



OSCILLATOR STRATEGIES APPLICATION IN STOCK MOVEMENT PREDICTION ON THE RUSSIAN FINANCIAL MARKET: EFFICIENCY ISSUES

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ABSTRACT

Background: Technical analysis is one of the most frequently used by traders instruments. However, many of its elements (in particular oscillators) may show varying efficiency depending on the particular markets characteristics. Therefore, taking into account the distinctive features of the Russian stock market, it is reasonable to examine which oscillators can be effectively applied on it. **Objective:** The purpose of the study is to analyze the effectiveness of technical analysis indicators for forecasting shares of the Russian stock market and to develop the most effective trading strategy combining various oscillators. **Methods:** In order to achieve this, the selection of stocks suitable for testing and technical analysis indicators representing various groups is carried out. The accuracy and the total number of signals act as criteria for the indicators effectiveness, while accuracy is given the main attention. The interval from mid-2020 to mid-2021 is used for testing. **Results:** Based on the results obtained, the indicators are divided into efficiency groups; recommendations for the application of each oscillator are given. The result of the study is the development of the most effective strategies for the usage of technical analysis indicators that have passed the test. The strengths and weaknesses of each formed strategy are highlighted. **Conclusion:** The novelty of the research lies in obtaining the results of comparing the different types of technical analysis indicators effectiveness in the modern conditions of the Russian stock market and in building optimal strategies for their application.

Keywords: Investments; Technical analysis; Russian stock market; Liquidity; Active trading; Trading strategies.



APLICAÇÃO DE ESTRATÉGIAS OSCILATÓRIAS NA PREVISÃO DO MOVIMENTO DE EXISTÊNCIAS NO MERCADO FINANCEIRO RUSSO: QUESTÕES DE EFICIÊNCIA

RESUMO

Antecedentes: A análise técnica é um dos instrumentos mais utilizados pelos traders. No entanto, muitos de seus elementos (em particular osciladores) podem apresentar eficiência variável dependendo das características particulares dos mercados. Portanto, levando em consideração as características distintivas do mercado de ações russo, é razoável examinar quais osciladores podem ser efetivamente aplicados nele. **Objetivo:** O objetivo do estudo é analisar a eficácia dos indicadores de análise técnica para prever ações do mercado de ações russo e desenvolver a estratégia de negociação mais eficaz combinando vários osciladores. **Métodos:** Para isso, é realizada a seleção de ações adequadas para teste e análise técnica de indicadores representativos de vários grupos. A precisão e o número total de sinais atuam como critérios para a eficácia dos indicadores, enquanto a precisão recebe a atenção principal. O intervalo de meados de 2020 a meados de 2021 é usado para testes. **Resultados:** Com base nos resultados obtidos, os indicadores são divididos em grupos de eficiência; recomendações para a aplicação de cada oscilador são fornecidas. O resultado do estudo é o desenvolvimento das estratégias mais eficazes para a utilização dos indicadores de análise técnica aprovados no teste. Os pontos fortes e fracos de cada estratégia formada são destacados. **Conclusão:** A novidade da pesquisa está em obter os resultados da comparação dos diferentes tipos de indicadores de análise técnica de eficácia nas condições modernas do mercado de ações russo e na construção de estratégias ótimas para sua aplicação.

Palavras-chave: Investimentos; Análise técnica; Mercado de ações russo; Liquidez; Negociação activa; Estratégias de negociação.

1 INTRODUCTION

At the present world economy development stage the stock market is one of the key elements that ensure the capital redistribution and provide companies with access to the funds necessary to ensure their activities. Nevertheless, despite stock market importance for the harmonious functioning of the economy, not every country managed to develop it sufficiently, so it can effectively perform its functions. Thus, the Russian market is significantly inferior both in terms of trading volumes and in terms of capitalization to the markets of most Western countries. In addition, it has a wide range of problems that slow down its development rate and scare off potential investors.

Among the list of problems, one can highlight low capitalization and its uneven distribution between industries. There is also high volatility and excessively high risk levels (Saibel' & Koval'chuk, 2018). These problems negatively affect investment attractiveness, discouraging the flow of new investment funds.

Not least is the problem of low liquidity. This problem is also largely exacerbated by



the uneven distribution of trading volumes, which leads to the fact that some of the industries are almost completely illiquid.

Another important aspect is the predictability of the market. The Russian stock market differs in many ways from the markets of Western countries. For this reason, the use of classical techniques shows poor results (Lavrenova & Ilina, 2020).

In addition, one can highlight the lack of interest in the market on the part of many investors and issuers. It also negatively affects market efficiency and leads to significant distortions observed in the Russian stock market (Vorobyov, 2017).

All of the above problems significantly change the market conditions and lead to a situation where a significant proportion of the tools and indicators used for its analysis lose their accuracy and efficiency. This, in turn, creates additional risks that are not offset by higher expected returns and discourage new investors and speculators. As a result, both the demand for capital from long-term investors and liquidity are reduced due to the outflow of speculators. In such a situation, entering the market loses its attractiveness for many issuers.

One of the ways to solve the problem described above is to examine the real effectiveness of different types of indicators on the Russian market and to compile strategy templates that allow combining indicators in order to improve the market analysis methods efficiency. As a result, it will be possible to separate the oscillators that can be effectively applied on the Russian stock market from their general aggregate and create models of their usage.

In this study, we conducted a comparative analysis of individual technical analysis oscillators in terms of their effectiveness and developed trading strategies based on a combination of indicators that showed the greatest efficiency. Also, based on the study, a list of general recommendations for the technical analysis application on the Russian stock market was compiled. The aim of the research is to find out which of the oscillators and their types are the most effective when applied on the Russian stock market, to create strategies of their applications and to make recommendations for traders who want to enter the Russian stock market.

2 METHODS

Most active trading strategies combine the use of various technical analysis oscillators. However, in order for trading strategies to be profitable, it is necessary that the indicators work effectively in the market for which this strategy is created.



The most important parameter that determines oscillators effectiveness is the accuracy of its signals. At the same time, to calculate the accuracy, it is logical to take the ratio of correct signals to their total number. However, in addition to accuracy, the amount of signals is also an important parameter, since an oscillator that delivers 1-2 signals per year cannot be called effective, regardless of its accuracy. For this reason, it is necessary to evaluate performance based on these two parameters. Therefore, in order to assess the effectiveness of different oscillator groups on the Russian market, we have tested oscillators from these groups on stocks traded on the Moscow Exchange.

During our research we used data on stocks obtained from the official websites of the Moscow Stock Exchange (n.d.) and the Investment Company “FINAM” (n.d.). All graphs were analyzed using TradingView platform (TradingView, n.d.).

According to the issuers by sector classifier, there are 12 sectors in which companies have placed their stocks on the Moscow Exchange. However, since most oscillators require a sufficient liquidity level to operate, we tested oscillators only on three industries with the highest trading volumes: oil and gas, financial, metallurgy. It should be noted that although these industries are the most liquid on the Russian market, this does not mean that all instruments related to them are as liquid. Because of this, the first step will be to conduct an initial stock selection based on average weekly trading volumes.

For this purpose, we have calculated this indicator for a three-year period. For each industry, the geometric mean was calculated (in the previous study, the greatest efficiency of this average was proved when analyzing the liquidity of the Russian market (Tolkachev & Kotov, 2021). Stocks with trading volumes below the geometric mean were excluded from each group. This process is presented in Table 1.



Table 1. The initial stock selection

Oil and Gas sector		Metals and Mining sector		Financial sector	
Ticker	Volume, ths. rub.	Ticker	Volume, ths. rub.	Ticker	Volume, ths. rub.
GAZP	31 416 075	GMKN	14 721 584	SBER	58 992 415
LKOH	21 682 953	ALRS	5 762 979	VTBR	5 278 784
ROSN	9 886 836	CHMF	3 906 885	SBERP	5 094 691
TATN	6 320 583	PLZL	3 269 037	MOEX	4 422 588
SNGS	5 498 799	NLMK	3 116 045	CBOM	431 523
NVTK	4 746 241	MAGN	2 355 987	SFIN	279 062
SNGSP	4 223 937	POLY	1 627 918	RGSS	163 943
TRNFP	1 479 232	RUAL	905 693	QIWI	95 852
TATNP	1 299 876	RASP	778 194	BSPB	56 229
BANEP	514 765	MTLR	716 411	INGR	5 063
RNFT	148 311	TRMK	381 801	-	-
KRKNP	31 098	MTLRP	306 966	-	-
KBTK	14 934	VSMO	32 956	-	-
MFGSP	2 036	SELG	16 688	-	-
-	-	ROLO	12 775	-	-
-	-	LNZL	11 097	-	-
-	-	AMEZ	7 512	-	-
-	-	SELGP	7 068	-	-
-	-	LNZLP	4 397	-	-
-	-	BRZL	3 843	-	-
-	-	CHMK	3 295	-	-
-	-	UNKL	1 807	-	-
Geometric mean	969 838	Geometric mean	144 302	Geometric mean	572 469

The initial selection made it possible to reduce the list of analyzed stocks, leaving 9 stocks of oil and gas companies, 12 - metallurgical and 4 - financial. On these instruments, we further tested the effectiveness of individual technical analysis oscillators.

Since it is impossible to check all existing technical analysis indicators, the most significant oscillators from their groups were selected. These groups are:

- moving averages;
- overbought/oversold levels oscillators;
- trend strength and market speed oscillators;
- volume oscillators;
- volatility oscillators.

The first group includes different variations of simple and exponential moving averages. The most common and convenient oscillator based on the moving averages is the MACD (Moving Average Convergence Divergence). For this reason, we chose it for testing.

The next group is overbought / oversold indicators. Here you can find a large number



of oscillators that assess the buyers and sellers strength in the market. To calculate these oscillators, the extreme minimum and maximum values, as well as the closing prices, are used. Also, some indicators of this group use moving averages in their formulas. The most common oscillators in this group are Stochastic, W%R (Williams Percent Range) and RSI (Relative Strength Index). At the same time, the Stochastic and the Williams Percent Range are almost identical, so it makes no sense to test both of them. Thus, from this group, we tested the W%R and the RSI.

The indicator that stands out from this group is Connor's RSI. It has significantly higher sensitivity and extremely high signal frequency. Taking into account its peculiarities, it made sense to test it too in order to understand whether it outperforms the standard overbought / oversold indicators.

Another group of oscillators is formed by indicators that measure the trend strength and the price change rate. They are simpler in terms of formulas and calculations than previous groups. These indicators measure the ratio of the current price and closing prices, or their changes. We considered Momentum as the best representative of this group.

Volume indicators should also be noted. To predict trend changes, this group uses not the instrument price, but the transactions volume as a basis for calculations. The most famous oscillator of this type is the Volume Oscillator.

The last group is volatility oscillators. These indicators are used to measure the volatility levels and to place the stop signals. They can't be used to determine the trend reversals. Therefore, this group of indicators did not participate in this study.

Then, all of the indicators above were tested on selected stocks. Testing took place in the interval from mid-2020 to mid-2021 with a candlestick interval of one day.

Let's see how the signals were counted using the example of several oscillators. This process is illustrated in Figures 1, 2.

Figure 1 shows an example of the Williams Percent Range application. Signals of this oscillator are entry or exit from 20% overbought/oversold zones and divergence. When using it opening signals occur when leaving the lower 20% of the zone (long) or the upper 20% of the zone (short). A return to the zone is a signal to close the position; therefore, we counted the full path from the entry point to the exit point as one signal. Also, when working with such an oscillator, the reliability of the signal is usually checked by the first candlestick after touching the edge of the zone, so an entry/exit not confirmed by such a candlestick will not be considered as a signal.





Figure 1. The example of Williams Percent Range application

In Figure 1, the oscillator gave 7 signals: 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8. Of these, 1-2, 2-3, 4-5, 7-8 are correct, 3-4, 5-6, 6-7 are wrong. At the same time, we consider the correct signals to be those that allow the trader to make a profit, and the wrong ones - a loss, or a zero result (entry with a sideways movement).

A number of other oscillators that we have considered worked in a similar way. So, the use of RSI is completely identical to the Williams Percent Range, the only difference in RSI application is the increase in the extreme zones from 20 to 30%. When using it, you should also rely on two types of signals: divergences and exits from extreme zones. To test the entry/exit signal, the rule of one additional candle is used again.

CRSI, like the previous indicators, also works on the principle of extreme zones and divergence. Its key difference is the opposite application of the lower and upper zones. Exit to the lower zone is a signal to sell, to the upper one - to buy. Given the extremely high frequency of signal changes, the fact of leaving the central zone without returning back itself is considered as a signal.

The use and depiction of the MACD is different from the indicators discussed earlier. Therefore, let's consider its application (Figure 2).



Figure 2. The example of MACD application

As you can see, this oscillator is represented by two lines and a histogram. Signals here are the intersection of lines (coincides with the zero value on the histogram) and divergence. At the same time, the convergence of the histogram from the bottom to the zero mark is a signal to buy, from the top - to sell.

As with the other oscillators, only a significant intersection is considered as a signal, i.e. sufficient deviation of the histogram from the center. Only those signals are considered correct, having reacted to which the trader could make a profit. So in Figure 2 the correct signals are 1-2, 3-4, 4-5, 8-9.

We should also consider the process of usage Momentum and Volume OSC. These indicators have significantly different calculation formulas and the theories underlying them, but their representation is highly similar. Both of them are depicted as a central straight line and a curve that can cross this straight line upside down and vice versa. Their signals are also quite similar. In both cases divergences and passages of the curve through the central straight line are the main signals. When the curve passes the central line, movement from bottom to top is a signal to buy, from top to bottom – to sell. Also, with both oscillators, you can build trends along the tops of the indicator line. Momentum, however, has additional signals in the form of overbought/oversold zones. However, there is no such consistency as in the case of oscillators tailored for these zones, therefore, overbought/oversold is determined on the basis of moving away from the center to the level at which a given stock has a reversal according to historical data.

Thus, in further research, we used the methods above to identify true and false signals.

3 RESULTS

Utilizing the methods described earlier, the accuracy of the oscillators application on the Russian stock market was evaluated. For this purpose, on the interval from mid-2020 to mid-2021, all signals issued by oscillators were considered in one-day intervals. The signals were considered on all the stocks that passed the initial selection of suitability, and were divided by sector. Only those signals that would enable a trader to make a profit by catching at least half of the movement were considered correct, results close to zero, opening a position with a sideways movement and unprofitable transactions were considered mistakes.

Tables 2-7 present the results of oscillators accuracy analysis that we received during their testing on the Moscow Exchange. For each of the industries total and average per stock amount of signals is presented. The accuracy is calculated by dividing the number of correct signals by their total amount.

Table 2. The evaluation of the Williams Percent Range accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	203	141	22,6	15,7	69,46%
Financial	87	61	21,8	15,2	70,11%
Metals and Mining	252	157	21,0	13,1	62,30%
Total	542	359	21,7	14,4	66,24%

Table 2 shows results of the Williams Percent Range accuracy evaluation. It can be noted that a trading model based on its usage without taking into account other analysis tools will produce quite a large number of errors. It is also worth paying attention to the fact that its effectiveness significantly varies between sectors. Thus, in the Metals and Mining sector, a significant part of which is made up of the least liquid instruments from those that have passed the primary selection, the lowest accuracy is observed. In general, the average accuracy of the oscillator allows it to be used on the Russian stock market, provided that additional technical analysis tools are applied.

Table 3. The evaluation of the Momentum accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	161	95	17,9	10,6	59,01%
Financial	80	43	20,0	10,8	53,75%
Metals and Mining	221	120	18,4	10,0	54,30%
Total	262	258	18,5	10,3	55,84%

Let's consider the results of the Momentum oscillator accuracy analysis shown in Table 3. Compared with the previous one, its accuracy is significantly lower and only slightly exceeds 50%. The number of signals we received is also lower than that of the W%R. In general, its effectiveness in individual usage is quite low, but it can be applied as a part of a trading strategy, although it does not have particular practicality.

Table 4. The evaluation of the Volume Oscillator accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	374	194	41,6	21,6	51,87%
Financial	154	76	38,5	19,0	49,35%
Metals and Mining	482	248	40,2	20,7	51,45%
Total	1010	518	40,4	20,7	51,29%

Let's move on to the Volume Oscillator accuracy evaluation in Table 4. Of the three considered, it has the least accuracy. At the same time, this indicator gives a really large number of signals, twice as much as the amount obtained when using the previously considered technical indicators. However, too many errors generated by the Volume Oscillator leads to the fact that its application in trading strategies cannot allow traders to achieve an acceptable accuracy level.

Table 5. The evaluation of the MACD accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	163	122	18,1	13,6	74,85%
Financial	64	46	16,0	11,5	71,88%
Metals and Mining	183	125	15,3	10,4	68,31%
Total	410	293	16,4	11,7	71,46%

Next, we checked the MACD (Table 5). Among all the oscillators considered at the moment, it has the highest accuracy (71.46% on average). At the same time, certain fluctuations in the accuracy level between various sectors can be noticed, as well as the fact that the Metals and Mining sector again has the largest percentage of errors. The main disadvantage of the MACD lies in a smaller number of signals, which, however, is compensated by increased accuracy. Thus, we can say that the MACD is

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the most effective of all considered indicators for application on the Russian stock market. Therefore, it should be included in the trading strategy.

Table 6. The evaluation of the CRSI accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	506	318	56,2	35,3	62,85%
Financial	260	153	65,0	38,3	58,85%
Metals and Mining	727	378	60,6	31,5	51,99%
Total	1493	849	59,7	34,0	56,87%

Now let's examine Connors RSI (CRSI) accuracy in Table 6. First of all, attention should be paid to the amount of given signals. CRSI gave significantly more signals than all the others. However, its accuracy only slightly exceeds 50% and greatly varies. For this reason, it can only be used as an additional tool when deciding whether to open or close a trading position.

Table 7. The evaluation of the RSI accuracy

Sector	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
Oil and Gas	62	42	6,9	4,7	67,74%
Financial	24	17	6,0	4,3	70,83%
Metals and Mining	69	36	5,8	3,0	52,17%
Total	155	95	6,2	3,8	61,29%

Finally, we estimated the accuracy of the RSI (Table 7). This oscillator is the third most accurate among all considered. However, its accuracy varies greatly between sectors – the spread between Metals and Mining and Financial sector is almost 20%. It is also worth noting that the number of its signals is extremely small in comparison with all the others. Therefore, it is impractical to use it as the main trading instrument.

Now, let's compare the accuracy of all the oscillators we have tested. In order to do it, we created Table 8.

Table 8. The indicators accuracy comparison

Indicator	Signals				Accuracy
	Total		Average per stock		
	All	Correct	All	Correct	
W%R	542	359	21,7	14,4	66,24%
Momentum	262	258	18,5	10,3	55,84%
Volume OSC	1010	518	40,4	20,7	51,29%
MACD	410	293	16,4	11,7	71,46%
CRSI	1493	849	59,7	34,0	56,87%
RSI	155	95	6,2	3,8	61,29%

It can be noted that most of the indicators that we tested showed low accuracy. Therefore, in order to create an effective strategy on the Russian stock market the application of additional tools is required. The MACD and the W%R show the greatest accuracy, but even they are not accurate enough to be used the only market analysis tool. The number of signals sent between different oscillators also varies significantly, as the CRCI sends signals almost 10 times more often than the RSI. However, the frequency of signals of almost all the considered indicators is sufficient for their usage in active trading.

Next, we checked how securities liquidity level affects the accuracy of the indicators. In order to do it, we discarded the least liquid securities from the already formed group. As a selection criterion, we used the geometric mean again. This process is illustrated in Table 9.

Table 9. The secondary stock selection

Ticker	Volume, ths. rub.
SBER	58 992 415
GAZP	31 416 075
LKOH	21 682 953
GMKN	14 721 584
ROSN	9 886 836
TATN	6 320 583
ALRS	5 762 979
SNGS	5 498 799
VTBR	5 278 784
SBERP	5 094 691
NVTK	4 746 241
MOEX	4 422 588
SNGSP	4 223 937
CHMF	3 906 885
PLZL	3 269 037
NLMK	3 116 045
MAGN	2 355 987
POLY	1 627 918
TRNFP	1 479 232
TATNP	1 299 876
RUAL	905 693
RASP	778 194
MTLR	716 411
TRMK	381 801
MTLRP	306 966
Geometric mean	3 527 249

The method shown above made it possible to form a more liquid set of stocks. However, for a more accurate analysis, another group should be made. Due to the significantly reduced list of securities, it makes no sense to resort to the geometric mean again. Therefore, we discarded all securities with average weekly trading volumes below 5 billion rubles (Table 10).



Table 10. The stock selection by a fixed criterion

Ticker	Volume, ths. rub.
SBER	58 992 415
GAZP	31 416 075
LKOH	21 682 953
GMKN	14 721 584
ROSN	9 886 836
TATN	6 320 583
ALRS	5 762 979
SNGS	5 498 799
VTBR	5 278 784
SBERP	5 094 691
NVTK	4 746 241
MOEX	4 422 588
SNGSP	4 223 937
CHMF	3 906 885

Thus, we managed to form three groups of stocks with different degrees of liquidity. Next, for each oscillator, we evaluated the accuracy within the formed groups. The initially formed group of stocks that passed the primary selection (Table 1) is called group "A". Groups "B" and "C" are the aggregates obtained as a result of repeated selection in Tables 9 and 10, respectively.

Table 11. Accuracy comparison by liquidity groups

Indicator	Group		
	A	B	C
W%R	66,24%	68,05%	72,81%
Momentum	55,84%	56,75%	55,68%
Volume OSC	51,29%	50,00%	52,68%
MACD	71,46%	74,06%	76,97%
CRSI	56,87%	59,66%	59,62%
RSI	61,29%	62,77%	66,18%

According to Table 11, it can be noted that liquidity has a significant impact on the accuracy of oscillators. Thus, group "C", which includes the most liquid stocks, has the highest accuracy, while "A" has the lowest. It is also important to mention that this dependence is most pronounced in the most accurate indicators. The effect of liquidity can be more clearly traced on the graph (Figure 3).

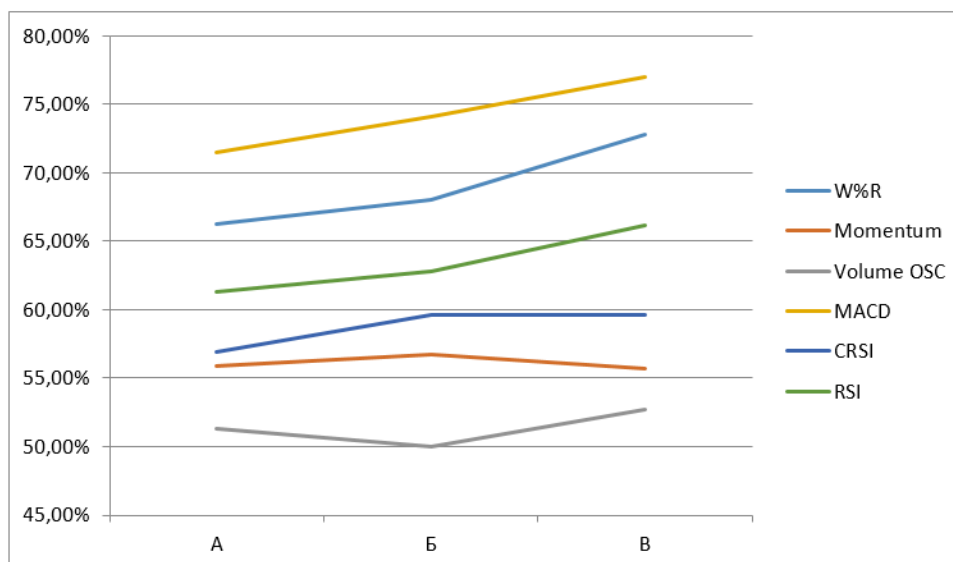


Figure 3. Accuracy comparison by liquidity groups

Based on our analysis, it can be concluded that with proper application, a significant part of oscillators can be used with a sufficient degree of efficiency. However, both the accuracy of individual indicators and the specifics of their application should be taken into account. For this reason, strategies based on combining technical analysis indicators have been developed.

For this purpose, we started by highlighting which of the analyzed indicators should be used to form a trading strategy. Therefore, we have formed several groups.

The first group includes oscillators that have sufficient accuracy and frequency of signals to use them as basic indicators. Based on the analysis, it can be concluded that this group contains the Williams Percent Range and MACD. These oscillators became the basic ones and were used in all the strategies that we formed.

The second group includes oscillators that can be used to improve the accuracy of the strategy as additional analytical tools, but the signals accuracy or frequency of which does not allow them to be used as the main means for decision-making. This includes RSI and CRSI.

The last group consists of oscillators whose efficiency is not high enough to be used in the conditions of the modern Russian stock market. Here we have included Momentum and Volume OSC.

Based on the above, we concluded that the main indicators that should be used in the trading strategies are the MACD and the Williams Percent Range, while the RSI and the CRSI can be used as additional analytical elements. Thus, we are left with four possible options, each of which we considered in more detail.

The first option is to use the MACD and the Williams Percent Range without other additional indicators. This strategy is quite simple and had already been considered earlier. Its main advantage is the fact that there is a significant difference between the MACD and the W%R, as these oscillators belong to different types. Therefore, the signal on both oscillators usually indicates high accuracy. However, the application of only two indicators cannot provide sufficient accuracy and makes this strategy not variable enough.

There is an additional opportunity to improve this strategy. It can be achieved by an application of other technical analysis elements, such as trend analysis and candlestick patterns. These elements can significantly improve its efficiency.

In fact, with proper realization, such a strategy can be highly effective. However, it is necessary to highlight a certain number of key features that should be taken into account, as well as consider the rules for its application.

Firstly, this strategy is designed for active trading, with a fairly high frequency of transactions. At the same time, you shouldn't forget that the oscillators used in it can periodically produce errors, which is why the application of such a strategy is fraught with risks and possible drawdowns of the assets amount.

Also, based on the conducted research, it can be concluded that the accuracy of the MACD and the Williams Percent Range increases significantly with increasing liquidity. Thus, it is advisable to apply this strategy on only stocks that belong to the most liquid group (group "C" in our research).

Now we should consider possible ways of applying this strategy. Let's start with detecting the change/emergence of a trend. The easiest way to achieve it is to use indicators. In this case, attention should firstly be paid to the W%R. Here a stock in the extreme 20% zone must be found. Further on, a position should be open after receiving same signals from both indicators. To increase the accuracy, it is possible to use candlestick and trend analysis. In this case, these tools can be used to find reversal patterns at the time of receiving signals from indicators, or taking into account signals only in the case of obvious breakouts of support/resistance levels or rebounds. Adding such elements will lower the frequency of receiving signals from the strategy, but will increase accuracy, which is more important, as the application of only two indicators makes the strategy highly risky.

An additional way to apply this strategy lies in finding trend continuation signals, or in using same oscillators for portfolio management. The use of trend analysis is highly important here. After the expected rebound point is detected, confirmations from the



oscillators indicate the continuation of the trend. Additional position opening is possible when moving away from the signal zones on both oscillators without reversal trends, or when rebounding on an already ongoing trend. When managing a portfolio, it is also possible to focus on such indicator signals.

Let's move on to the other trading strategies. The second strategy is in many ways similar to the first one, except for the addition of the CRSI. It is worth noting that this indicator has a significantly lower accuracy than the other two used here, but its signal frequency is much higher. Thus, its application will not affect the total number of combined signals received during the implementation of this strategy.

The rules regarding the application of this strategy are also similar to the previous one. The only difference lies in the need to receive signals from three indicators instead of two to make a decision. Given the not too high accuracy of the CRSI, its separate use without other oscillators is not recommended.

The third strategy involves using the MACD and the Williams Percent Range together with the RSI. Here it is worth noting the high similarity of the RSI and the Williams Percent Range, which leads to the duplication of their signals. Because of this, the cumulative effect of using these indicators is significantly lower than from adding MACD to them. Also, we must not forget the fact that the number of signals issued by the RSI is significantly inferior to amount received from other indicators. It makes the third strategy potentially less profitable due to a decrease in the number of open positions.

This strategy has two different implementation options. In the first case, the RSI is used the same way as CRSI in the second strategy. This approach significantly reduces the total number of opened positions, but increases the number of successful operations. The second option assumes the interchangeability of the Williams Percent Range and the RSI. In this approach, the signal must be confirmation by the MACD and one of the other two oscillators. It is important to pay attention to the fact that joint signals from the Williams Percent Range and the RSI will not be considered sufficient to perform operations without confirmation by the MACD. Other rules for opening and closing positions of this strategy coincide with the first strategy.

The last strategy is formed by four oscillators: MACD, Williams Percent Range, RSI and CRSI. Here again, we can distinguish several variations of the mutual use of these indicators. The first variant is to receive a positive signal from all four indicators at once. Given their large number together with the low frequency of RSI signals, this happens quite rarely. In addition, this requires a certain period of time, which is why the trader

may miss a significant part of the movement. Thus, such a way of using these indicators cannot be called effective.

A more logical option is to require a signal from several, but not all, oscillators. However, simply assigning the number of oscillators from which a signal is required is not the right solution. This is confirmed by the fact that all indicators have different significance based on their accuracy and frequency of signals. Therefore, it is important to highlight which combinations must be taken into account.

The most accurate indicator is the MACD. While it has not the highest signal frequency it is sufficient enough for active trading strategies. From this we can conclude that the signal on it should be a necessary element for all operation. The accuracy of the Williams Percent Range and RSI is lower and they belong to the same type. Also, the total number of RSI signals is quite low. Thus, as in the third strategy, they should be interchangeable. Also, they should be used as some kind of "starting" indicators, since in the beginning you should focus on approaching the extreme overbought/oversold zone. CRCI has the largest number of signals and changes its value extremely quickly, so adding it doesn't lead to missing a movement part. Thus, in order to perform the operation, it is necessary to receive signals from the MACD, W%R and CRCI, or from the MACD, RSI and CRSI.

This strategy, like the first one, can be improved by adding elements such as trend and candlestick analysis to it. In general, it is the most effective of all trading strategies we have considered.

4 DISCUSSION

The problems of stock market analysis are highly significant for many scientists and market professionals. Taking into account the constant changes taking place on it, the methods of its analysis also need to be changed and improved, so they can remain accurate enough in new market conditions.

The application of technical analysis is one of the most common market analysis methods. Its effectiveness has been proven by a large number of market practitioners and a wide list of conducted studies.

At the same time, there are both comprehensive studies (Han et al., 2021) and those aimed at individual stocks (Horak & Sulek, 2021). All of them confirm the effectiveness of such methods.

Research conducted by Abuselidze, Slobodianyuk and Reznik also confirms the



effectiveness of technical analysis. However, they also state a necessity to combine it with other market analysis approaches (Abuselidze et al., 2019).

Nevertheless, it is easy to notice significant differences in the indicators accuracy at different time intervals and on different securities. In addition, the conditions of individual markets can lead to the fact that some oscillators may be not accurate enough when applied on the specific markets.

It is important to know how accurate and effective technical analysis can be on emerging markets where a high degree of efficiency has not been achieved. Masry's research has shown that its application allows traders to get additional profit in such markets and the profitability of strategies which use technical analysis is higher than those with long-term retention of securities (Masry, 2017).

On the Indonesian market, which is also characterized by low efficiency, technical analysis again turns out to be one of the most suitable market analysis tools (Sulistiawan et al., 2020).

It is also possible to highlight a research that tested the moving averages application strategies on the markets of BRICS countries. It was revealed that such strategies are capable of making a profit, but there are significant deviations in profitability at different time intervals and indicators vary by their accuracy. Therefore, the question of finding the most suitable oscillators and their combinations for individual markets still remains (Souza et al., 2018).

The accuracy of technical analysis indicators was also studied by Stankovic J., Markovic I., Stojanovic. Based on the conducted research, the possibility of using a number of indicators to form a predictive model was established. The MACD and EMA indicators proved to be the most efficient (Stankovic et al., 2015).

It is a well known fact that there are different theories describing the market and its behavior. Among them a significant place is held by the market efficiency theory. One of its postulates is the impossibility of the future price movement prediction as all the information is already reflected in the price. Thus, this theory completely contradicts technical analysis, according to which it is possible to predict future changes based on historical data. However, both of these approaches have existed for a long time and both have shown their effectiveness, which causes a contradiction. However, in practice there is no contradiction, as on the one hand, full efficiency is not achieved, which allows you to earn additional income by detecting the existing inefficiency, and, on the other hand, the psychology and behavior of traders, many of whom use analytical methods to predict price movements, also affect the price. Thus, by



predicting the actions of other market participants, it is possible to predict price movements (Sturm, 2013).

A more classical way of investing activity is a portfolio formation. This method is designed for medium- and long-term investment and is based on portfolio optimization and fundamental analysis. There is also a wide range of researches in this area aimed at its improvement. It is possible to distinguish a model formed on the basis of hidden Markov models. This approach can improve the efficiency of portfolio investment (Novikov & Valiev, 2018).

However, in an insufficiently efficient market, it is technical analysis that is able to show the highest results. Nevertheless, when using it, it is worth considering a wide range of factors that can affect its effectiveness.

An important factor here is the kind of data that is used, namely, what is taken as the basis for the price. Research in this area shows that the most appropriate is to use the closing price (Ma et al., 2013).

Also, while analyzing, it is important to distinguish a purposeful price movement from a random wander. For this purpose, it is necessary to investigate the price movement over long historical intervals in order to find out at what duration the movement follows the trend (Galanov et al., 2017).

Liquidity is also one of the most important parameters. Moreover, it's becoming even more important nowadays when almost all investors pay close attention to it and include its analyze into their trading models (Snigaroff & Wroblewski, 2018). Although a sufficient level of liquidity is required for securities to be attractive to investors, excessively high liquidity can have a negative effect. An increase in liquidity is often accompanied by an increase in volatility, and thereby raises the risk of a security (Hauser & Kedar-Levy, 2018).

One of the trends of the current trading strategies development stage is the active application of artificial intelligence. Such models, even when using fairly simple analysis tools, are capable of bringing high profits (Singh & Khushi, 2021). Taking into account the fact that most of them rely on technical analysis, increasing its effectiveness is one of the most significant tasks.

5 CONCLUSION

Thus, considering the oscillators usage on the Russian stock market, it can be noticed that most of them show a low level of accuracy. The analysis showed that on



the Russian market, the indicators which use moving averages calculated on the basis of past price changes have the most accuracy in predicting price movements. Indicators that calculate overbought/oversold levels are able to detect trend changes with sufficient accuracy only on the most liquid stocks. The market speed and volume oscillator turned out to be almost completely useless. Also, the conditions of the Russian market lead to a situation where only half of indicators signals turn out to be correct.

Four strategy templates were also created, combining various technical analysis oscillators. The most variable and effective strategy is the combination of MACD, W%R, RSI and CRSI. At the same time, taking into account the features of the oscillators used in this strategy, in order to make a decision, it is necessary to receive a signal from one of the following combinations of indicators: MACD, W%R and CRSI, or MACD, RSI and CRSI. To increase the accuracy of the strategy, it is also possible to use other (non-oscillator-based) methods of technical analysis.

Overall, the conducted research allowed us to conclude that, despite the problems of market imbalance, low liquidity and high volatility, an opportunity remains for the successful application of technical analysis oscillators on the Russian stock market. Nevertheless, the effectiveness of most standard indicators is at a low level, and only by a comprehensively approaching and developing strategies that combine elements of various indicator types, it becomes possible to achieve positive results. Thus, the application of strategies similar to those developed in this article is one of the ways to carry out effective trading on the Russian stock market. Another way lies in identification of the most effective indicators and groups of indicators, as well as in creation of new trading oscillators based on them. Taking into account the revealed effectiveness of such groups as overbought/oversold indicators and moving averages, it is advisable to conduct further research in this direction.

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