithm assumes that all analyzed features are associated with points in n-dimensional space. The k-nearest neighbor algorithm has been considered laborious for a long time and was not used until the power of the computer became necessary for such calculations.

All the methods presented above were described in order to compare their effectiveness for the purpose of identifying manipulative trading in the stock market. The researchers have shown that most of the models obtained good results of accuracy and sensitivity, however, the best in all parameters (accuracy, correctness, sensitivity and efficiency of classifiers) were shown by the algorithms: decision tree (DTC) and the k-nearest neighbor algorithm (KNN) [13].

In addition to the analysis of the above mentioned methods in theoretical studies on the identification of manipulative trade, you can also select a number of alternative methods: machine algorithms aimed at detecting pools of manipulators on the basis of trade networks, the identification of which is based on the methods of graph clustering [14]; Markov's clustering algorithm, capable of successfully detecting cyclical trading [15]; spectral analysis to identify clusters of individual manipulators [16]; an alternative method is also to identify the similarity of trading activity among investors to identify the collusion of individual traders. These

² Compiled by the authors [9-12]

collusions are based on the total volume of orders calculated at specified time intervals calculated through the correlation matrix [17]. However, it should be considered that most of the researches in this area are theoretical, which in many ways at the moment greatly alienates alternative methods from empirical research based on real-time experiments.

IV. PRACTICAL ASPECTS OF MANIPULATIVE TRANSACTIONS IN THE DOMESTIC STOCK MARKET

To perform all the necessary research tasks in the conditions of new industrialization, it is necessary to carefully consider all the features of the domestic stock market. First of all, it is worth noting the long-term tendency to reduce the capitalization of the entire stock market [18]. So, by the end of 2017, the capitalization of the market of shares of Russian issuers amounted to 35914 billion rubles, decreasing by 5.0% compared with 2016. From 2007 to 2017, the capitalization in nominal terms remained almost unchanged, while in real terms it decreased noticeably. There was a deep drop in capitalization in the crisis of 2008 (by 66.4%) and active growth in 2015–2016 (an average of 27.9% annually). The capitalization / GDP ratio reached its maximum value only in the distant 2007 - 98.5%, currently this result seems to be unattainable. In 2017, this indicator amounted to 39.0% - by 5 percentage points less than a year earlier (Tab. III). Such a long-term negative trend, with a rather significant relationship observed between GDP growth and growth in the stock market capitalization, reflects the presence of serious systemic problems throughout the Russian economy and this cannot be explained solely by market factors.

TABLE III. CAPITALIZATION OF THE MARKET FOR SHARES OF RUSSIAN ISSUERS³

Period	Capitalization of the stock market, billion rubles	GDP, billion rubles	Capitalization / GDP, %
2007 г.	32740,0	33247,5	98,5
2008 г.	11017,3	41276,8	26,7
2009 г.	23090,9	38807,2	59,5
2010 г.	29253,2	46308,5	63,2
2011 г.	25708,0	55967,2	45,9
2012 г.	25212,5	68163,9	37,0
2013 г.	25323,8	73133,9	34,6
2014 г.	23155,6	79199,7	29,2
2015 г.	28769,1	83387,2	34,5
2016 г.	37822,8	85917,8	44,0
2017 г.	35913,8	92081,1	39,0

If we take into account the fact that the capitalization of the global stock market has more than doubled over the past 11 years, the domestic stock market is in a diametrically opposite direction. The second bright feature of the Russian stock market is a high concentration of the capital. The list of the most capitalized Russian issuers is stable from year to year and changes in composition only at the bottom of the list, which indicates monopolistic trends in the main sectors of production, which ultimately can lead to a decreasing returns of the scale and slow down the development of the largest issuers.

The most important task for the Russian stock market is to increase the low level of liquidity, since the low level of

market liquidity reflects the degree of demand of the stock market itself, which is also applicable to the inverse relationship of the influence of liquidity on the overall demand and attractiveness of the stock market. According to PJSC Moscow Exchange, in 2017 the number of issuers whose shares and bonds circulate on the organized market increased by nine companies (1.7% in relative terms) - up to 535 legal entities (Table 4). A year earlier, the opposite was the reduction of issuers by 41 companies (7.2% in relative terms). At the same time, the number of issuers whose securities are included in high-level quotation lists continues to decrease: in 2017 it decreased by another 2%, to 199 companies.

It should also be noted that there has been a sharp decrease in the number of legal entities licensed to be a professional participant in the securities market for broker, dealer and depository activities, as well as securities management. Thus, by the end of 2017, the number of professional participants decreased to 565 organizations, which is 9.3% less than the results of the previous period. The decrease in the number of professional participants is a fairly directional and strong trend, since for the period from 2007 to 2017. their number decreased by 70.7% (Fig. 1). Thus, by the end of 2017, the number of professional participants decreased to 565 organizations, which is 9.3% less than the results of the previous period. The decrease in the number of professional participants is a fairly directional and strong trend, since for the period from 2007 to 2017 their number decreased by 70.7%.

However, there are positive aspects, such as the steady growth of the corporate bond market. At the end of 2017, the volume of corporate bond issues reached 11.448 trillion rubles at par, which is 21.3% more than a year earlier. In the period 2007–2017 the domestic corporate bond market remains small and does not indicate a huge debt load of issuers: in 2017, the ratio of market volume to GDP was 12.4%, increasing by 1.45 percentage points per year. Summing up the above characteristics of the stock market, it can be concluded that the key financial institution of the country is underdeveloped, which is reflected in low capitalization, the lack of a sufficient level of liquidity, and a large and inert concentration of the capital. At the same time, high margins with a fairly narrow selection of tools and strategies available for a private investor greatly increase the risks, including professional stock market participants, which can be used by dishonest participants for their illegal purposes.

Currently, the Russian stock market continues to be characterized by a high level of irregularities in concluding securities transactions from the point of view of private investors, both individuals and legal entities, which may also be due to the lack of an effective market regulation system, in particular, to identify and suppress manipulations. Based on information obtained from the Bank of Russia website, in the period from 2010 to 2017, the regulator identified 73 cases of manipulative trading on the Russian stock market, as well as 4 cases for 4 months of 2018, which makes it possible to make an assumption about the future identification for 2018 about 9 manipulative practices, based on the average values of past periods (Fig. 1).

³ Compiled by the authors according to the Moscow Exchange» URL: <https://www.moex.com>

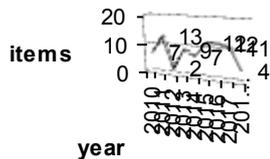


Fig. 1. Identified cases of manipulative trading on the Russian stock market⁴

Summarizing the violations revealed by the Bank of Russia, on the one hand, it is possible to draw a conclusion on the disclosure of ever more diverse and complex cases, which indicates an increase in the competence and coherence of the work of state bodies, professional participants in the securities market, as well as issuers and investors themselves. On the other hand, the revealed violations and subsequent response usually take considerable time, which, at the current level of globalization and informatization, creates great risks for all participants, especially considering the characteristic properties of the stock market described above. In addition, there are positive trends in increasing the complexity of the disclosed manipulations and in the rapid response.

V. IMPROVING THE EFFECTIVENESS OF STATE REGULATION IN THE FIGHT AGAINST MANIPULATIVE TRADE IN THE STOCK MARKET

In the conditions of new industrialization the nature and characteristics of each type of manipulation in the stock markets are individual, and it is obvious that it is rather difficult to create any kind of general automated solution that determines manipulative trading at early stages to quickly suppress such practices.

However, based on the above features of the manipulations themselves, as well as the practice of the regulator by their definition to identify suspicious actions and transactions, it makes sense to list several signs on the basis of which you can create simple and well calibrated algorithms for the initial statistical processing of stock information and easily digitize them, e.g.: impulse purchases or sales of a large volume of a financial instrument with simultaneous issuing of reverse orders at already adjusted prices, through the same brokerage accounts; increase of the spread several times from the average market value between the best purchasing and auction prices in liquid instruments; the increasing inverse proportionality of the financial result of several bidders; the total share of short-term transactions (less than 5 minutes) with a positive financial result, which is several times higher than the number of unprofitable for the set period; a high proportion of all transactions is associated with high-frequency movement of a given number of securities between several participants; regular price slippage as a result of cancellation of request for close values to the market price before carrying out transactions; impulse purchases or sales (transactions with a large average volume per minute) of securities in the last seconds of the close of a trading session; purchase of more than 50% of the shares in free float, in a

situation when the company's price / earnings ratio is extremely high, etc.

Since the basic information about the proposed signs of manipulative trading is closed and anonymous, available exclusively to the state authorities and the stock exchange, for our research we will use the k nearest neighbors algorithm (KNN). The task of the k nearest neighbors algorithm will be to find the nearest neighbor, which is to search among the set of elements located in a multidimensional metric space, of the elements close to a given one, according to the proximity function. The authors of the classic book "The Elements of Statistical Learning" consider it as a theoretically ideal algorithm, the applicability of which is simply limited by computational capabilities and dimensional problems [19].

The task of classification in our case will be in the assignment of an object to one of the predetermined classes on the basis of its formalized features. Each of the objects in this problem is represented as a vector in space, and each dimension in it is a description of one of the features of the object. Thus, the object of the method will be the last minute of closing each trading session of a financial instrument. And the measurements will be: the difference between the calculated value of the volume of completed transactions at the last minute compared to the average daily value also in minutes (x) and the ratio between the change in percent of the opening price and the closing time of the last minute of trading compared to the change in quotations as a percentage for one day session (y). To compile a sample for the classifier in the manual mode, examples of such anomalous deviations in numerical form using the Finam platform were selected and exported as numerical values. Then, to determine the objects on the plane, the formulas (1,2) were compiled and the values suitable for each case were calculated.

$$x = \frac{Vol, m(18 : 40)}{Vol, d / 520} \tag{1}$$

where Vol, m is the last minute trading volume; Vol, d is the daily volume.

$$y = \frac{price, cl(18 : 40) / price, op(10 : 00) - 1}{price, cl(18 : 40) / price, op(10 : 00) - 1} \tag{2}$$

where price, cl is the closing price per trading minute; price, op - the opening price per minute of trading.

To create a classification of each of the sample objects, the distance between each of the objects of the sample under study was calculated on a plane (a total of 36 values from 10 sample samples). Further, it was decided to select the 4 closest sample objects, the distances between which were minimal that the algorithm could produce the correct result. If you take one value, the algorithm will lose the generalizing ability and will not be able to produce the correct result for data not previously encountered in the algorithm. At the same time, if you set the too large value, the number of errors will increase significantly. In the following, the described the k nearest neighbors algorithm was compiled into an algorithm in the Python programming language, since this programming language has a high speed of execution of programs and

⁴ Compiled by the authors according to the Bank of Russia URL: <https://www.cbr.ru>.

scripts written with the help of “Python” are executed on most modern operating systems used by most users around the world.

By connecting the necessary libraries, including most of the established statistical methods, and including the exported data, the k-nearest-neighbors algorithm showed the average standard distribution of the majority of transactions made during the last minutes of trading. The impact on the price of a financial instrument was minimal, and the volume was in average values. However, during the period under review, an event occurred once, which significantly affected the price of shares at the last minute of trading, which also manifested itself in an increased volume of transactions carried out at that time. Based on the above mentioned, it can be argued that the presented statistical method of computer data processing can easily identify non-standard suspicious transactions with minimal human involvement in the case of a relevant sample studied, fine-tuning for specific manipulative practices and financial instruments.

VI. FINDINGS

In the past two decades, it has become obvious that all financial markets have entered the new digital reality, which dictated new challenges for all participants, such as increasing the coherence of all global markets, increasing the depth and expansion of the line of investment instruments and services, increasing the share in trading of instruments, increasing liquidity, trading volumes and speed of information flows, along with simplifying entry into the stock market for issuers and investors, becoming of a machine trade with minimal human participation and its almost complete ousting from arbitrage operations, the emergence of a cryptocurrency market, etc. However, the ability to take advantage of the digital leap to attract financial flows can only be realized a priori by modern and sustainable financial centers with well-functioning and developed financial institutions integrated into cross-border financial flows, one of the important sides of which should be an effective fight against manipulative trade.

Analysis of the measures used to counter manipulation in the domestic stock market suggests that there are serious problems both in the existing mechanisms for detecting and suppressing non-standard transactions in the market, and in legislative acts aimed at bringing to responsibility for manipulation. The construction of an integrated regulatory system based not only on the investigation of violations of the law already committed several years ago, but, above all, on preventing new ones can be considered as one of the most important and key recommendations in this study.

The system will be able to exist and effectively deal with manipulative practices only if a digital, multi-level automated monitoring platform is introduced that can, for a short time, prohibit and cancel transactions that undermine the safety and efficiency of the stock market, suspend trading in individual instruments, freeze accounts for a certain period without justification reasons. At the same time, in the case of excessive regulation, the consequences can become much worse than in the case of deregulation and further entail an

even greater outflow of capital and private investment from Russia.

In terms of financing, the creation and further maintenance of a workable automated system based on simple algorithms, with currently quite modest volumes of intraday trading on the stock market and a small number of issuers and participants in transactions will never become a costly and inefficient investment, even if stock pricing of the market will change a lot. Most of the above initiatives, tools and methods proposed in the work are multifactorial in nature and in a positive way affect the entire stock market and the economy as a whole, as well as related phenomena that are not directly related to the identification and execution of manipulative actions.

References

- [1] Jensen M. C. (2008) The use of relational discrimination to manage market entry: When do social status and structural holes work against you? // *Academy of Management Journal*. P. 167–247.
- [2] Fischel Daniel R, Ross David J.. (1991). Should the Law Prohibit “Manipulation” in Financial Markets? // *Harvard Law Review*.. P. 503–553.
- [3] Tom Lin C. W. (2015). Reasonable Investors / *Boston University Law Review*. pp.1253–1314.
- [4] Silvani A. (2012). Beat the FOREX dealer: An Insider's Look into Trading Today's Foreign Exchange Market. *Alpina Publisher*. - 258 p.
- [5] Teall John I. (2013). Financial trading and investing. *Academic Press* – 863 p.
- [6] Verstein Andrew. (2018). Insider tainting: Strategic tipping of material nonpublic information // *Northwestern University Law Review*.. – pp. 208–236.
- [7] Aldridge Irene. (2017). Real-Time Risk: What Investors Should Know About FinTech, High-Frequency Trading, and Flash Crashes. *Wiley*. – 227 p.
- [8] Scopino Gregory. (2015). The questionable legality of high-speed «pinging» and «front running» in the futures market. *CONN. L. REV.* – 656 p.
- [9] Yadav Yesha. (2014). Insider Trading in Derivatives Markets // *Georgetown Law Journal*. P.968–1033.
- [10] Pagano Marco, Röell Ailsa. (2013). Market liquidity: theory, evidence, and policy, Thierry Foucault. *Oxford University Press*. – 424 p.
- [11] Aldridge Irene. (2016). High-frequency runs and flash-crash predictability // *Journal of Portfolio Management*. – P. 204–226.
- [12] Slama, M. (2008). Trade-based stock price manipulation and sample entropy. *Master's thesis in Finance*. – 70 p.
- [13] Aihua Li, Jiede Wu, Zhidong Liu.(2017). Market manipulation detection based on classification methods // *Procedia Computer Science*. Vol.122. P. 788–795.
- [14] Palshikar G.K., Apte M.M. (2008). Collusion set detection using graph clustering // *Data Min. Knowl. Disc.* April. Vol. 16. No 22. P. 135–164.
- [15] Islam Md Nazrul, Haque SM Rafizul, Alam Kaji Masudul, Tarikuzzaman Md. (2009). An approach to improve collusion set detection using MCL algorithm // *Computers and Information Technology, 2009. ICCIT'09. 12th International Conference*. Dhaka. P. 237–242.
- [16] Franke M., Hoser B. Schroder J. (2008). On the analysis of irregular stock market trading behavior // *Conference «Data Analysis, Machine Learning and Applications»* Berlin. P. 355–362.
- [17] Wang J.J., Zhou S.G., Guan, J.H. (2012). Detecting potential collusive cliques in futures markets based on trading behaviors from real data. *Neurocomputing*.

- [18] Zalesova A.A. (2017). Russian stock market: current trends and problems // *Economy and business: theory and practice*. №7. pp. 29–32.
- [19] Hastie Trevor., Tibshirani Robert, Friedman Jerome. (2017). *The elements of statistical learning / Springer; 2nd edition.* – 745 p.