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# Modification of technical analysis indicators and increasing the rate of return on investment

**Abstract**
Financial markets are seen as one of the most important markets in economic terms. The activities of investors in the financial markets consist in predicting how best to invest the accumulated capital, using all kinds of analyzes and forecasts. In the literature on the subject, apart from fundamental analysis, technical analysis is distinguished. While the first one is to help you choose a specific asset with profitable potential, technical analysis is designed to help the investor find a specific moment that is most suitable for buying or selling. The aim of the article is to demonstrate the potential benefits associated with modifying the default settings of technical analysis indicators on the example of the EUR/USD currency pair using the MetaTrader4 investment platform. Analizing was carried out on the basis of the most popular currency pair in terms of turnover on the Forex market - EUR/USD. The research used an investment strategy based on Parabolic SAR and Relative Strength Index RSI technical analysis indicators, whose indications were verified both in the context of default settings and after the author's modification. The results of the conducted research indicate significant differences, depending on the adopted parameters of the above-mentioned indicators.

**Keywords**
Currency exchange rate | Intraday Trading | OTC Market | Technical analysis

**JEL Codes**
G11, G15, G17

## 1. Introduction

The level of economic development of any society is related to the level of development of the financial market. This encourages us to learn about the dependencies occurring in the financial market and to analyse the behaviour of investors, among others, by identifying their preferences and beliefs, which are the basic factors underlying their behaviour. An important role in the analysis of investors' behaviour is played by the assessment of the effectiveness of their investment decisions. Investors' investment goals and strategies affect the portfolios they choose and the returns they earn. The basic methods by which traders make their investment decisions are fundamental analysis and technical analysis. Since most of the scientific work deals with the benefits of fundamental analysis, this paper attempts to determine whether investors who use technical analysis tools can increase the effectiveness of their investment decisions in the capital market.

According to Hoffmann, Shefrin, Pennings (2010), traders who rely on fundamental analysis have higher aspirations and turnover, take more risk, are more confident, and perform better than investors who rely on technical analysis. However, the undeniable advantage of technical analysis is its ease of application. Additional advantages of this method are the benefits associated with the possibility of mobile investing. The answer to the needs of investors are mobile applications, enabling the use of a wide range of technical analysis tools via a mobile device with Internet access. An example of such an application is the MetaTrader software, the usefulness of which is appreciated by investors around the world. The MetaTrader trading platform provides access to the market to many entities, including individual investors, who can observe price

changes in real time and trade according to their expectations. After concluding a transaction via the above-mentioned platform, the investor has access to changes in the balance of his account in real time, along with the changing quotes of the assets being invested. The advantage of the MetaTrader platform is the technical analysis tools that are built into this application, which are used to assess the market situation and in the process of making investment decisions. The aim of this article was to identify how the use of selected technical analysis indicators looks like in practice. The analysis focused on the currency pair EUR/USD. An investment strategy based on technical analysis indicators was used for the research. The study, aimed at comparing investment results, was conducted on the basis of data from the publicly available MetaTrader4 platform resource from the period of September 1, 2021 to February 10, 2023. It was decided to use the above-mentioned data source due to very easy access and relatively high prevalence of the mentioned platform among investors. Our research is therefore part of the study of investors' investment strategies and their decisions regarding capital structure, which we consider to be one of the basic research areas of modern financial markets.

The analyses concerned three strategies based on technical analysis indicators: (1) default settings of Parabolic Stop and Reversal (SAR) and Relative Strength Index (RSI) indicators, (2) default settings of Parabolic SAR and RSI indicators, with a modification regarding the level of maximum loss, and (3) modification of Parabolic SAR and RSI indicators. The above strategies focus on the results obtained in the period September–December 2022 for strategies one and two and results from the period September 2021 to February 2023 for strategy three. Despite the much lower share of profitable transactions, the second strategy turned out to be much more profitable than the first strategy. In the third strategy, the individual transaction signals were focused on a longer execution time, and the average value of the profitable position was higher; this was a deliberate effect associated with the change of indicator settings.

We saw a positive relationship between the strategy used and the return of investors. Therefore, our analyses can be useful for investors' decisions. The rest of the article consists of several parts. The next section provides a literature review on the theoretical foundations and practical application of technical analysis. The methodological section contains a description of the data and an explanation of the strategies that were used for the study. Our findings are presented below. The last part contains conclusions and discussion.

This study demonstrates the practical usefulness of technical analysis for retail investors. Moreover, to the best of our knowledge, this is the first comparative study on the subject. We examined the impact of various investment strategies that use technical analysis indicators on profitability. It can be assumed that in addition to the share of profitable signals, the ratio of a losing to a profitable position is crucial in the context of the profitability of a given strategy.

The analysis will be the starting point for further research on the identification of factors determining the decisions of individual investors. We will focus on observable socio-demographic variables as indicators underlying the psychological processes that drive investment choices. The aim of these analyses will be to demonstrate the heterogeneity of investors in terms of their preferences and beliefs, which are fundamental factors in their investment behaviour. To better understand the relationship between the decisions of individual investors, the research will take into account the investment strategies presented in this test.

# 2. Literature review

## 2.1. Theoretical Basics

Identification of factors determining the level of prices in financial markets is of interest to many researchers. Investors, in order to increase their profits from investments, expect tools and techniques that allow them to effectively and reliably predict price changes. Numerous polemics in this regard are available in the literature on the subject (Reilly & Brown, 2011). Two analyses are used to forecast prices of stocks: fundamental and technical. Despite the many differences in these approaches, the supporters of each of these analyses agree on the key factors explaining the level and trends of prices in financial markets. The relationship between stock prices and factors in fundamental analysis is described, among others, by Gordon and Shapiro (1956). In the field of fundamental analysis, one of the researchers who provides the most significant research is J.A. Ohlson (1995). He formulated a model that indicated the share price as a key factor determining an investor's profit. Using Ohlson's model is a recognised method of stock

valuation. The relationship between profit and share price is also indicated by O'Collins (1994, 2011). As part of fundamental analysis, two approaches are distinguished in the literature (Figure 1).

Fundamental analysis is an analysis that is based on many economic measures and indicators (Jajuga, 2015; Małachowski & Gadowska-dos Santos, 2021). The presented approaches (Figure 1; top-down approach) indicate that the investor (or potential investor) starts with an analysis of economic conditions, then an analysis of the economic environment. The final stage of this approach is the organizational analysis of the company in question. This approach is used in the event that an investor is looking for the best stocks in which to invest. In the bottom-up approach, the opposite analysis occurs—starting with company analysis.

An alternative to fundamental analysis is technical analysis. It is defined as the study of any market by using historical information about prices and trading volumes to predict future price changes (Moghaddam & Momtazi, 2021). Murphy (2017) defines this method of price forecasting as information about prices, number of transactions, and existing transactions in order to predict the price trend in the future. The advantage of this method is that the trader can use technical analysis to predict the direction of price movements, thus achieving an effective decision (Elbialy, 2019). Price prediction using technical analysis may consist of (1) trend analysis or (2) analysis of indicators (Figure 2).

Technical analysis is mainly used to forecast changes in the prices of selected financial assets by investors investing their money in various instruments, most often on the stock exchange or the currency market (Dolan, 2011; Lim, 2015; Rockefeller, 2019). As part of technical analysis, various indicators and candle formations are used, and support (or resistance) zones are determined. Technical analysis indicators used to forecast prices on financial markets can be divided into several categories. The first of them are oscillators, i.e. indicators that oscillate between certain values that are used to read discrepancies, neutral market conditions, or estimates (Shannon, 2008; Kahn, 2011). The most popular oscillator indicators include the RSI and the Stochastic Oscillator (STS). In the case of price forecasting more volatile assets, momentum indicators can be used which show the dynamics of price change, placing more weight on price amplitude and the periods of analysis closest to the current one (Dunham, 2012).

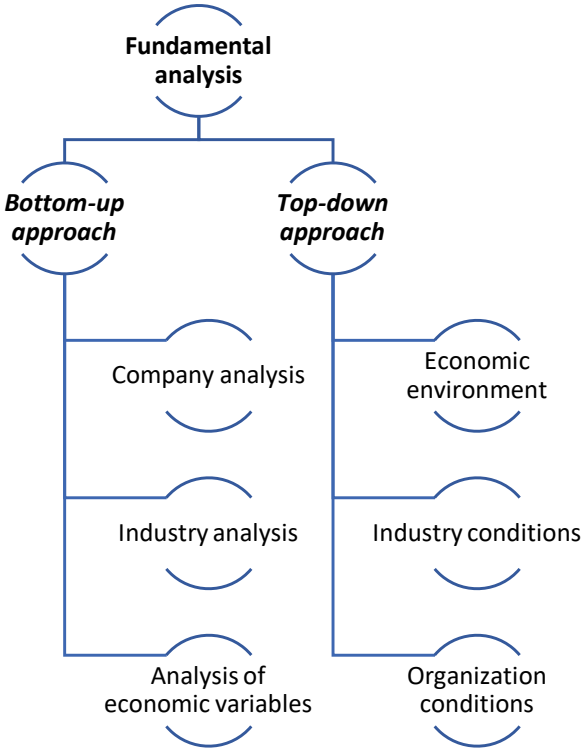


**Figure 1.** Fundamental analysis approaches
Source: own elaboration based on Elbialy (2019)

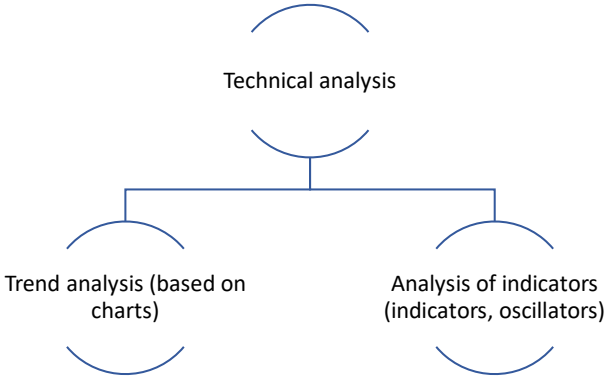


**Figure 2.** Technical analysis approaches
Source: own elaboration based on Bettman et al. (2009)

Popular indicators in this category are the momentum index and CCI (Commodity Channel Index).. In order to determine what price trends will prevail in a given market, you can use indicators typically provided for determining the trend in which a given market is located. Among the most popular in this group, Bollinger Bands, or, for example, Parabolic SAR, can be distinguished (Borowski, 2017). Please note that the indicators indicate only potential, projected price changes. Technical analysis is based on the assumption that prices or exchange rates are subject to trends,

and its assumptions are to help determine whether the market trend will continue when it reverses or a completely new one will be established. The task of technical analysis indicators is therefore to, among other things, help determine the moment of trend reversal. Technical analysis focuses the investor's attention on price changes, not on fundamental aspects of the valuation of a given company or asset, as is the case with fundamental analysis (Murphy, 2017). It should be emphasised that there is no indicator characterised by flawlessly generated trading signals (Plummer, 2010). There are many technical analysis indicators, and each of them can be calculated on the basis of individually selected parameters, which in practice implies almost unlimited possibilities of personalisation of the indicator in order to best match the analysed asset (Grimes, 2012; Hassen, 2017). However, it should be remembered that even if the historical analysis of a selected asset clearly indicates a given investment strategy as potentially profitable, the market may function completely differently in the future. This means that assumptions based on historical price movements may result in a loss. Summing up the theoretical considerations, it can be said that in the literature on the subject, fundamental analysis and technical analysis are not treated as complementary techniques. Researchers suggest conducting two analyses in parallel to achieve the optimal effect of investment plans (Drakopoulou, 2016). The second solution leading to the optimisation of investment profits is a two-stage operation: (1) fundamental analysis (price modelling) and (2) analysis of price changes—technical analysis (Schwager, 1984). Such a hybrid approach for investors would be an optimal solution. However, it should be remembered that not every investor (primarily individuals) has the ability to carry out modelling, the use of fundamental analysis. Therefore, technical analysis provides more opportunities for such investors.

## 2.2. The Use of Technical Analysis in Forecasting Trends and Future Price Changes

Technical analysis indicators are used to forecast trends and future price changes also on the Warsaw Stock Exchange. The Polish market is run by the Polish Securities Depository (GPW) and the National Depository for Securities in Warsaw (GDPW). GPW organises stock exchange trading in financial instruments, and GDPW is a capital market infrastructure institution operating in the area of securities registration, transaction settlement and services related to transaction reporting. The above authorities are supervised by the Polish Financial Supervision Authority (KNF), which also performs supervisory tasks delegated by the European Securities and Markets Authority (ESMA) (Banaszczak-Soroka, 2019). The over-the-counter market (OTC), on the other hand, is an alternative exchange system, which means that it is not subject to such restrictive requirements, although it is regulated by relevant regulations and authorities—a.o. restrictions on leverage or a complete ban on offering certain instruments (e.g. binary options). The most popular over-the-counter market is Forex. Trading on this market takes place over-the-counter, as transactions are carried out outside a centralised exchange, and this market does not have a physical headquarters. The Forex market operates in the mode "around the clock," which means that transactions can be conducted 24 hours a day; thanks to that, it is often used for intraday trading (Noonan, 2022). A very important role in the popularisation of the OTC market is played by a wide range of available instruments, as well as relatively low transaction costs, amounting even to less than 0.01% of the contract value (Cuthbertson, Nitzsche, & O'Sullivan, 2019). Investors can buy and sell currencies through a network that directly connects individual banks, traders, and brokers. In the OTC market, buying and selling transactions are concluded on the basis of bilateral agreements between participants who set their terms without the intervention of a centralised regulatory authority. Today's market of OTC financial derivatives allows trading in many different types of complex derivatives without the need to obtain specialised certificates, authorisations, or permits. This is one of the aspects affecting its growing popularity (Czekaj, 2017). This market is characterised by the highest degree of internationalisation among all segments of the world's financial markets. When comparing the regulated market, offering the underlying instruments to the OTC market, the concentration of capital is much higher in the case of the derivatives market (Mishkin & Eakins, 2021). It should be noted, however, that all securities and derivatives related to the financial turmoil, which began with the collapse of the U.S. mortgage market in 2007, were traded on OTC markets (Stępień & Kawa, 2015). Trading in OTC instruments is enabled through more than 40 investment banks, and most of the trading is generated by a group of 16 of the largest providers (G-16 liquidity dealers). These entities are classified as systemically

important (G-SIBs), due to their majority share in the global derivatives market. This group consists of well-known transnational corporations, such as: Bank of America, BNP Paribas, Barclays, Citigroup, Credit Suisse, Goldman Sachs, JP Morgan Chase, HSBC, Morgan Stanley, Merrill Lynch or UBS, and Wells Fargo (Fałat-Kilijańska et al., 2017; Hull, 2023).

In order to minimise the impact of emotions and relieve the investor, who is often somehow attached to an open position, the aforementioned Take Profit and Stop Loss orders were created For investment strategies that have a predetermined level of loss and profit, the trader can activate automatic orders that will be executed when the instrument reaches a certain price. Take Profit (TP) orders are definitely more optimistic because they are related to profit taking. The possibility of using the TP order allows investors to automate trading on the market. A Forex trader, after receiving a signal to take a long position based on his investment strategy, sets an automatic TP order at a given level and can wait for events to develop by performing other actions. If the exchange rate reaches the indicated level, the position will be automatically closed, and the investor will make a profit—this is how the TP order works. Similarly, Stop Loss (SL) orders are not responsible for taking profits and losses. These orders are intended to close a position at a predetermined loss. Returning to the previously mentioned example of an investor and his strategy based on the EUR/USD currency pair, let us assume that the strategy, apart from the optimistic variant—profit taking, also provides for a pessimistic variant—is cutting losses. In this case, the investor's task is to close the losing position at the moment of negative deviation of the price by a given value from the price from the moment of the trading signal. In order to not observe the chart or stress unnecessarily, the investor, using the option of setting a SL order, activates its level at the price determined in accordance with his strategy. If the price falls to this level, the position will be automatically closed and the trader will incur a loss—this is how SL orders work (Surdel, 2006; Mladjenovic, Brooks & Dolan, 2021).

# 3. Methodology

The aim of the article is to demonstrate the potential benefits associated with modifying the default settings of technical analysis indicators based on the example of the EUR/USD currency pair using the MetaTrader4 investment platform. Technical analysis on the MetaTrader platform is made on the basis of historical data on price changes of selected assets in the past. An investor using technical analysis, based on a selected indicator or several indicators at the same time, tries to forecast the future price of a given asset.

## 3.1. Data Sources

The data used to conduct the research came from the publicly available resource of the MetaTrader4 platform from the period of September 1, 2021 to February 10, 2023. The above-mentioned data source was used due to easy access and relatively high prevalence of the mentioned platform among investors.

The subject of the research was indications of the investment strategy based on technical analysis indicators, Parabolic SAR, and RSI in the context of their accuracy, measured on the basis of correctness of indicating the future change in the EUR/USD currency pair.

The analyses were carried out over a period of 4 months (September–December 2022) for the first and second strategies, and a period of 17 months (September 2021–February 2023) for the third strategy. The discrepancy in the duration of the analysis period is related to the frequency of generated trading signals. As verified during the conducted analyses, the first and second strategies generated almost 1.5 transactions per day in the period under review, which is more than 4 times more than the third strategy which generated 0.34 signals per day. Due to this discrepancy and with a view to standardising the number of analysed signals, in order to make the best possible comparison of the above-mentioned strategies, the observation period for the third strategy was extended accordingly to obtain an equal number of trading signals.

To build an exemplary strategy, technical analysis indicators, i.e. Parabolic SAR and RSI, were used. The strategy was developed for use in the Forex market, where the Euro-Dollar (EUR/USD) currency pair was used to test it. The strategy was applied on a 1-hour time series (H1). Three modifications of this strategy were used. The results achieved by the above-mentioned strategies in the period of September–December 2022 in the case strategies one and two and the period from September 2021 to February 2023 in the case of the third strategy were compared. The comparison of parameters and assumptions of the analysed strategies is as follows:

1. Strategy 1: Basic strategy based on the default setting of Parabolic SAR and RSI. The position is opened in accordance with the default settings for the above-mentioned indicators, i.e.

a) Long position: entering into a trade at the time of closing the H1 candle, at the same time with the RSI indicator level above 50 points and the position of Parabolic SAR below the price chart. The transaction is closed when the position of the Parabolic SAR indicator changes above the price chart—an indication to take a short position.

b) Short position: conclusion at the time of closing of the H1 candle, while at the same time the RSI indicator value below 50 points and Parabolic SAR above the price chart. The transaction is closed when the position of the Parabolic SAR indicator changes to a place below the price chart—an indication to take a long position.

2. Strategy 2: This strategy is based on a slight modification of the first strategy. Only the moment of closing (execution) of the transaction changed, where the SL order at the level of 200 points (20 pips) was used. The order is activated at the time of the transaction, and its execution takes place in the event of an unfavourable price movement of 200 points, depending on the type of transaction.

3. Strategy 3: Was created by modifying the Parabolic SAR and RSI indicators. In the case of the first one, the parameter of the acceleration coefficient, "step", was changed to 0.003 and its maximum, cumulative value was set at 0.015 (default values are 0.02 – step and 0.2 – maximum value). The RSI indicator has also been modified, where the number of periods has been changed to 21 (14 by default), and the levels necessary to conclude positions have been changed.

Closing of a transaction in the third strategy:

a) Long position: taking a long position occurs when the Parabolic SAR indicator is placed below the price chart, with the RSI indicator level greater than or equal to 60 points.

b) Short position: the position is taken when the Parabolic SAR indicator is placed above the price chart, with the RSI indicator level less than or equal to 40 points. The position is taken both in the case of long and short and takes place at the moment of closing the first hourly candle H1, meeting the above conditions.

c) When taking a long or short position, set the TP level to +1480 points (148 pips), from the closing rate (price) of the signal candle. This is the level that will identify a trading signal as correct, and a potential trader will make a profit.

d) After setting the TP level, you should observe the chart and indicators parameters, because as research has shown, only 18% of trading signals of the third strategy end with reaching the assumed TP level. In other cases, the profit from the potential trade was smaller (10%) or a loss was recorded (72% of signals). The process of closing the position may take place due to the indication of the Parabolic SAR indicator or due to the level of the RSI indicator.

Closing a transaction can occur in several cases:

1. An unfavourable price movement after the conclusion of the transaction (increase in the exchange rate in the case of a short position or decrease in the case of a long position), and the related change in the value of the RSI indicator at the close of a given H1 candlestick, at the level of more than 50 points (short position) or at a level below 50 points (long position), causes the closing of the position at the current level of loss, together with the closing of the first H1 candle, at which the RSI exceeds the given level.

2. Favourable price movement in the expected direction, a decrease in the price in the case of a short position and an increase in the case of a long position. In the above case, the transaction will be closed at the time:

a) "Touching" by the price (exchange rate) of the Parabolic SAR indicator, following from the bottom up (short position) or from the top down (long position),

b) the RSI indicator reaches the level above 50 points (short position) or the level below 50 points (long position) with the closing of the H1 candle (the position is still at the profitable level). In a situation where the position is profitable, while the RSI indicator has changed its position above/below the level of 50 points with the closing of the H1 candle, the investor expects further development of the situation, as the previous trend may continue and the originally set TP level will be reached. In the latter case, however, the rate may reverse and move towards the level of taking the position (increase in the case of a short position or fall in the case of a long position). In this situation, you

should close the position with the closing of the H1 candle, during which the opening price of the position was reached or when the Parabolic SAR is touched by the price, whichever comes first.

On the basis of the above assumptions, analyses were made of the third strategy during the period considered.

# 4. Results

## 4.1. Descriptive Statistics

This study uses data characterising changes in the EUR/USD exchange rate. These were the opening price and the closing price on a given day of quotations of the EUR/USD currency pair or the average price, respectively for a given period. In addition, the analysis concerned (%) changes in the EUR/USD exchange rate. An appreciation of the Euro was observed in the case of an increase in the value of the exchange rate and depreciation in the event of its decrease. Volume determines the average of the numbers of transactions concluded on this currency pair over a given period. The average value of the opening and closing prices, the change (%) directly related to the EUR/USD exchange rate. The number of transactions concluded on the EUR/USD currency pair are presented in Table 1.

In 2021 and 2022, we observed a decrease in the value of the EUR/USD currency pair. At the beginning of the period, in September 2021, the closing price was 1.1764, and in February 2023 the closing price fell to 1.0783. It is worth noting that in the analysed period

**Table 1.** Average values of opening and closing prices. changes (%) relating directly to the EUR/USD exchange rate and number of transactions concluded on the EUR/USD currency pair

| Period | | Closing price | Opening price | Euro appreciation/ depreciation [%] | Volume (average number of transactions concluded on the EUR/USD currency pair) |
|---|---|---|---|---|---|
| 2021 | | 1.1515 | 1.1522 | -0.04% | 73.83 |
| 2022 | | 1.0532 | 1.0536 | -0.02% | 79.92 |
| 2023 | | 1.0778 | 1.0781 | -0.01% | 84.22 |
| 2021 | September | 1.1764 | 1.1776 | -0.09% | 69.52 |
| | October | 1.1598 | 1.1600 | -0.01% | 62.28 |
| | November | 1.1407 | 1.1418 | -0.09% | 83.80 |
| | December | 1.1305 | 1.1306 | 0.01% | 78.98 |
| 2022 | January | 1.1316 | 1.1324 | -0.06% | 64.05 |
| | February | 1.1342 | 1.1341 | -0.01% | 75.33 |
| | March | 1.1014 | 1.1025 | -0.06% | 77.41 |
| | April | 1.0799 | 1.0830 | -0.23% | 72.61 |
| | May | 1.0581 | 1.0574 | 0.08% | 74.02 |
| | June | 1.0562 | 1.0573 | -0.11% | 80.38 |
| | July | 1.0181 | 1.0194 | -0.12% | 83.73 |
| | August | 1.0122 | 1.0131 | -0.07% | 79.36 |
| | September | .9897 | .9911 | -0.11% | 84.80 |
| | October | .9840 | .9837 | 0.04% | 92.18 |
| | November | 1.0210 | 1.0185 | 0.24% | 90.53 |
| | December | 1.0588 | 1.0576 | 0.13% | 84.06 |
| 2023 | January | 1.0776 | 1.0771 | 0.07% | 84.48 |
| | February | 1.0783 | 1.0807 | -0.21% | 83.51 |

Source: own elaboration

**Table 2.** Descriptive statistics for analyzed variables

| Variable | N Important | Average | Median | Minimum | Maximum | Standard dev. | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| Price closing of EUR/USD quotations | 378 | 1.078023 | 1.073500 | 0.959200 | 1.188200 | 0.059063 | -0.04244 | -1.07920 |
| Price opening of EUR/USD quotations | 378 | 1.078474 | 1.074250 | 0.959400 | 1.187900 | 0.059316 | -0.04546 | -1.08409 |
| Euro appreciation/ depreciation [%] | 378 | -0.00025 | -0.000200 | -0.014900 | 0.021400 | 0.005673 | 0.305433 | 0.87710 |
| Volume (number of transactions concluded on the EUR/USD currency pair) | 378 | 78.84444 | 78.37500 | 17.50000 | 155.9600 | 19.15545 | 0.377485 | 1.630956 |

Source: own elaboration

the downward trend was not homogeneous, and the exchange rate showed some volatility. In September and October 2022, there was a situation of parity on the above-mentioned currency pair, i.e. 1 euro was equal to 1 dollar. Percentage changes for individual months are relatively small and range from -0.21% to 0.24%. These changes indicate a small monthly volatility of the EUR/USD currency pair. The average trading volume of the EUR/USD currency pair also shows some volatility during the period under review. The lowest average volume occurred in October 2021 (62.28) and the highest in October 2022, reaching a value of 92.18. It is worth noting that there is no clear correlation between the percentage change and the volume of trade.

To summarise, the analysis of data from the table on the EUR/USD currency pair indicates a downward trend in the analysed period. Monthly percentage changes are relatively small, indicating moderate volatility of the currency pair. The trading volume also shows volatility, but there is no clear relationship between the percentage change and the trading volume. The mean and median of all described variables (in the entire analysed end) of both closing and opening are similar, which suggests that there are no large differences between the values (Table 2).

The determined coefficients (skewness and kurtosis) for the variables accepted for analysis indicate asymmetry of the distribution. For closing and opening prices, the skewness value is negative, which means that the distribution is left-sided. A low kurtosis (-1.07920) indicates that the values are scattered over a wide range. The average value of the percentage change (Euro appreciation/depreciation) indicates that there are no significant overall upward or downward trends in the analysed dataset. For a change in the EUR/USD exchange rate, the value of skewness (0.305433) is positive, indicating a right-hand asymmetry in the distribution. Kurtosis (0.87710) is relatively low, which means that there are more extreme outliers in the analysed dataset than in the normal distribution. The average and median for the number of transactions concluded on the EUR/USD currency pair are similar, so there are no large differences between the volume values. The skewness for this parameter (0.377485) indicates a right-sided asymmetry of the u distribution, while kurtosis (1.630956) is higher than for other variables, so in the volume distribution most of the values are concentrated around the mean.

## 4.2. Analysis Results

The research was conducted on the MetaTrader4 (MT4) platform, which is one of the most popular online trading platforms. It offers the possibility of trading using leverage, mainly in the Forex currency market and the Contracts for Difference (CFD) market. All transactions made through the MetaTrader platforms are made online. The analysis covered a period of 4 months (September–December 2022) in the case of the first and second

strategies, and a period of 17 months (September 2021–February 2023) in the case of the third strategy, where the observation time was extended due to the lower average number of generated transaction signals. The results of individual transactions achieved under individual strategies are presented in Figures 3–5.

Analysing the data presented in Figures 3 and 4, one can see similarities in frequency and values in the case of profitable trading signals. Due to the SL level, nine potentially profitable trades were closed when they turned negative. A significant difference, at first glance, can be seen on the losing (negative) side of transactions. The rigidly set SL meant that relatively numerous transactions below -200 points occurring in the first strategy did not take place, and therefore there were no excessive losses in the second strategy. As can be seen from the analysis of the aggregate results presented in Table 3, the SL level applied significantly contributed to achieving a favourable outcome when using the second strategy compared to the first one.

As in the case of the first two strategies, analysing Figure 5 relating to the third strategy, one can see a dominant number of losing trades (72%), while correspondingly higher profitable transactions made the overall result of the strategy unambiguously favourable. Figure 3–5 show the results achieved by the analysed strategies 1, 2, and 3 broken down into individual transactions. While in the case of the first two strategies, the occurrence of strong upward or downward trends is relatively less important, the third strategy has been developed in accordance with the slogan that the trend is the investor's greatest "ally". A higher number of profitable third strategy trades can be seen during periods of increased price amplitude shown in Figure 6. This is due to the fact that the TP level provided for the third strategy is relatively high, approximately 1.3–1.5% of the EUR/USD exchange rate.

The daily price range of the EUR/USD currency pair, measured by the difference between the maximum and minimum prices for each day, is shown in Figure 6.

Figure 7 presents the development of the total result of the analysed strategies along with subsequent transactions.

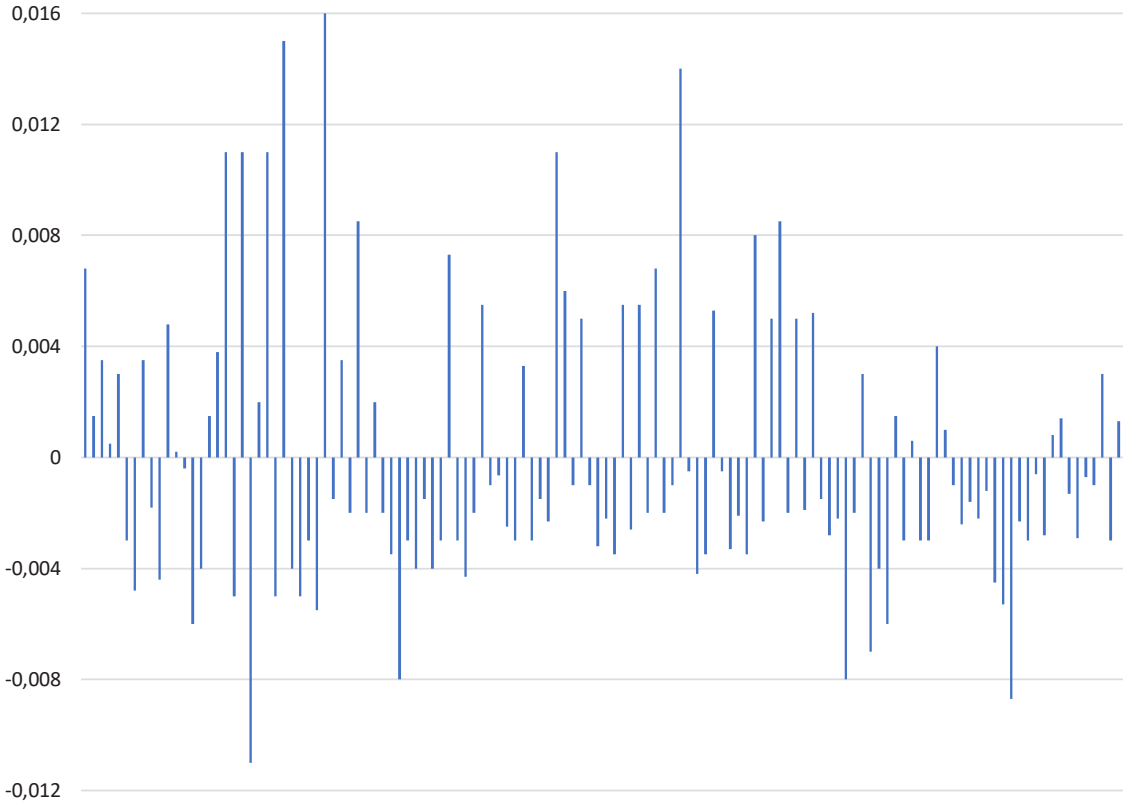


**Figure 3.** Strategy 1 result in the period September-December 2022 by individual transactions
Source: Own calculations based on MetaTrader4

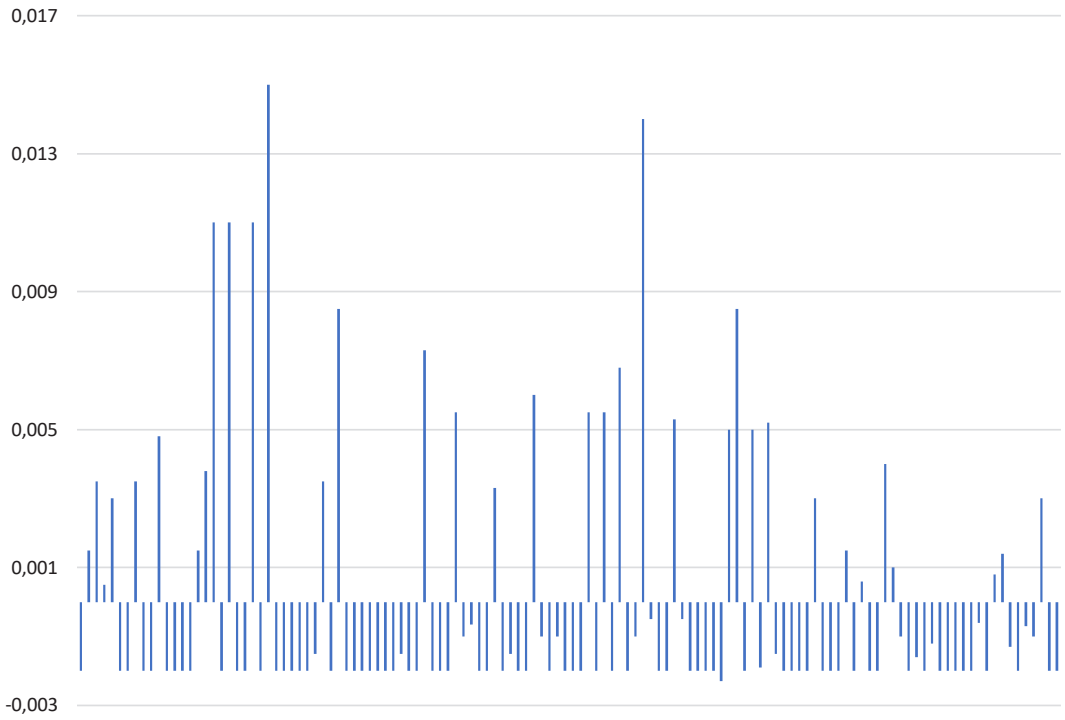


**Figure 4.** Strategy 2 result in the period September-December 2022 by individual transactions
Source: Own calculations based on MetaTrader4

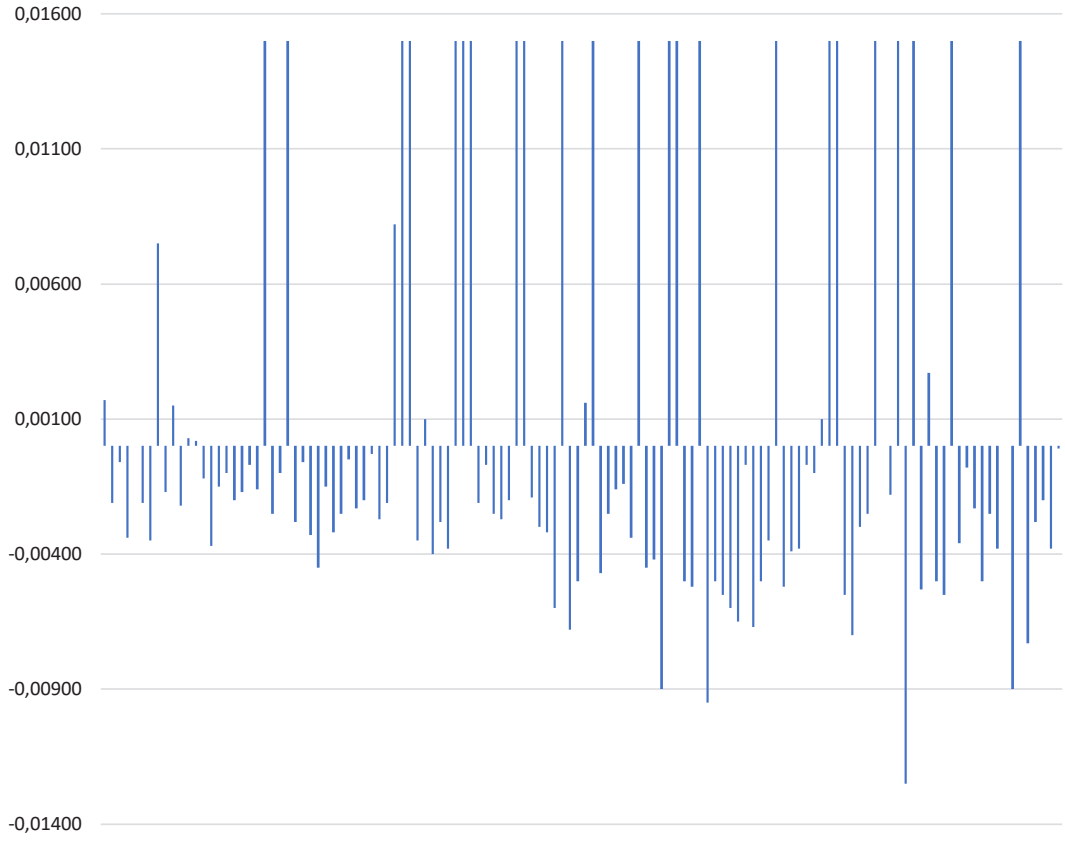


**Figure 5.** Strategy 3 result in the period September 2021 – February 2023 by individual transactions
Source: Own calculations based on MetaTrader4

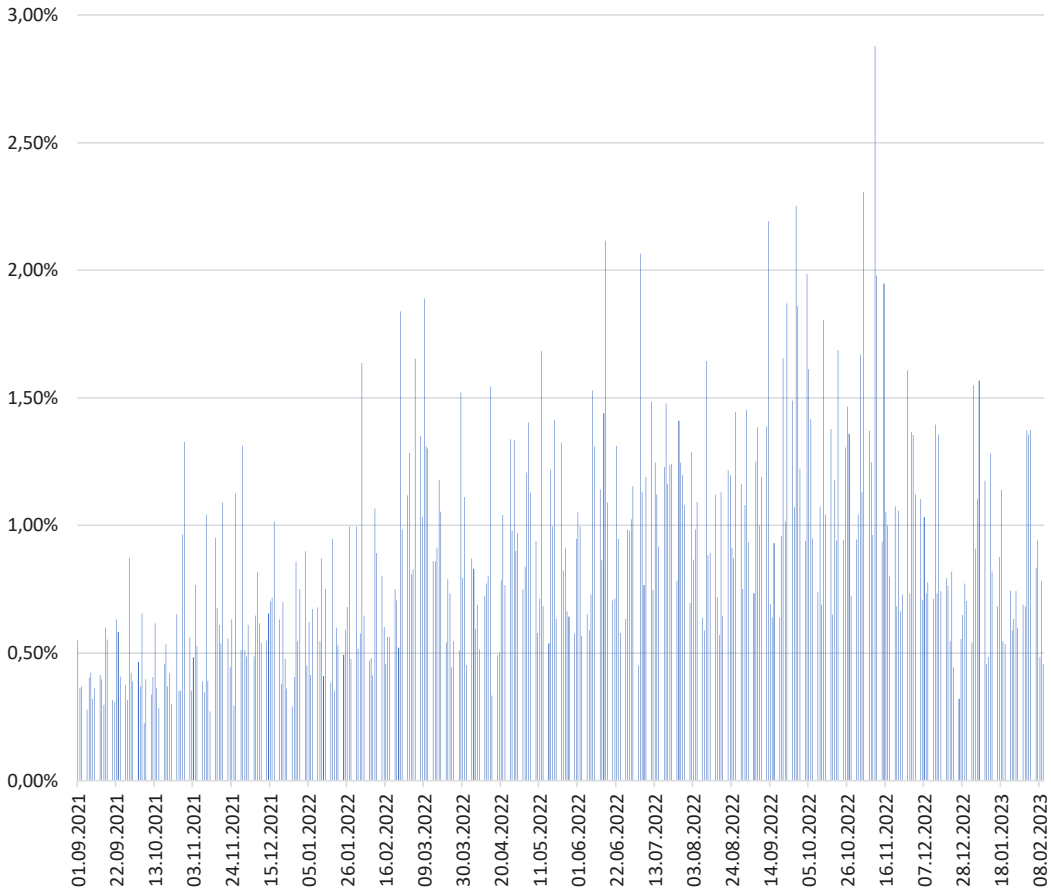


**Figure 6.** Daily price range (%) EUR/USD September 2021 – February 2023
Source: Own calculations based on: https://pl.investing.com/currencies/eur-usd-historical-data

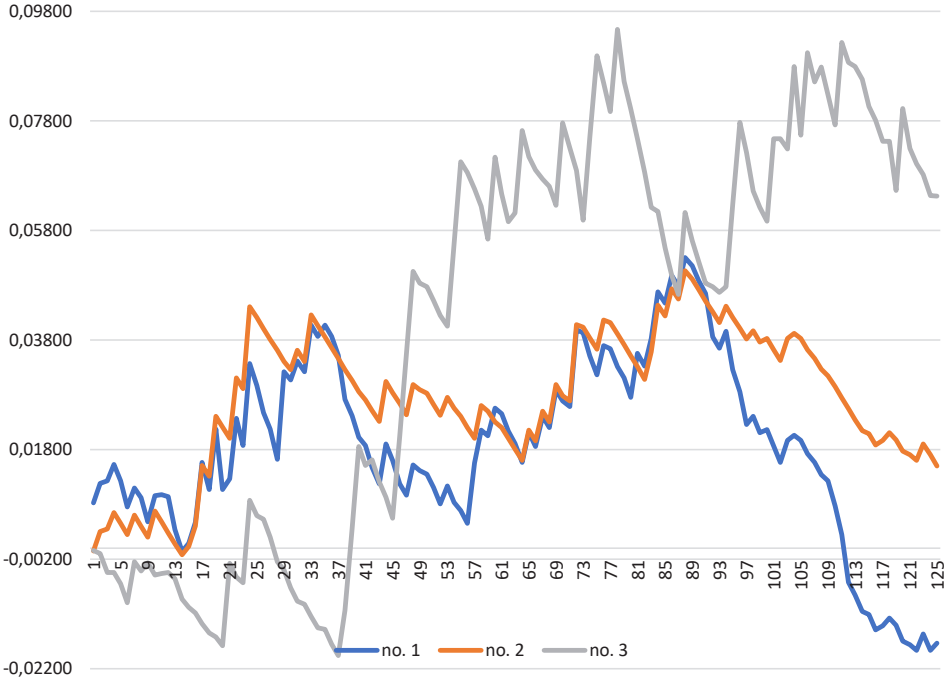


**Figure 7.** Total result of individual strategies over the examined periods (126 transactions)
Source: Own elaboration based on MetaTrader4

**Table 3.** Results achieved by individual strategies during the examined periods.

| Strategy | No. 1 | No. 2 | No. 3 |
|---|---|---|---|
| Number of trading signals during the period considered | 126 | 126 | 126 |
| Share of profitable signals | 35% | 27,78% | 28,57% |
| Average value of a profitable position | 525 pts | 543 pts | 1020 pts |
| Average value of a losing position | (-)305 pts | (-)182 pts | (-)340 pts |
| Average number of trading signals per day | 1,44 | 1,44 | 0,34 |
| Aggregate result during the period under analysis | (-)1735 pts | 1505 pts | 5970 pts |

Source: Own elaboration based on MetaTrader4

The result is presented in points, which in the case of Forex and currency pairs quoted to five decimal places, are as follows: 1000 points = 100 pips = e.g. 1 gr / 1 cent, depending on the currency pair. The parameters for the analysed strategies are presented in Table 3.

It is worth noting that despite a lower share of profitable transactions, the second strategy turned out to be much more profitable than the first strategy. The explanation of this situation is undoubtedly related to the average value of the losing and profitable positions. While the average winning position in strategy two is slightly larger than in strategy one, the almost twice lower, average value of a losing position explains such a large difference in the aggregate result of these almost "twin" strategies. Slightly different statistics were obtained after the analysis of the results of the third strategy, the individual transaction signals of which were set for a much longer execution time, as evidenced by almost 5 times less generated signals per trading day. The average value of the profitable position was also much higher. This is a deliberate effect associated with the change of indicator settings. On average, a losing position accounted for 58% of the profitable position for the first strategy, 34% for the second strategy, and 33% for the third strategy. It can be assumed that in addition to the share of profitable signals, it is the ratio of a losing to a profitable position that is crucial in the context of the profitability of a given strategy.

# 5. Conclusions

The analysis of the conducted research clearly indicated the benefits associated with the modification of technical analysis indicators used in the investment strategy. The underlying strategy, based on the default indicator settings, achieved a negative rate of return in the period under review. Already, even the basic change related to the use of the SL order made a profit. Further benefits related to the modification of indicators were observed in the case of the third strategy, where proprietary parameters of Parabolic SAR and RSI indicators were used. This strategy achieved the highest overall result. An additional conclusion from the conducted research refers to the relationship between the average profit and loss transaction. The first strategy, despite having the highest share of profitable transactions, achieved the worst result. It turns out that the ratio of the losing position to the profitable position is crucial. In the case of the second and third strategies, which were created on the basis of modifications of the assumptions of the above-mentioned indicators, the average profitable position was, respectively, 2.9 and 3 times higher than the average losing position, which achieved a favourable overall result.

This study demonstrates the practical usefulness of technical analysis for retail investors. It can be assumed that in addition to the share of winning signals, it is the ratio of the losing position to the winning position that is crucial in the context of the profitability of a given strategy.

Further research will focus on identifying the factors that determine the decisions of individual investors. We will focus on observable socio-demographic variables as factors that guide investment choices. The purpose of these analyses will be to demonstrate the heterogeneity of investors in terms of their preferences, taking into account the investment strategies presented in this article.

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