



ESTIMATING ECONOMIC EFFECTIVENESS OF USING AUTOMATED TRADING SYSTEMS IN THE FOREIGN EXCHANGE MARKET

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Abstract

Since share of algorithmic trading in the global foreign exchange-market increases, justifying an appropriateness and evaluation of economic effectiveness of using a particular automated trading system is becoming increasingly relevant. Considering that automated trading system is a full-featured software, methods for estimating effectiveness of information technologies shall be utilized to identify effectiveness of using thereof. Thus, in this work the methods for estimating effectiveness of information technologies have been analyzed, without regard to the subject area. The following groups of methods have been considered: cost-based methods; methods for estimating a direct result; methods on the basis of estimating ideality of a process; qualimetric methods. It should be noted that there are no methods ready for practical use. The primary challenge here is in choosing parameters and estimating the results of introducing information technologies.

With no any uniform approach, the paper suggests that one of methods for evaluating a direct result, namely, Economic value source estimation method should be used to estimate effectiveness of automated trading systems. In a general way, this method implies that the four parameters are applied: an increase in income, growth in labor productivity, reduction of in-service time, minimization of risks. This method cannot be said to be suitable for obtaining an objective and accurate assessment of effectiveness of using automated trading system. Therefore, when adjustment to the particular case and certain conditions associated with trading in the foreign exchange market, is made, the benefits shall be evaluated that accrue from automated trading system for trade expert as compared to manual trading within one time period and one trading strategy. The paper suggests that the conclusions about effectiveness of automated trading system should be made by the following

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parameters: an increase in trade expert's income, an increase in the number of transactions made, acceleration of trading process, minimization of risks.

A comparison is made between trading results of trade expert and P. Scalp automated trading system after having employed one trading strategy over 4 months. Computations have shown cost-effectiveness of using automated trading system by all parameters: income of automated trading system is higher by 23%; automated trading system made 1.5 times more transactions than a trade expert made; automated trading system 19 days earlier reached the same income as that earned by a trade expert; use of automated trading system reduces the risks of losing proceeds more than twice.

The practical value of the carried out study lies in justifying an appropriateness of using parameters suggested in the paper to evaluate economic effectiveness of automated trading systems within Economic value source estimation method. To correctly choose effectiveness parameters is essentially equivalent to a proper statement of a problem. It enables to identify an area of feasible solutions.

Keywords : Algorithmic trading; automated trading system; economic effectiveness of information technologies; Economic value source estimation.

I. Introduction

Since development of computation technologies is underway and such type of trading as internet-based trading has appeared, a particular tendency to make market transactions has started to develop in the middle of 90's of the XXth century, namely, an algorithmic trading, i.e. trading using automated trading systems. Currently, more than a half of transactions within the largest stock and currency exchanges are made through automated trading systems. According to SEC data, in USA, 73% of all trading fall within algorithmic trading; the volume of transactions made by "robots" in Amex and NYSE exchanges is about 70-90% [XXI]. In Russia, there is still low percentage of automated trading systems. It amounts to approximately 15-20%, which states that domestic markets have a huge potential for algorithmic trading [I].

The essence of algorithmic trading is that an order of making trading transactions is fed into the special-purpose computing programs. It enables to automate the process of identifying trading signals and market order transactions. An automated trading system is capable of opening and closing trading positions on its own at the real moment in time. Its major advantage lies in availability of a mechanism responsible for delivering trade order to the exchange or trading platform of a stock broker. It provides a way of carrying on trade with no direct human involvement [VI]. An automated trading system obtains information about the state of a market, based on the methods of technical and/or fundamental analysis, processes it, and independently comes to a decision about making trading transactions. Thus, an automated trading system is a full-featured software for conducting trade in the foreign exchange markets. Trade experts and stock brokers often use words "trade robot" or "trade automated machine" to designate an automated trading system.

The objective of creating automated trading systems is to automate the process of exchange assets trading. Modern information technologies enable financial structures to achieve an order-of-magnitude increase in the number of clients

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throughout the world, to carry out an unlimited number of exchange assets purchase-and-sale transactions [XIV]. A human being has physical limitations when issuing exchange orders, however, a speed of issuing exchange orders by a trading system is restricted only by the computational capability of computer. Hence, an extension of online trading with the use of automated trading systems in the foreign exchange markets is forecasted.

Since a share of algorithmic trading in the global foreign exchange market increases, *the relevance of justifying an appropriateness and evaluation of economic effectiveness of using a specific automated trading system* increases as well. *The intention of this work* is to analyze the existing methods, choose and adjust a certain method for evaluating economic effectiveness of using automated systems in the foreign exchange market. *The studies were carried out based on the following data:* financial and economic literature; works of domestic and foreign equity analysts and trade experts; a history of trading conducted by a trade expert and an automated trading system, obtained from trading terminal Metatrader, where exchange operations were carried out; data of independent ratings of automated trading systems.

II. Materials and Methods

A detailed analysis of specific features of automated trading systems demonstrated that operations on the stock exchange can be conducted by the methods not commonly used in previous practice [VIII]. *First*, a profound diversification of exchange assets is concerned. One stock broker is not capable of tracing movement of more than two dozens of assets. It is beyond human capabilities to monitor the dynamics of several thousands of assets. While a trading robot, i.e. an automated trading system can easily cope with the scope of several orders greater. *Second*, automated trading systems monitor the dynamics of stock exchange assets the same way as men, but with academic accuracy. *Third*, automated trading systems have their individual strengths: they, for example, don't need a license for controlling assets. A license is needed only to those organizations that accept (accumulate) funds of clients for controlling. Automated trading systems do not accept funds of clients. They control them on accounts of the clients themselves, and these accounts may be opened by investors involving different stock brokers. *Fourth*, automated trading systems enable to simultaneously conduct exchange operations on several stock exchanges. Use of automated trading systems in exchange industry provides clear benefits to companies-developers. However, equity analysts will probably be the first victims of trade robots. Their major goal is to encourage public investors to make as many transactions with stock exchange assets as possible. Here, they don't assume any responsibility for their forecasts [VIII].

Use of automated trading systems has a number of advantages and disadvantages in comparison to the use of classic independent procedure for conducting trading operations in the market [IV, IX, XVII].

The key advantages of using automated trading systems are as follows:

1. *Strict compliance with the specified algorithm, with no human factor involved.* "Human factor" first implies impact of emotions, unhealthy physical and

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moral state, frame of trade expert's mind, which can negatively affect making trading decisions and carrying out operations in the market. Emotions may result in making serious mistakes and force a man to deviate from its own strategy that leads to extremely negative consequences. Pursuit of profit, making premature decisions for opening a transaction, and unwillingness to close current red ink operation, an increased level of trading activity, taking wrong actions due to rumors, and many other activities may crucially change positions of a trade expert in the market. If automated trading is underway, there is no any effect of emotions experienced by an operator of the utilized automated trading system as well as his frame of mind and other factors inherent in a human being, on the effectiveness of the latter. It allows to consistently and properly conduct operations.

2. *Potential implementation of the own unique strategy within automated trading system.* Automated trading systems are created based on a certain algorithm of actions, i.e. on the basis of some trading strategy. Trade experts with many years' experience worked out their own trading strategy explored in all aspects and elaborated to perfection. In this case, having introduced its own thoroughly studied algorithm into automated trading system, trade expert mitigates potential unforeseen situations, since an automated trading system conducts operations in the market as if a trade expert carried out them.

3. *High speed of processing data and conducting operations.* The automated trading system speed of analyzing information and making trading decisions is substantially higher than that of a human being when trading independently. Therefore, automated trading systems respond faster and more frequently to market signals and, respectively, open more positions, and are capable of simultaneously open and close dozens of transactions.

4. *More effective control over investment portfolio.* Automated trading systems implement rather complicated algorithms of actions in the market. Many men are just not capable of understanding these schemes, and even experienced trade experts may be short of time to implement these algorithms because of their scope. An automated trading system can simultaneously process multiple signals and control over several portfolios.

5. *Potential use of many years' experience in making market transactions.* To successfully make transactions on the foreign exchange market, many years' experience, that only professionals in this area have, is required. The more a person deals with markets, the clearer situation he sees therein, the more various trading strategies and methods he can employ. Therefore, newcomers in the foreign exchange market incur significant risks of losses during initial stages due to lack of experience and failure to understand market movement. An automated trading system may address this problem, since the overall experience of professionals has already been included therein in the form of algorithm [XVIII, XXVI].

In addition to positive aspects, use of automated trading systems has certain shortcomings.

1. *Risk of technical problems to occur.* Since an automated trading system is a software that works subject to normal functioning of the respective equipment, a number of problems exist that may arise at any moment both in software, and

hardware as well. Basic problems may involve delayed quotes and trading signals, failure in stock exchange operation, Internet interruptions or computing technique failure. Therefore, controlling the system operation and preventing potential breakdowns is indispensable.

2. *Conflict of automated trading system and stock exchange terminal.* Prior to starting work, an automated trading system shall be connected to trading internet-terminal, through which trading is implemented by a person itself. Sometimes, there are conflicts within software occur that does not enable automated trading system to correctly work and make transactions in the market. There can also be errors in the process of programming the trading algorithm as such.

3. *Many fraud acts in the market of automated trading systems.* Many trade experts, mostly, newcomers, which are only getting acquainted with automated trading and do not know about many aspects of this work, buy automated trading systems on suspicious websites, where misleading trading statistics and false information about the product are presented. Buying this product, a man usually acquires a wrong thing not stated by a seller, and just wastes his own money on software that will cause losses instead of earning income, up to a total loss of initial investments [X].

Trade expert can purchase a ready-for-use system or order a system on the basis of his own strategy. In any case, he makes a decision, according to his demands, style of trading, and financial capabilities. Effectiveness indices are those objective parameters, which can serve as a reference when selecting an automated trading system. Competition facilitates compliance of automated trading systems with the specified parameters of effectiveness with a certain degree of probability. There will always be an imbalance between actual and specified indices, since automated systems are tested (and effectiveness parameters are specified based thereupon) using history data, and real conditions never fully reproduce the past, and this is the case in conditions of fair competition, in addition to which there is a risk of unfair competition and just fraud acts [XVI].

At times, in various periodicals there are ratings of companies-developers of automated trading systems and particular models of automated trading systems, for instance, Forex Expert Advisors, Best forex robots, Review forex robots, which enable trade experts to have a reference in the market of automated trading systems, when selecting and purchasing thereof[XIII, XII, XX, XXI, XI]. However, it is not always clear here, what criteria were used for compiling these ratings. Usually, few indices are used to make a rating, which in either way reflect effectiveness of trading systems, but do not take into account many peculiarities of e-trading.

The presented in paper [V] methodology of compiling rating enables trade experts to compute on their own a rating of models of automated systems to make decisions on purchasing. When making a rating, it is suggested in this paper to use a total index of effectiveness, computed according to the rated specific parameters (indices) of effectiveness on the basis of additive models, and a relevant correlation relationship between ranks of automated systems in terms of effectiveness and price [XV] has been proved based on Spearman coefficient. Therefore, when choosing an automated trading system, foreign exchange market participants may use ratings of

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their effectiveness or price ratings, since there is a statistically significant and proved positive correlation relationship between them. It should be noted that computation of the total index of effectiveness is also of interest to identify competitiveness of certain automated trading systems that, in its turn, may be used both by trade experts, and companies-developers to determine competitiveness of their developments and developments of other market players.

Thus, a search for prospective tools, markets, and an automated trading system is a rather labour-intense process, which involves not only estimation of effectiveness, but evaluation of economic effectiveness of using an automated trading system as well.

Economic Effectiveness of Automated Trading Systems

Prior to creating his own or purchasing a ready-made automated trading system, a trade expert shall answer to the questions: how profitable will the use of a particular automated trading system be, and will it be profitable at all? Will investments in purchasing and servicing an automated trading system be repaid? I.e., it is necessary to identify an economic effectiveness of using an automated trading system, and *the major challenge lies in choosing a method for estimation.*

Generally, effectiveness is defined as an effect-to-costs ratio. When using an automated trading system: costs include aggregate costs for purchasing, installing, and configuring, maintenance and support, and expenses related to downtime during technical maintenance or troubleshooting, effect implies an effect resulting from using an automated trading system. However, due to specific nature of employing automated trading systems and constant instability of work environment (currency market), where they are used, it is difficult to determine a direct effect arising from their use (in terms of time and financial indices). Since an automated trading system is full-fledged software, this work justifies an appropriateness of using methods employed to estimate effectiveness of information technologies [II, VII, III, XVII, XXIII].

The main methods used to estimate economic effectiveness of software and information systems are as follows:

1. *Cost-based methods.* Estimation is made on the basis of resources consumed as against measuring end-product or result;
2. *Methods of estimating a direct result.* A direct measurable result is estimated. For example, a decrease in ownership costs, an increase in the system functionality, reduction in labor input.
3. *Methods based on estimating ideality of a process.* These methods use statistical or dynamic comparative algorithms. An object of the system in question is chosen as a basic parameter. Then, an information system with cost parameters best within a sector per unit of output is considered ideal. A comparison can also be made with the alternative solution.
4. *Qualimetric methods.* Such methods consider information system in its entirety, arrange for measuring it and process the obtained results by statistical, sociological, and expert methods [VII].

Each group of methods shall be analyzed and the one shall then be chosen that is more suitable to estimation of effectiveness of such a specific software as an automated trading system.

The first group of cost-based methods for estimating effectiveness contains such rather simple and easy-to-understand methods as:

- *Boiler method* is based on determining the ratio of volumes of investments in software including introduction and maintenance, enterprise sizes, and business lines;

- *Function point method*. This method implies approximate assessment of costs for creating and introducing information system depending on a user's requirements. Each such requirement is estimated both in terms of complexity, and importance for a user. The requirements are presented in the form of vector (function point) in multi-dimensional space. Then, pursuant to the hypothesis of "compactness", it is supposed that the closer function points of the projects are to each other in the area of requirements, the more similar are their parameters, including effectiveness as well. Respectively, one system shall be found in the database of the previously used systems, which function point is the closest to the examined software, and it is supposed that their effectiveness indices are close as much as possible.

- *Total cost of ownership (TCO)*. This method implies quantitative estimation of costs for introduction and maintenance of software [XVII]. TCO model allows understanding the structure of expenses related to information system and offers wide perspectives to reduce them; also facilitates identification of current problems, and ensures constant feedback on controlling expenses.

An analysis of cost-based methods showed that they are not suitable to estimate effectiveness of automated trading systems. The main expenditure items may be defined, which are related to creating and maintaining an automated trading system, namely: cost of purchase or cost of services of the automated trading system developer, remote server hosting for continuous work, payment for work of software expert, providing maintenance services on automated trading system. Here, automated trading systems require for implementing their algorithm that money deposit should always be available, which also implies certain expenses for end user. It should be noted that costs for creating various automated trading systems may be almost equivalent; however, amounts of deposits, likewise amounts of losses and profits, will substantially differ. Furthermore, an end effect from using an automated trading system often cannot be accurately predicted, since unforeseen situations may occur both in terms of software code (errors, failures), and market or trading tools, used by an automated trading system. The main obstacle to the use of these methods is that, usually, most automated trading systems cover the expenses incurred for their development and operation, and, hence, almost all examined automated trading systems will be more or less economically viable. Trade expert first needs not to reimburse expenses but to receive a profit from using an automated trading system that is higher than he receives from manual trading at the current moment. Thus, the use of cost-based methods will not allow to obtain parameters suitable to estimate

effectiveness of an automated trading system, but will only provide false data, unpractical and highly risky to be relied upon.

Methods of the process ideality are based on comparing the results of using software with already existing satisfactory (ideal) examples. It is supposed that the closer ideal examples are, the higher effectiveness of the new software is. However, there cannot be an ideal trading system when working in the foreign exchange market. All automated trading systems have their advantages and disadvantages. One trading system works better at some specific time and using certain trading tools, however, in a month, a week, or tomorrow a completely different one will work better. There is no definitely the best trading system in this trading line, therefore, it is impossible both to objectively compare some specific automated trading system, and to employ the group of methods that are based on ideality of a process, for estimating effectiveness of automated trading systems.

As far as *qualimetric methods* are concerned, they are mostly designed to analyze office software within a certain company. The use of automated trading system is mostly private, and qualimetric methods will not help in defining effectiveness of trading system.

Now, the remaining group of the *methods for estimating a direct result* shall be considered. *EVS estimation* shall be singled out from multiple methods of this group. *Economic value source* is an estimation of benefit brought by software when used, made by the four parameters: an increase in income, growth in labour productivity, reduction of in-service time, minimization of risks. This method cannot be said to be absolutely suitable to obtain an objective and accurate estimation of effectiveness of using an automated trading system. The four basic parameters, employed for estimation, will be taken from this method, after replacement of some of them with more adequate ones to estimate effectiveness in the foreign exchange market, since this study analyzes not an enterprise, but a trade expert, a person who directly receives an income from using an automated trading system.

Since when computing economic effectiveness of automated trading system, it is impossible to directly associate expenses with the end result, EVS estimation method shall be used to determine the benefit that an automated trading system brings to a trade expert in comparison to that received while trading manually, within one period of time and one trading strategy. *Conclusions on economic effectiveness of an automated trading system can be made by the following parameters obtained when comparing ATS trading and manual trading by trade expert:*

1. *An increase in trade expert's income;*
2. *An increase in the number of transactions made;*
3. *Speeding up trading process;*
4. *Reduction of risks.*

Thus, to determine economic effectiveness of an automated trading system, its results shall be considered as compared with those results that were obtained by a trade expert prior to introduction and involvement of ATS into its activities. After analyzing trading of trade expert and ATS, indices of effectiveness taken from the

EVS method of estimating a direct result may be calculated, and a final conclusion can be made about economic effectiveness of the automated trading system as such.

III. Results and Discussion

To determine indices of economic effectiveness using EVS estimation method, a comparison was made between trading results of a trade expert and an automated trading system. To obtain the most accurate results, a comparison was made according to the results of simultaneous trading.

Statistical results of comparing trading results of a trade expert and an automated trading system.

Conditions of carrying out an analysis:

- Trading results were analyzed according to the reports on making transactions within 4 months from 01.01.2018 to 30.04.2018. The report contains the following information on each transaction carried out: type of transaction (purchase/sale), date of opening transaction, date of closing transaction, opening transaction price, and closing transaction price.
- Trading of both ATS and trade expert was conducted as per one trading strategy within 4 months from 01.01.2018 to 30.04.2018.
- Work of ATS was continuous with no corrections while trading; work of trade expert was underway normally.
- Trading strategy used in this analysis is based on making transactions by Stochastic Oscillator and Parabolic SAR signals, and on a bounce from support and resistance levels. When there is a drawdown, an algebraic averaging of positions is made. P. Scalp automated trading system was employed in the study.
- Trade expert involved in the research study has 7 years' experience and has a monthly result of not less than 15% profit from starting deposit.
- Computations were made in US dollars.
- Starting deposit is \$10000.

In analyzing, the following basic effectiveness indices were used, calculated by many broker companies-developers to analyze work of trading strategies and automated trading systems:

- a) Average profitability per month is computed as a ratio between monthly profit and starting deposit (amount of initial investments)
- b) Maximum Intraday Draw Down(MIDD) index reflects maximum value of a decline in deposit over the entire period of testing trading system;
- c) Number of transactions made within the period in question;
- d) Profitable transactions: a ratio between the number of all profitable transactions and total number of transactions;
- e) Number of continuous losses/profits shows the longest sequence of profitable/unprofitable transactions over the entire period;
- f) Profit-factor is a basic criterion for estimating effectiveness of trading system. It is computed as a ratio between profit amount in all profitable transactions and losses amount in all unprofitable transactions; this index should be more than 1, since only in this case trading system is profitable.

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g) Average loss/profit shows an average profitability/loss ratio in US dollars of one transaction;

h) Total profit over the reporting period.

Comparison between trading results of a trade expert and ATS is presented in Table 1. According to trading history data, trading of ATS is more stable and frequent than that of a trade expert.

The following conclusions can be made based on the obtained data.

Average monthly profitability of trade expert is higher than that of ATS (17% against 8.5%), however, the total profit over the reporting period of ATS substantially exceeds profit earned by a trade expert (85.6% of ATS against 69.4% of trade expert). Such result may be explained as follows. First, trading system made more transactions than trade expert, not least because an automated trading system works with no interruptions for eating and sleeping. A human being is just not able to afford it physically. Over the entire research period ATS made 97 transactions, while a trade expert made only 66 ones. Here, ATS has 91% of profitable transactions of the total number, while a trade expert closed positions with profit in 74% of cases. Second, attention should be paid to profit-factor, the basic index of trading. According to the results of trade expert trading results it is seen that there are 3 acquired dollars per each lost one, while almost 15 dollars are acquired by ATS per each lost dollar. Here, a human factor, emotions of a trader are probably of importance, since even an experienced trader is not always able to act strictly within the elaborated strategy, to timely stop trading, not to enter the market in unfavorable conditions.

Comparison of the other parameters is as follows:

- Number of continuous ATS profits is 30. It exceeds 9, the number of consecutive profitable trade expert transactions.

- Maximum drawdown, i.e. maximum intraday ATS drawdown didn't exceed 7% of deposit, since an algorithm included in software will not just allow a higher drawdown. While trading manually, in case of deviating from the strategy a drawdown can reach any limits, up to destroying investments. In this case, a trade expert allowed a maximum 14% drawdown of deposit, which is a failure to comply with a trading strategy, although not very serious.

- Average ATS loss is a little higher than that of a trade expert. At the same time, both these trader's indices (average profit is \$211.7; average loss is \$214.5) exceed almost twice ATS indices (average profit is \$100.9; average loss is \$123.5), that demonstrates riskier trading of a trade expert.

Table 1: Trading indices of trade expert and automated trading system

No.	Trading indices	Trade expert	Automated trading system
1	Average profitability per month (% of deposit)	17	8.5
2	Maximum drawdown (% of deposit)	14	7

3	Total number of transactions	66	97
4	Profitable transactions (% of all transactions)	74	91
5	Number of continuous profits	9	30
6	Number of continuous losses	2	1
7	Profit-factor	3.02	14.87
8	Average profit (\$)	211.7	100.9
9	Average loss (\$)	214.5	123.5
10	Total profit (% to deposit)	69.4	85.6

Thus, after analyzing the final results of trading, it can be seen that ATS makes more transactions than a man, closing most of them with profit and incurring minimum losses. Even despite a higher profitability of each operation of a trade expert, an automated trading system is in advance in terms of the total profit, because trading of a trade expert is riskier, and he suffers more losses than ATS.

Here, it should be understood that an automated trading system is profitable right in conditions of the existing market and current settings of the algorithm. It is impossible to say if a trading system is also profitable in a year, and will it be profitable at all. Therefore, ATSS shall be verified and revised when minor deviations take place [XXIII].

Computing Parameters of Economic Effectiveness of Using an Automated Trading System According to EVS Estimation Method

Comparison between operations made by a trade expert and an automated trading system demonstrates a clear predominance of algorithmic trading over a manual one. Then, the effectiveness indices shall be calculated using a method based on EVS estimation method. As it has already been stated previously, economic effectiveness of ATS can be determined only as compared with the similar trading implemented manually:

1. Index of automated trading system profitability:

$$Ip = \frac{\text{Total profit of automated trading system}}{\text{Total profit of trader}},$$

$$Ip = \frac{\$ 8564}{\$ 6941} = 1.23.$$

This index shows, how many times ATS trading results are more profitable or unprofitable as compared with the results of a trade expert trading. Here, when using ATS instead of manual trading, a trade expert increases his profit by 23%.

2. Quantitative index:

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$$Iq = \frac{\text{Number of ATS transactions}}{\text{Number of trader transactions}},$$

$$Iq = \frac{97}{65} = 1.49.$$

These index shows, how many times the number of transactions made by ATS differs from the number of transactions made by a trade expert. Here, a trade expert would make 1.5 times more transactions using ATS than manually.

3. Time index

These index shows, how much time a trade expert would save, using ATS. His profit amounted to \$ 6941, which he received over 4 months of almost everyday trading. If ATS made transactions instead of him in the market, he would receive this profit 19 days earlier on 11.04.2018, rather than on 30.04.2018.

4. Risk index

Level of risk of trading shall be estimated using by the magnitude of mean-square deviation of the transaction profitability value:

$$\sigma = \frac{\sqrt{\sum_{i=1}^n (x - \bar{x})^2}}{n - 1},$$

where: x – sampling element,

\bar{x} – average value of sampling,

n – number of sampling elements.

Thus, the following is obtained:

$\sigma_{ATS} = \$ 77,4$ – mean square deviation of transaction value

of ATS,

$\sigma_{tr.} = \$ 231,12$ mean square deviation of trader's transaction value.

It can be seen that trader's deviation index is almost 3 times higher than that of ATS that demonstrates a riskier nature of human trading.

To more accurately determine effectiveness of ATS, Sharpe coefficient shall be computed based on the obtained mean-square deviation value. *Sharpe coefficient is intended* to assess reliability of trading strategy and risk level of investments in a particular project [XV]. A universal method for estimating effectiveness of various trading systems involves a ratio between the obtained profit and risk within each specific trading strategy. It is the Sharpe coefficient that reflects a ratio between these two indices. The higher the ratio between them, the more efficient analyzed trading system is. To compute this coefficient, the following formula is used:

$$K_{Sha} = \frac{r_x - R_f}{\sigma},$$

where: r_x – average transaction return on asset R_f – risk-free income (is 0 on FOREX),

σ – standard deviation r_x .

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Numerator of the formula is a value of average profit received by a trade expert within one trading period (month, year). FOREX market always implies investments with high risk, hence, risk-free profitability here equals to zero. Nominator of the coefficient shows a risk: mean square deviation from the value of average profitability. Risk is usually compared with the index of volatility of certain movement in price of some financial asset in the market. And, the higher volatility of this financial asset is, the higher risk is, and vice versa. When Sharpe coefficient is lower than zero, ATS or financial asset are less efficient, than financial investments in risk-free assets (equals to 0 in FOREX market); and estimation of this automated trading system will be negative, its use will be inefficient. If Sharpe coefficient is 1 or more, it demonstrates positive effectiveness. However, according to recommendations of the formula author, an optimum value of Sharpe coefficient should be about 2. There are very good values of more than 2, however, they are very rare in FOREX market.

The Sharpe coefficient is computed by most traders to analyze effectiveness of their own trading systems and strategies. For the sake of computations' simplicity, profitability and deviation shall be expressed in percentage terms. Then, the following shall be obtained:

$$K_{Sharp\ ATS} = \frac{88 - 0}{77.4} = 1.14,$$
$$K_{Sharp\ tr.} = \frac{107 - 0}{231.12} = 0.46.$$

The results of computations show that ATS trading is efficient, and risks while trading are low. As regards a trade expert, according to Sharpe coefficient his trading is risky, and he achieves high results only due to experience gained and in-depth knowledge of foreign exchange market.

Computations have shown that the use of ATS is economically viable in terms of all indices of EVS estimation method: profitability of ATS is higher by 23%; an automated trading system made 1.5 times more transactions as compared with those made by a trade expert; an automated trading system reached the same profit level as that of a trade expert, 19 days earlier; use of ATS reduces risks of losing money more than twice.

Thus, it can be deduced that in conditions of stable foreign exchange market automated trading systems have a great advantage over manual trading, and are considered practical and economically efficient to be used by the principal participants of the market in terms of all the basic parameters. *The practical value of the carried out study* lies in justifying an appropriateness of using parameters suggested in the paper to evaluate economic effectiveness of automated trading systems within Economic value source estimation method.

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