

MACD stock market indicator

The indicator is presented in the form of two lines: MACD and the so-called signal line.

The MACD line is formed by subtracting the long term average from the short term average. In the cases analyzed, these are the 26- and 12-period averages.

The signal line is the average of the MACD line formed above, in the cases analyzed we use an exponential average with a period of 9.

The MACD histogram consists of vertical bars, reflecting the difference between two MACD lines. The histogram has its own zero line. If the lines are positively aligned (*the faster one is above the slower one*), then the histogram runs above its zero level. The intersections of this level from below and above by the histogram coincide with the buy and sell signals resulting from the intersections of the MACD lines. The histogram allows you to determine the moment when, the gap between the lines increases or decreases. At the moment when the histogram, which runs above the zero line, begins to fall towards it, then the upward trend weakens, and vice versa, when the histogram is below its zero level, but begins to rise towards it, then the downward trend loses momentum. **Returns of the histogram towards the zero line can be used as early signals to close positions.**

The principle of my proposed algorithm is based on a few simple rules. Buying and selling are alternated, i.e. there is no way, for example, to buy shares of a particular company twice in a row. Then it checks:

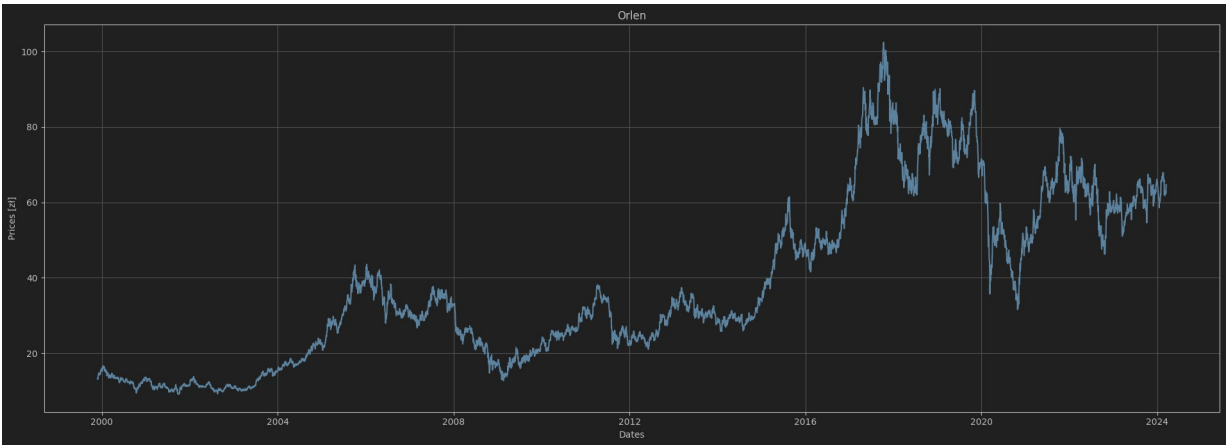
1. According to the MACD indicator, is there now a buy/sell opportunity¹
2. How the MACD line is arranged at any given time, if it takes positive values - it means that he has the opportunity to sell, while if it takes negative values - it means that he has the opportunity to buy shares.
3. Whether there is at least a three-day upward trend if you buy the stock and whether there is at least a two-day downward trend if you sell the stock.

The starting capital in each of the cases analyzed is **PLN 100,000**.

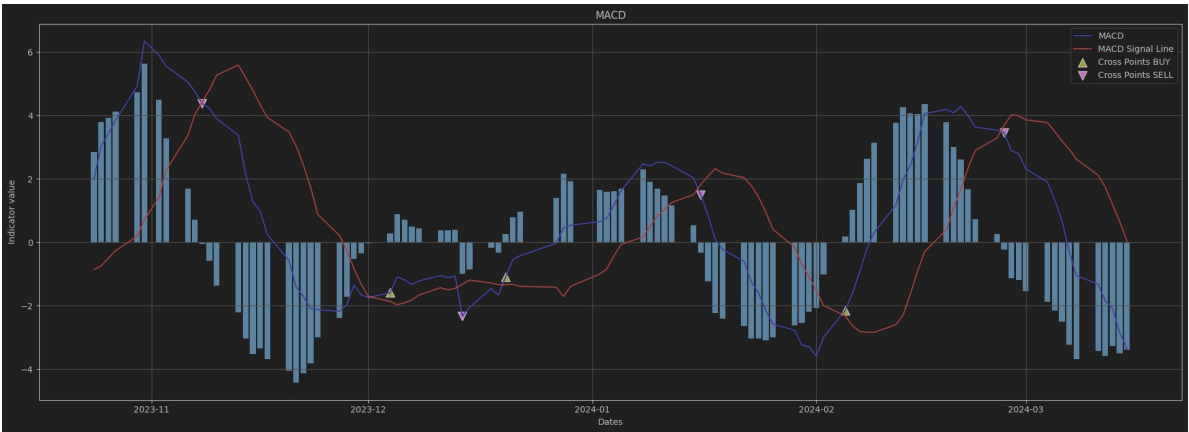
¹ Buy/sell - when the MACD line crosses the signal line from below and the MACD histogram is greater than zero it is a buy signal, the opposite is a sell signal

Orlen SA (PKN)

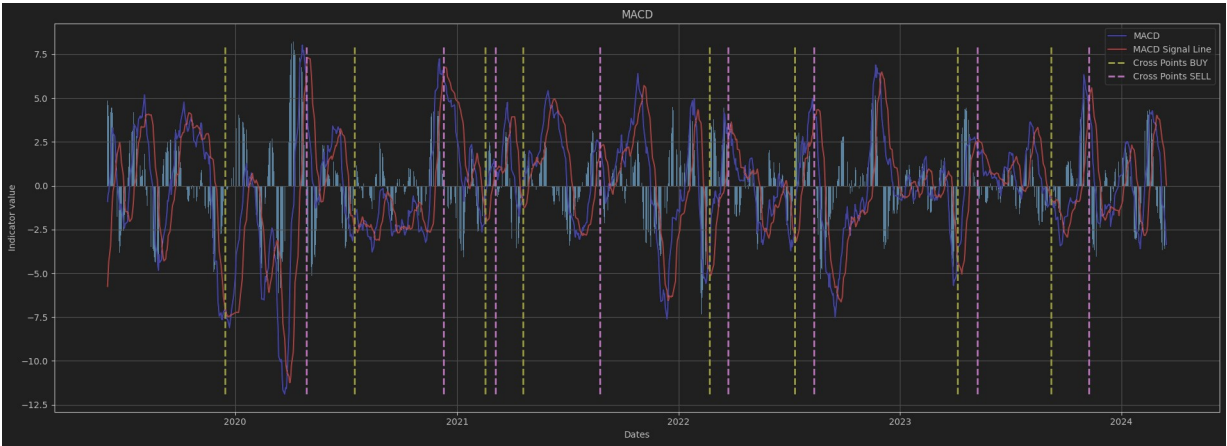
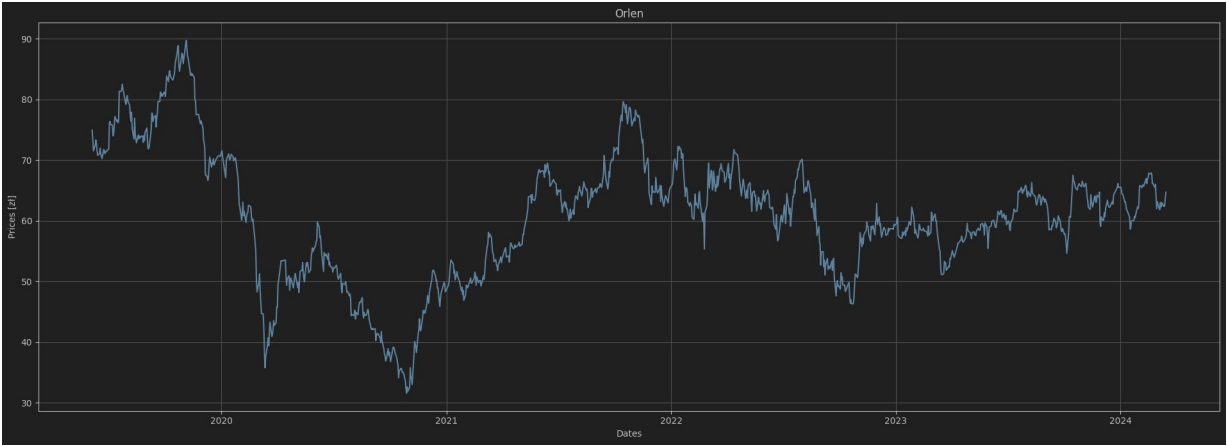
The first company to be analyzed will be a Polish multinational conglomerate - **PKN Orlen SA**.



An example graph of the MACD indicator with a histogram and MACD Signal Line for a short interval would look like this.



We will base our analysis of the MACD indicator on the quotations of the above-mentioned company for the period from **5-06-2019.** to **15-03-2024r.**



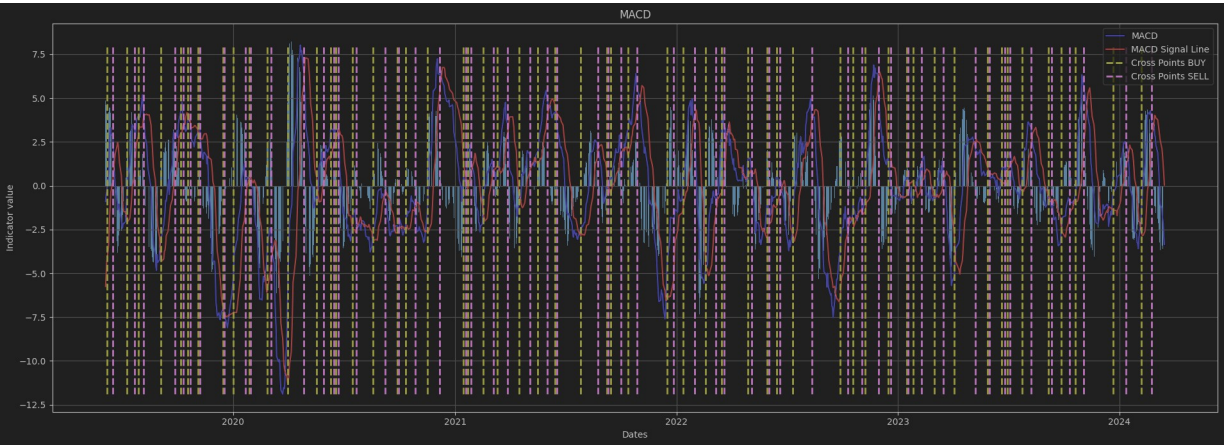
The constructed algorithm selected the buy and sell moments defined by the dashed lines.

The raw data representing bid and ask prices at a given point in time selected by the algorithm look like this:

	Type	Date	Price
0	Bought	2019-12-16	68.8250
1	Sold	2020-04-28	49.7886
2	Bought	2020-07-16	49.6585
3	Sold	2020-12-10	51.8334
4	Bought	2021-02-16	51.5153
5	Sold	2021-03-05	53.3219
6	Bought	2021-04-20	55.3622
7	Sold	2021-08-24	65.3408
8	Bought	2022-02-21	59.8578
9	Sold	2022-03-24	68.7503
10	Bought	2022-07-12	61.0879
11	Sold	2022-08-12	66.5792
12	Bought	2023-04-06	53.9633
13	Sold	2023-05-08	58.1624
14	Bought	2023-09-07	58.4600
15	Sold	2023-11-08	63.8000
Start date:			2019-06-05
End date:			2024-03-15
Profit:			18846.600000000002

As we can see, a total of **16 transactions** were executed. During each transaction, the algorithm operated on 1,000 shares of the company. It bought in most cases at a lower price, while it sold at a higher price. Thanks to this way of operating, it managed to make a profit of **PLN 18846.6** in about 3 years.

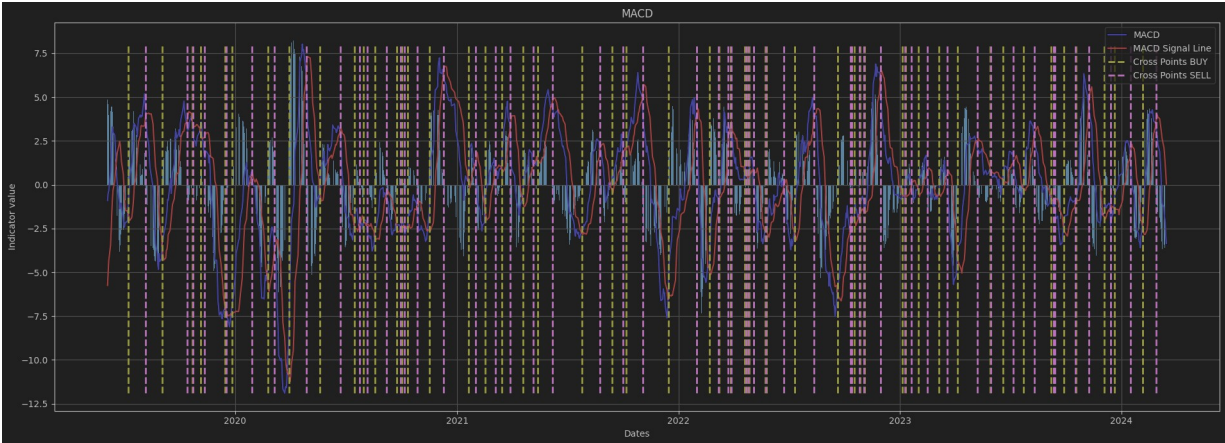
In the event that the algorithm was based solely on the analysis of the 2/3-day MACD downtrend/uptrend, it would have earned **476 zlotys in profit** and made **112 trades**.



	Type	Date	Price
0	Bought	2019-06-07	71.4980
1	Sold	2019-06-17	71.0534
2	Bought	2019-07-10	74.4144
3	Sold	2019-07-23	81.5926
4	Bought	2019-07-29	79.5197
..
107	Sold	2023-11-03	65.5600
108	Bought	2023-12-22	64.4600
109	Sold	2024-01-12	61.6500
110	Bought	2024-02-06	65.8400
111	Sold	2024-02-23	66.1200

[112 rows x 3 columns]
Start date: 2019-06-05
End date: 2024-03-15
Profit: 476.09999999999476

On the other hand, if he took into account only all the buy/sell points indicated by the MACD we would have gained **23380.5 zlotys** after **108 trades**.



	Type	Date	Price
0	Bought	2019-07-09	73.9707
1	Sold	2019-08-07	76.4258
2	Bought	2019-09-03	72.9883
3	Sold	2019-10-14	83.1726
4	Bought	2019-10-23	88.8464
..
103	Sold	2023-12-14	62.1900
104	Bought	2023-12-20	62.7200
105	Sold	2024-01-16	60.5600
106	Bought	2024-02-05	65.4200
107	Sold	2024-02-27	65.9800

[108 rows x 3 columns]
Start date: 2019-06-05
End date: 2024-03-15
Profit: 23380.5

The analysis of these results allows us to draw some important conclusions about the effectiveness of the investment strategy based on the MACD (Moving Average Convergence Divergence) indicator for **ORLEN**:

1. Profit size:

The strategy based on the constructed algorithm, which took into account the buy and sell moments defined by all factors of the algorithm, yielded a sizable profit (**PLN 18846.6**) compared to the strategy based only on the analysis of the 2/3-day MACD downward/upward trend (**PLN 476**), while trades based only on the points indicated by the MACD indicator yielded the highest profit (**PLN 23380.5**).

2. Number of transactions:

The strategy based on the constructed algorithm had a significantly lower number of trades (**16 trades**) compared to the strategy based only on the trend or buy/sell points indicated by MACD (**108 or 112 trades**).

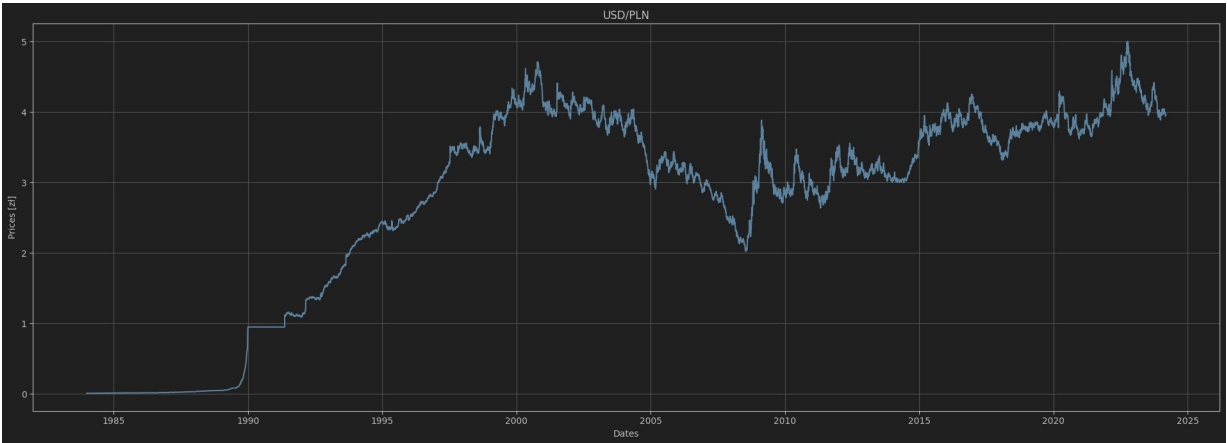
3. Stop-loss effectiveness:

The strategy based on the constructed algorithm has proven effective in avoiding loss, which is noticeable in most cases.

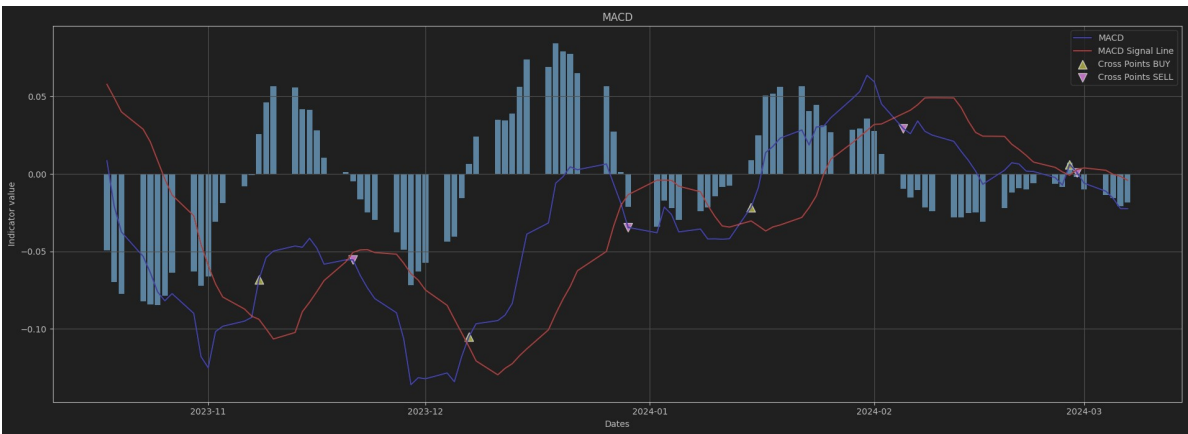
Based on the data mentioned above, the algorithm made a profit in each case. The least, only **0.48%** earned in the case of the algorithm based solely on the trend, much more would be gained on the full algorithm - **18.85%**, while the algorithm based on the intersections of the MACD and MACD Signal Line was the most effective, as it gained as much as **23.38%**.

USD/PLN

In the second analysis, we will focus on the analysis of a currency pair related to the Polish zloty. This will be the relationship between the US dollar (**USD**) and the Polish zloty (**PLN**).

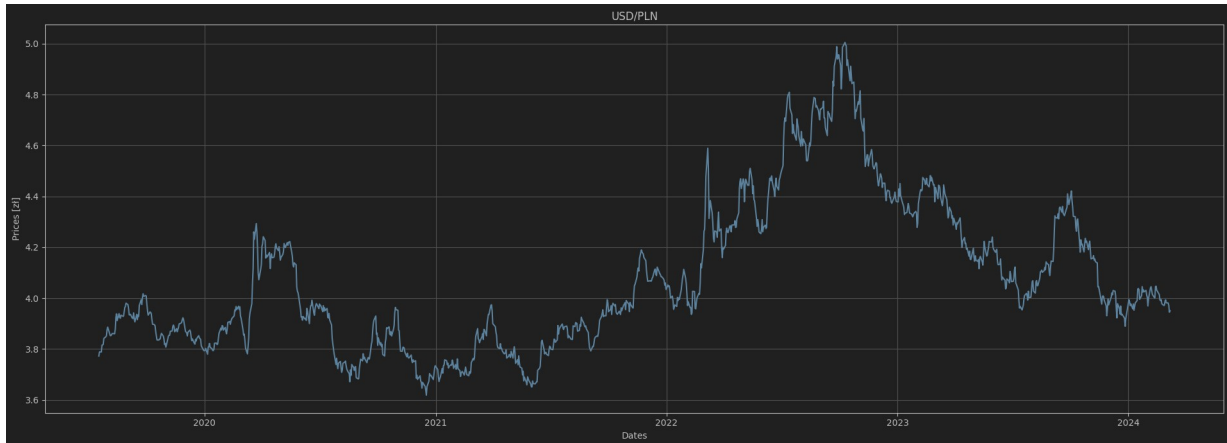


An example graph of the MACD indicator with a histogram and MACD Signal Line for a short interval would look like this.

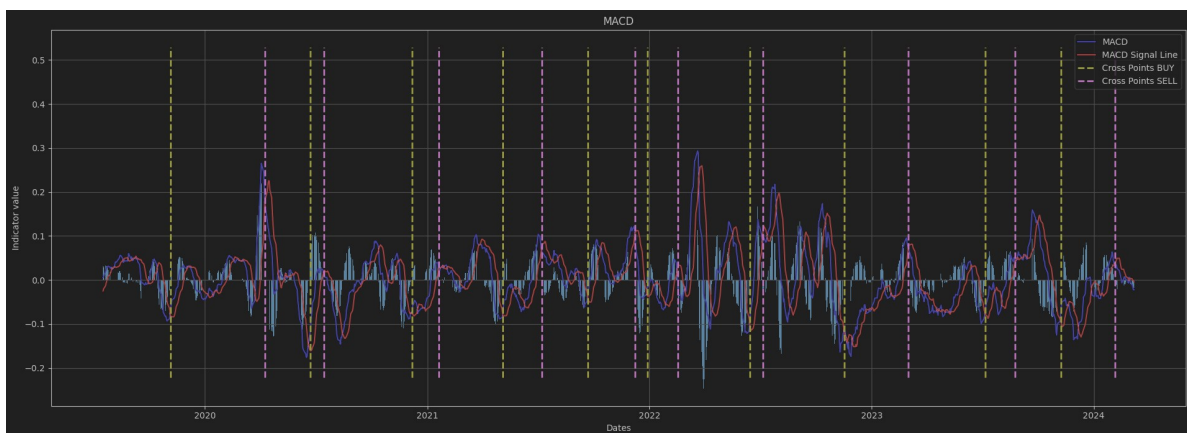


In this case of MACD analysis we will use data from **18-07-2019.** to **07-03-2024.**

The valuation of the Polish currency against the U.S. during this period looked like this:



On the other hand, the MACD and MACD Signal Lines, together with the histogram and the dashed buy and sell lines of the algorithm in question, look like this:



The strategy on which the algorithm was based, in this case made a profit (**457 PLN**), during which time he made **20** transactions.

	Type	Date	Price
0	Bought	2019-11-06	3.85401
1	Sold	2020-04-09	4.16196
2	Bought	2020-06-22	3.94229
3	Sold	2020-07-15	3.92240
4	Bought	2020-12-07	3.69495
5	Sold	2021-01-20	3.74481
6	Bought	2021-05-05	3.80902
7	Sold	2021-07-08	3.83650
8	Bought	2021-09-22	3.95425
9	Sold	2021-12-08	4.06840
10	Bought	2021-12-28	4.06977
11	Sold	2022-02-16	3.95795
12	Bought	2022-06-15	4.46163
13	Sold	2022-07-06	4.69006
14	Bought	2022-11-17	4.54040
15	Sold	2023-03-02	4.43495
16	Bought	2023-07-07	4.06099
17	Sold	2023-08-25	4.13688
18	Bought	2023-11-08	4.14980
19	Sold	2024-02-05	4.04020
Start date: 2019-07-18			
End date: 2024-03-07			
Profit: 456.9999999998545			

The algorithm's strategy reduced to take into account only the 2/3-day downward/upward trend of the MACD indicator brought us in this case a loss of **PLN 908** in **100 trades**.



	Type	Date	Price
0	Bought	2019-07-22	3.78850
1	Sold	2019-07-30	3.85235
2	Bought	2019-08-07	3.85663
3	Sold	2019-08-19	3.93932
4	Bought	2019-10-07	3.94598
..
95	Sold	2023-11-17	4.02010
96	Bought	2023-12-08	4.03000
97	Sold	2023-12-28	3.91884
98	Bought	2024-01-16	4.03650
99	Sold	2024-02-02	3.99842
[100 rows x 3 columns]			
Start date: 2019-07-18			
End date: 2024-03-07			
Profit: -908.0300000000425			

On the other hand, if the algorithm analyzed buy/sell in cases where MACD values were less than or greater than MACD values Signal Line lost us **PLN 79** in **108 trades**.



	Type	Date	Price
0	Bought	2019-08-06	3.85240
1	Sold	2019-08-20	3.92436
2	Bought	2019-08-28	3.96311
3	Sold	2019-09-04	3.93475
4	Bought	2019-09-06	3.93645
..
103	Sold	2023-12-29	3.93417
104	Bought	2024-01-15	3.99115
105	Sold	2024-02-05	4.04020
106	Bought	2024-02-28	3.98625
107	Sold	2024-02-29	3.99365
[108 rows x 3 columns]			
Start date: 2019-07-18			
End date: 2024-03-07			
Profit: -79.05000000004657			

Analysis of these results allows us to draw some important conclusions about the effectiveness of the investment strategy based on the MACD (Moving Average Convergence Divergence) indicator for the **USD/PLN** currency pair:

1. Profit size:

The strategy based on the constructed algorithm, which took into account the buy and sell moments defined by all the factors of the algorithm, yielded a profit (**PLN 457**), the strategy based on the analysis of the 2/3 day MACD downward/upward trend yielded loss (**-£908.03**), as did a strategy based only on the points indicated by the MACD indicator, which yielded a loss (**-£79**).

2. Number of transactions:

The strategy based on the constructed algorithm had a much smaller number of trades (**20 trades**) compared to the strategy based only on the trend or on the buy/sell points indicated by MACD (**100 or 108 trades**).

3. Stop-loss effectiveness:

The strategy based on the constructed algorithm proved effective in avoiding loss, which is noticeable when compared to a strategy that took into account all the buy/sell points indicated by the MACD.

Based on the aforementioned data, an algorithm that takes all factors into account for long-term investments has shown to be effective.

Summary

1. Profit size:

The strategy based on the constructed algorithm, which took into account the buy and sell moments defined by all factors of the algorithm, yielded a significant profit **(18.85%)** in the case of the analyzed company, while in the case of the currency it yielded a profit **(0.46%)**.

Compared to the strategy based only on the analysis of the 2/3-day downward/upward trend MACD for the company profit **(0.48%)**, while currencies a loss **(-0.9%)**.

Trades based solely on the buy/sell points of the MACD indicator resulted in a significant gain **(23.38%)** for the company and a minimal loss for currencies **(-0.08%)**

2. Number of transactions:

The strategy based on the constructed algorithm had a significantly lower number of trades **(16 and 20 trades)** compared to the strategy based only on the trend or buy/sell points indicated by MACD **(112 or 100 and 108 trades in both cases)**.

Fewer transactions can mean lower transaction costs and less risk associated with frequent buying and selling of shares.

3. Stop-loss effectiveness:

The strategy based on the constructed algorithm showed effectiveness in avoiding loss only **66% of the time** in the cases analyzed. In contrast, in the case of the company, its effectiveness is **100%**.

The algorithm based on analysis of the 2/3-day trend was the worst in the cases analyzed.

From the above analysis, it can be seen that the MACD indicator performs best in the analysis of companies and the algorithm based on it brings the highest returns there. The algorithm based on the MACD line intersection strategy along with the MACD Signal Line performed best there. In the case of currency pairs, the algorithm did not show significant gains or losses.