

# Using technical indicators in swing and position trading of financial instruments

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*Abstract: This study sets technical analysis in the context of organized markets (exchanges). Two commonly used indicators are explained and the trading signals given by these indicators from 1990 to 2023 are evaluated in an ex post approach. A simple trading rule is defined and the profit of this rule is calculated over the period 1990-2023. Without accounting for exchange commissions the rule yielded excess profit over the treasury benchmark.*

*Keywords: Stock trading; Technical analysis, Exchange technical indicators, NASDAQ; S&P; MACD; RSI;*

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## 1 Introduction

The topic of the appearance of organized markets is one of the interesting areas examined through economic history. From our point of view, the important thing is that it is one of the important institutions of modern capitalism, which has been present for centuries in countries with developed money circulation. Currently, organized markets have three main branches, but thanks to financial innovations, the product range is constantly expanding and there is a very strong connection between the individual sectors. These three branches are the stock

exchange, the commodity exchange and the foreign exchange market (FOREX). Securities (originally shares representing ownership and bonds representing debt) are traded on the stock exchange. The primary profile of the commodity exchange is the trade of basic foodstuffs, animal feed and industrial raw materials. World currencies are traded on FOREX, it is the largest market in terms of turnover value.

The capital strength, trading time and motivations of the players appearing on the markets are as diverse as the corresponding characteristics of the entrepreneurs and businesses operating on the input and out markets. The easiest way to understand this is through the example of the commodity exchange. The commodity exchange is very suitable for a farmer with a surplus of grain and a bakery company with a long-term demand for grain to find at once a price that corresponds to the supply/demand conditions of the given product. However, not only actors with net demand or net surplus trade, but also stock market players trying to take advantage of price movements. Speculation (the general name for the actions of these latter actors) can have a clearly adverse, market-distorting effect on stock market trading from a macroeconomic point of view, several regional currency crises have arisen for this reason in the last thirty years. At the same time, the presence of speculators increases liquidity (the continuity of price quotations in terms of time, price and quantity), and mostly facilitates the activities of actors with actual supply/demand who are looking for a suitable entry point to the market.

Hungarian authors research both, the Hungarian and international (USA) markets [1] [2]. Souza *et al* examined the profitability of the moving average technical trading rules in the case of BRICS countries [3]. Xiaoye Jin found that excess profits are not gained by simple technical trading rules and attributed the popularity of technical trading rules to the fact that players prefer a daily return distribution with positive skewness[4].

## **2. Stock trading in a technical approach**

### **2.1. Typical periods of stock market trading**

In the simplest case, an actor enters the stock market with the intention of selling or buying, this is now considered independent of what was described in the previous section. In general, the stock trader makes a profit if the purchase price is lower than the selling price - unfortunately, he almost always pays stock exchange commissions from the profit, but in some cases also on top of the loss. When the participant appearing with the intention of trading actually buys or sells (e.g. index contract on the futures market) the instrument, he takes a position (buying – long

or selling – short position). The net stock market exposure of participant becomes zero again by closing the position (selling the purchased instrument or buying back the sold instrument).

Nowadays (in 2023), the time span of holding a stock market position can range from a fraction of a second (the former is obviously possible in the case of algorithmic - machine - trading) to even decades. If a person (and not a computer software) decides to open the position, this period of time can be between minutes and decades. In general, the longer the time frame, the more the so-called "fundamental" factors play a role, the shorter the time frame, the more important the "self" movements of the market.

The economically based supply and demand factors for the given instrument are called fundamental factors. So, for example, in the case of commodity markets - agricultural products - demographic, geographical, climatic, meteorological factors and dietary habits. Similarly, in the case of a share, the fundamental factors are the product portfolio of the given company, the company's market position, organizational/management efficiency, but mainly the indicators of the annual/quarterly reports and quick reports that retrospectively record the economic activity of the company.

Although the actors' intention with stock trading is always to achieve a profit, we distinguish between trading and investing approaches. Investors typically hold a stock position for more than a year.

Further refining the division, we distinguish intra-day position taking and closing (day trade), holding a position for a few days or even a few weeks (swing trade) and holding a position for a few weeks to a year or even longer than a year (position trade). The swing trader tries to "catch" a larger share of favorable price changes, the position trader typically tries to take advantage of stock market trends (longer-term one-way movements).

A possible approach is to use the data of the stock market information flow, primarily the price and turnover of the instrument (exchange contract number, turnover expressed in the number of shares) to predict further price movements. This approach is called technical analysis.

Within the technical analysis, it is possible to identify exchange rate patterns on price charts ("charts") and it is also possible to use indicators formed

from price and turnover data. Dozens, a few hundreds, of both, exchange rate patterns and indicators, are known.

In the subsequent sections, the interpretations of indicators are based on the Charts School articles of stockcharts.com (as seen in November 2023), however these pieces of information are widely available at both, printed and online media.

## **2.2. MACD – Moving Average Convergence Divergence**

MACD compares two exponential moving averages, a fast one (12 period path by default) and a slow one (26 period path by default). The difference between the two moving averages is the MACD indicator itself. Due to the formation of differences, the MACD reacts more quickly to the price change of the instrument, and thus to the starting trend, than the moving average itself, however, the MACD is still a lagging indicator in its nature - just like the moving average. The sensitivity of the MACD can be increased by not considering the positive and negative zero crossings as buying and selling signals, but by defining a signal line, which is the exponential moving average of the MACD. In this case, we receive a buy signal when the MACD crosses the signal line upwards and a sell signal when the MACD crosses the signal line downwards. Of course, increasing the sensitivity also increases the probability of false signals (and even the rapid succession of the latter). The "default" value of the signal line is 9 periods.

The indicator is able to "predict" trend reversals, on the one hand with positive and negative zero crossings (or signal line crossings), and on the other hand with positive and negative divergences defined below, for the RSI indicator.

One of the disadvantages of MACD, as an indicator derived from a moving average, is that its possible values are strongly influenced by the magnitude of the instrument's price. This makes it difficult to compare the MACD diagrams of different instruments, but it also makes it difficult to compare the diagrams of an instrument that has experienced a significant price increase between certain periods. The solution to this shortcoming is the "Price Percentage Oscillator", which is actually a MACD indicator that is divided (normalized) by the value of the slow moving average.

### 2.3. RSI- Relative strength index

The RSI (relative strength index) is a momentum oscillator. Like its category peers, it is extremely sensitive. To calculate the RSI, we record the positive and negative price changes of the instrument separately. We form the moving averages of these price changes, the quotient of the moving averages calculated for a given number of periods is the so-called RS ( $RS = \text{average\_gain} / \text{average\_loss}$ ) variable. The formula of RS variable is

$$RSI = 100 - \frac{100}{1 + RS} \quad (1)$$

With this formula, we convert the value between 0 and 100 into the RSI. If RS is zero (zero average gain), then the second term is 100, which is subtracted from 100 to give zero. If the RS is infinite because we divide a non-zero average profit by a zero average loss, mathematically we subtract from 100 a term with an infinite denominator converging to zero, but so that this does not cause a problem, by definition the value of the RSI is 100 for a zero average loss.

RSI can be used in several approaches. First, oversold (below 30) and overbought (above 70) RSI values are best used in markets without a strong trend (sideways). If the instrument turns to decline at higher and higher price levels (higher peaks), this trend is not visible in the RSI, then technical analysts typically identify a negative divergence signal, which can be a sign of a trend reversal (it is assumed that lower bottoms and lower peaks - i.e. decreasing trend-following). Similarly, if the instrument hits lower and lower bottoms (turns to increase at lower and lower values), and the local minimums of the RSI do not decrease, then we identify a positive divergence (an increasing trend can be assumed). However, this signal can be misleading in strong and longer trends. According to a point of view that is somewhat closer to reality, it is worth waiting for a downward trend when the RSI falls from an "overbought" state (from a value above 70) to below 70, and an upward trend is worth waiting for when the RSI rises from an "oversold" state (from a value below 30) to above 30. We get one more step closer to the correct (profitable) RSI interpretation if we use a trend indicator (e.g. moving average or MACD) to determine whether the trend is rising or falling, and in the case of a rising trend in the range between 40-50, we assume that the RSI has reached its local minimum and in the case of a similar downward trend at values between 50-60, we assume that the RSI (and the exchange rate) has reached its local maximum.

In summary, one possible approach is to buy in an uptrend when the RSI rises above 40 or 50, and sell at 70 or 80 when the RSI crosses below that level. In

a downtrend, sell at 50 or 60, buy when the RSI crosses the 20 or 30 level from below.

### 3. US index data for the last 33 years in a "position trading" approach

#### 3.1. Exchange rate diagrams with comments on indicators

Below (Figure 1) is the weekly price chart of the NASDAQ Composite Index and the Standard and Poor's 500 (blue line) (1 vertical line = 1 week) in the period 1990-2023. Above the main chart is the RSI for NASDAQ, below the main chart is the MACD for NASDAQ, and below that is the corresponding PPO (Price Percentage Oscillator).



Figure 1

NASDAQ Composite and S&P 500 (blue line) indices and NASDAQ volume (1990-2023) with RSI (top), MACD and PPO of the NASDAQ (Chart courtesy of StockCharts.com)

Strong trends can be observed in both indexes between 1990-2000 and 2010-2021. During these periods, the MACD (PPO) was above zero most of the time, and the RSI was also in the overbought rather than oversold range. The intensity of negative emotions (fear of loss) prevailing in the stock market during the bursting of the "dotcom" bubble (2000-2003) and the subprime credit crisis (2007-2009), the negative peaks of the PPO are apparently farther from zero than those observed during rising trends positive peaks. Compared to these setbacks, the crisis caused by COVID-19 and the stagnation in 2022 seem insignificant, either based on the index values or the indicators.

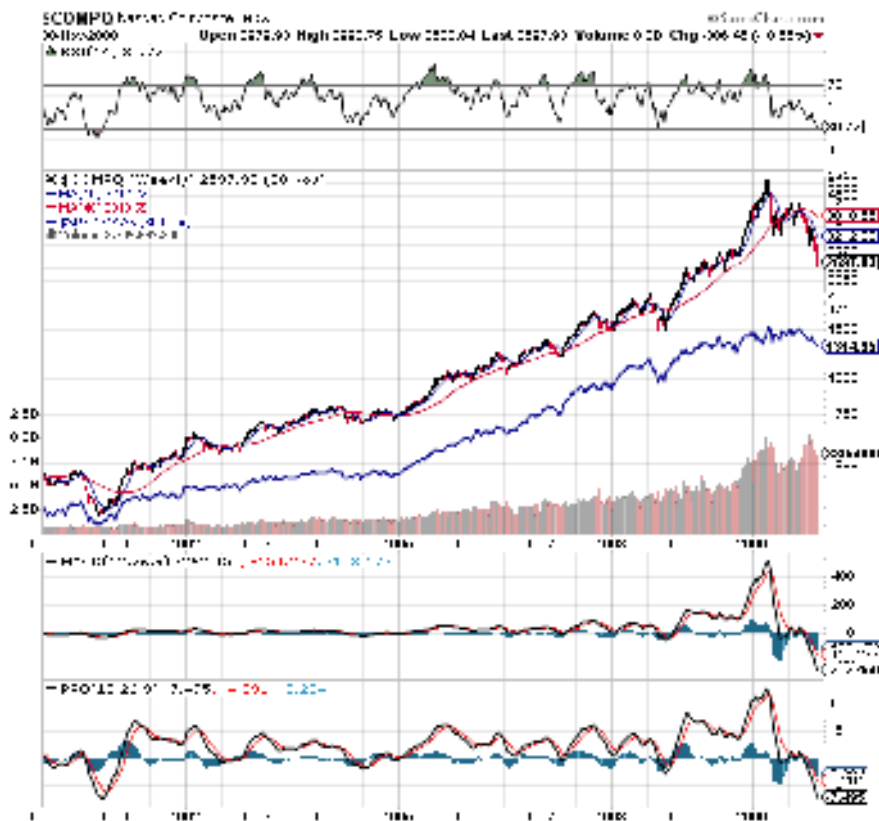


Figure 2

NASDAQ Composite and S&P 500 indices (blue line) and NASDAQ volume (1990-2000) with RSI (top), and MACD and PPO of the NASDAQ (Chart courtesy of StockCharts.com)

Figure 2 shows the price changes of the 1990s up to and including the end of December 2000. Since the NASDAQ index increased by 10 times during the examined period, it is worth monitoring the PPO instead of the MACD. From entering the positive range in 1991 until the decline in 2000, the PPO was negative for an extended period only in 1994. In the first half of the decade, the RSI at the height of 40-50 indicated very good index buying opportunities, in the 1995-2000 period, which was fraught with serious crises (Southeast Asian currency crisis, Russian state bankruptcy), the 30-40 zone represented good buying "entries". Taking a sell position when falling below the "excessive" (above 70) RSI values in an uptrend was a risky and promising attempt with little profit. The downtrends

of the NASDAQ within the uptrend typically "bounced" from its 40-week moving average (red line), corresponding to the 200-day moving average.

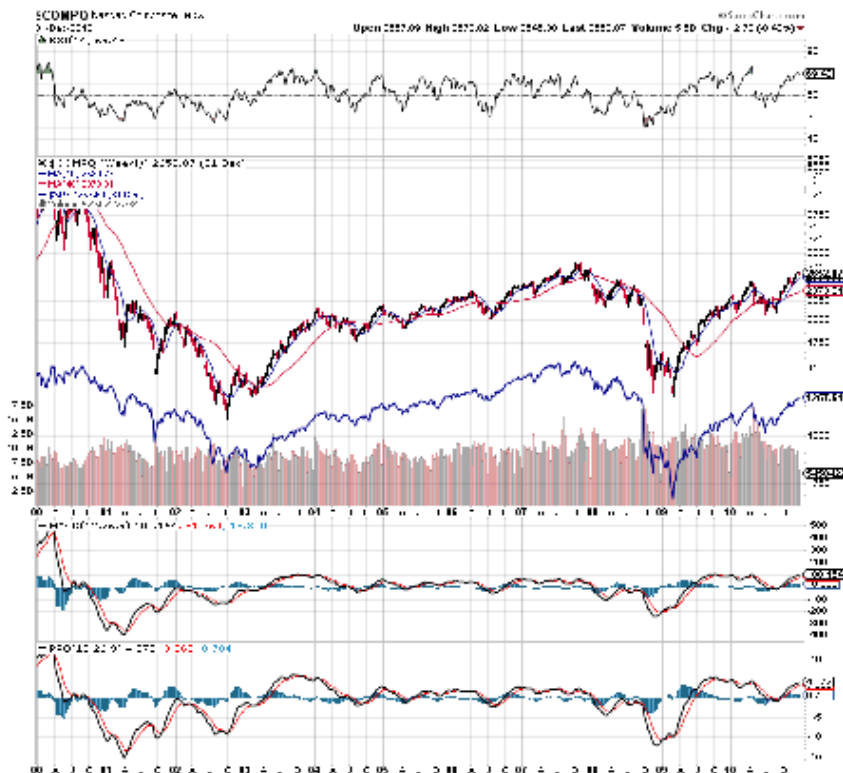


Figure 3

NASDAQ Composite and S&P 500 indices (blue line) and NASDAQ volume (2000-2010) with RSI (top), and MACD and PPO of the NASDAQ (Chart courtesy of StockCharts.com)

In Figure 3, we can also observe two periods characterized by falling prices (in stock market slang: bear market). In the year 2000, the NASDAQ started falling from around 5,000 points and the S&P 500 from around 1,500 points. The pace of the decline is indicated by the fact that the "bounces" in the negative basic trend did not reach the 40-week moving average, which was also falling, and typically turned back from the 10-week moving average. The decline of the NASDAQ moderated from the turn of 2002, but by this time it had already lost 60% of its highest value at that time. Price movement at this rate (and it is very often a price drop) is not suitable terrain for conservative traders experienced in risk management, large price swings are possible in both directions in quick succession, and hedging and insurance products are also expensive due to the high



volatility. At the beginning of the fall in 2000, the drop of the RSI from the overbought range gave a great sell signal, but as we wrote above, in previous years the same pattern was not worth using to open a position. In the third quarter of 2000, the RSI "spiked" above 50 twice, at which time the MACD was in a neutral signal regarding the zero transition. If someone used this signal to open a short position (e.g. by selling futures), they could make a considerable profit. The RSI reached the value of 50 at the end of 2001-2002 and then in the fourth quarter of 2002, and from the beginning of 2003 the 40-week moving average also indicates a rising market.

In the relatively calmer period between 2003-2007, the RSI's "classic" values of 30 and 70 correctly indicated the buy and sell points. In the NASDAQ, we do not see such a sharp rise as in the previous decade, the 40-week moving average is not a support (bottom turning point) in this period. The "subprime" crisis that is slowly becoming aware and the apocalyptic feeling that comes with it is clearly visible in the large negative swing of the PPO, the trend-following indicators (moving averages, MACD and PPO) turned negative at the beginning of 2008, after which spikes of the RSI around 50 indicated the opening of a suitable selling position. The price movement in the second half of 2008 was once again very fast, and the warning of caution formulated at the beginning of the 2000s is also true here.

The last thirteen years of the examined period can be characterized by a generally rising trend. There were periods of stagnation in 2010-2011, 2015, the COVID panic in 2020, and then the regression in 2022. It was possible to use the positive zero crossings of the MACD/PPO as a buy signal to achieve considerable profit with the trend, the issue of sell signals is more problematic. Since we use price charts with weekly resolution, PPO negative zero transitions arriving at quick price cuts (negative price spikes - for example in 2015 and 2020) were signaled so much later that the buy positions would have been closed near the local minimum. During the period in question, RSI dips around 40-60 in an uptrend, and up to 30 in the case of serious price declines, indicated good buying opportunities. RSI sell signals are also difficult to interpret if we want to link them to a drop below a specific value. On the contrary, in 2013-15 and 2020-2021, the negative divergence of the indicators can be observed. The instrument (the index) reaches higher and higher peaks, but the indicator has lower and lower maximums.

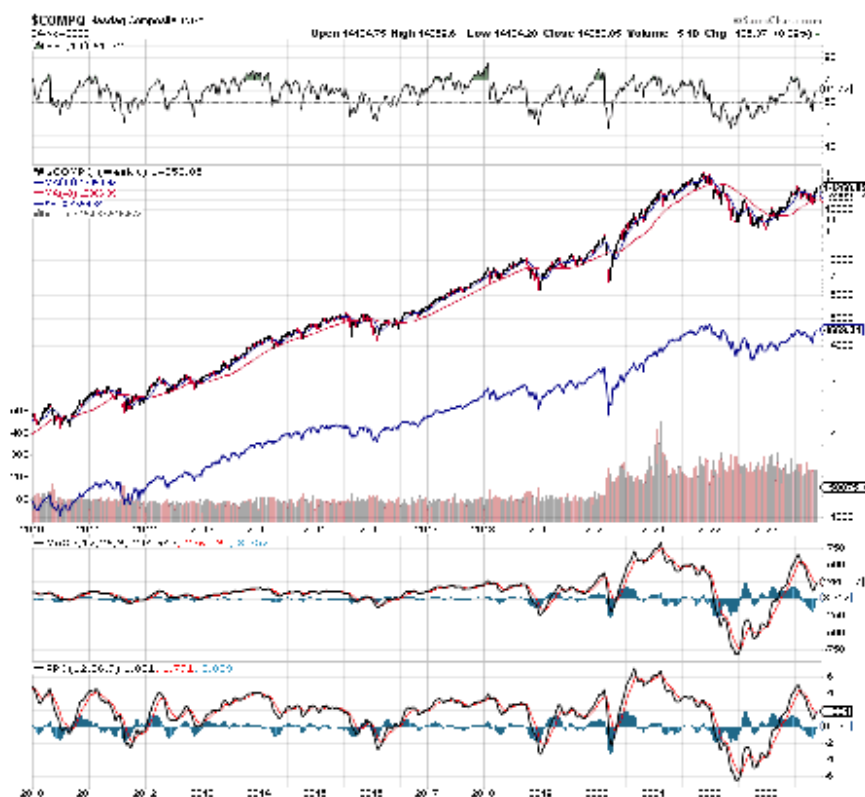


Figure 4

NASDAQ Composite and S&P 500 indices (blue line) and NASDAQ volume (2010-2023) with RSI (top), and MACD and PPO of the NASDAQ (Chart courtesy of StockCharts.com)

It is particularly interesting to compare the two decades characterized by a strong growing trend, the 1990s and the 2010s. Before the turn of the millennium, the RSI often peaked in the overbought range, compared to this, even in the case of strong growth in the 2010s, the maximum of the RSI was often below 70. Since the subject of our study is the examination of empirical facts, we cannot be certain about the cause of the phenomenon. Nevertheless, it was the Internet, and through it the wide spread of stock market data, that changed the effectiveness of the decision preparation tools of trading. In the Hungarian context, in the 1990s, only the most capital-strong players had such technical equipment and adequate, up-to-date data available at a significant price, not to mention the knowledge of indicators and their meaning, that they could use the signals of technical indicators on a daily basis. Starting from the second half of the decade of 2000, these devices became generally available, they are used by

millions worldwide, and as a result, the clarity and/or profitability of the given signals may even decrease.

### **3.2. Calculation of returns of a trading model based on MACD zero crossings**

Below we present the profitability of a very simple trading algorithm. Using weekly resolution data, we buy the index at the weekly opening price following the positive MACD zero crossing and sell the index at the weekly opening price following the negative MACD zero crossing. The profit (or loss) can be calculated as the difference between the sale price and the purchase price (absolute profit), or it can be calculated as the quotient of the sale price and the purchase price (relative profit or yield). The trader wins whenever the absolute profit is positive and the yield is above one, the trader loses in other cases.

Profits from a long only strategy has been calculated below. The S&P500 index is bought at positive zero crossovers and sold at negative ones, therefore the trader has either one contract exposure (long position) or none.

Alternatively profits could be calculated according to a „long and short” strategy or according to a „short only” one. As the name suggest, in the case of „short only strategy” the trader has either minus one contract exposure or none. In the case of „long and short” strategy, one contract is sold at the first negative zero crossover and it is bought back (a short position is closed) at the next positive zero crossover but at the same time one more contract is bought (a long position is opened). Logically at every subsequent zero crossovers two contracts are sold or bought, except the last positive crossover when the one long position is closed.

Multiplying the returns in Table 1 yields a quotient of 15.39, so by "playing" the described strategy with 1 unit, our investment would have grown to 15.39 units over the course of 33 years. On an annual basis (taking the 33rd root of 15.39), this is equivalent to an annual yield of 8.6%, calculated at compound interest. Of course, this attractive return expressed in dollars was achieved with risky stock market transactions, so for example, a higher return was expected compared to investing in government securities. Since we modeled the transaction on the American financial market, the authoritative ("risk-free") reference yield is the yield on American Treasury securities. It is a matter of perspective, whether we take 33 years as a basis, in this case we compare our profit on paper with the yield achievable with 10-20-30-year long-term securities, or we take it as a basis that 11 positions were opened and closed in 33 years, therefore the 3-year we consider the yield of government securities as a reference. As a reference, we attach the yield graphs of the 30-year, 10-year, 3-year and 1-year American government bonds for the period under review (Figure 5).

Table 1

Profitability calculation of MACD zero crossover (long only) strategy on the Standard and Poor's 500 index

Number	Character of zero crossing	Date	Purchase price	Sale price	Absolute profit	Yield
1	negative	1990.08.20		327,22		
2	positive	1991.02.04	332,72			
3	negative	1994.04.04		438,99	<b>106,27</b>	<b>1,319398</b>
4	positive	1994.08.22	461,76			
5	negative	1998.09.08		973,98	<b>512,22</b>	<b>2,109278</b>
6	positive	1998.11.09	1140,99			
7	negative	2000.10.16		1374,17	<b>233,18</b>	<b>1,204366</b>
8	positive	2003.05.12	933,41			
9	negative	2007.12.31		1475,25	<b>541,84</b>	<b>1,580495</b>
10	positive	2009.07.13	942,27			
11	negative	2010.06.28		1077,5	<b>135,23</b>	<b>1,143515</b>
12	positive	2010.09.20	1126,57			
13	negative	2011.08.08		1198,48	<b>71,91</b>	<b>1,063831</b>
14	positive	2012.01.03	1258,56			
15	negative	2015.08.24		1927,3	<b>668,74</b>	<b>1,531353</b>
16	positive	2015.11.23	2022,08			
17	negative	2016.01.11		1926,12	<b>-95,96</b>	<b>0,952544</b>
18	positive	2016.04.11	2078,83			
19	negative	2018.11.19		2730,74	<b>651,91</b>	<b>1,313595</b>
20	positive	2019.03.04	2814,37			
21	negative	2020.03.16		2508,59	<b>-305,78</b>	<b>0,89135</b>
22	positive	2020.06.22	3094,42			
23	negative	2022.03.07		4327,01	<b>1232,59</b>	<b>1,398327</b>
24	positive	2023.01.30	4049,27			

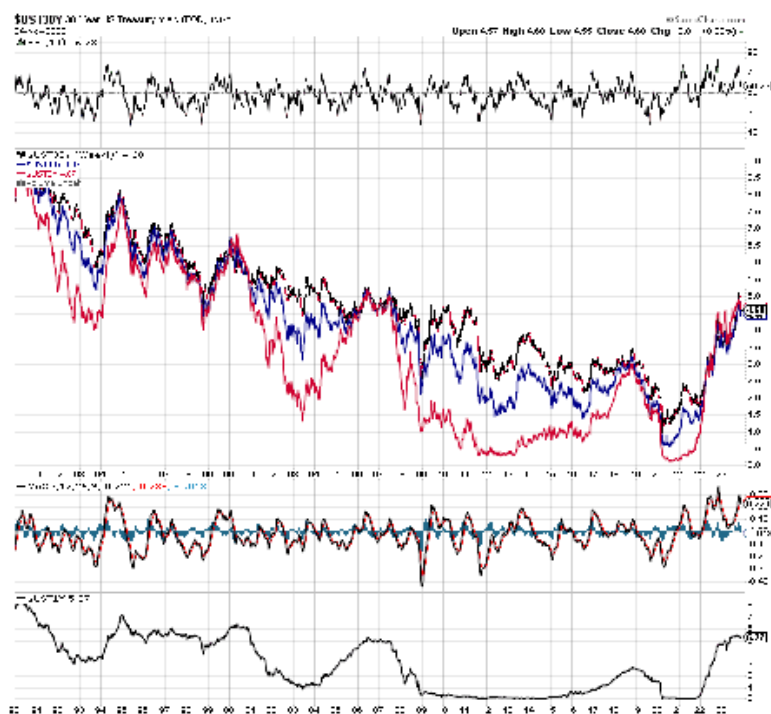


Figure 5

Weekly resolution chart of US government bond yields over the period 1990-2023. The basic diagram shows the yield of the 30-year bond, the blue line the 10-year bond, the red line the 3-year bond, the diagram below the MACD the yield of the 1-year bond. (Chart Courtesy of StockCharts.com)

## 4. Summary

The technical-based approach to the securities markets receives a lot of criticism from practitioners of academic finance. In this study, we presented the use of technical analysis (including price indicators), we examined the signals given by two very common examples of the hundreds of indicators, MACD and RSI, and we calculated the returns of a very simple strategy over the last few decades. period.

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