Rapid development of financial markets, taking into account both objective and institutional approach, causes investors’ demand for instruments enabling to act efficiently and control occurring phenomena and processes.

Systematic progress in areas concerning information flow and the access to foreign financial markets enabled their players to invest simultaneously in numerous goods on many stock exchanges. It has been growing into importance while joining European markets within the frames of the European Union. Multitude of information flows into markets, which has a direct influence on demand, supply and consequently, prices modelling. Under such circumstances, tools clearing the way for universal attitude towards every market and being the basis of the investment strategy building, are essential.

Technical analysis is one of the tools mentioned above. Thanks to its simplicity, it is an ideal and more and more common tool used by individual investors, banks, investment funds, pension and retirement funds all around the world. However, owing to enormous capitals they administer, they are not able to make the most of its potential. Its flexibility enables to analyse various markets. It is considered very useful especially for players of futures markets. The technical analysis assumes investigating behaviours which aims at forecasting future prices’ trends. While investigating, we use the following source of information: a price, a volume and a number of open items on the futures market.

It is based on three fundamental factors:

1) The market discounts everything

It is the essential assumption of the technical analysis according to which, all information of a basic and political nature is reflected in prices. From the
assumption, it results that the investigation of prices' behaviour is a totally sufficient approach because the market verifies all information immediately. It is equal to the thesis that the price should reflect changes in the demand and the supply. If the demand is bigger than the supply then, the price rises whereas it falls, otherwise. From the above statement it follows that all factors operating on the market are reflected in prices. Therefore, the investigation of prices is a completely self-sufficient approach.

2) Prices are influenced by trends

A definition of the trend is of great significance in the technical analysis. The investigation of prices' diagrams aims at recognizing trends at a preliminary stage, which enables to conclude a transaction compatible with their directions. Most methods are dedicated to the trends' investigation which means recognizing and monitoring them. Technical analysis assumes that the trend shows stronger tendency towards continuing its course in the previous direction than changing. It means that it will be continued until there are any signs of changes.

3) The history repeats

Technical analysis is based mainly on the trend analysis and the price formation. It is assumed that since the information appeared in the past announcing the boom or the fall, it will also have forecasting sense in the future. Therefore, the key to investigate the future is investigating the past.

Technical analysis is particularly useful on futures markets (Schwagier 2002, p. 768). It is connected with low requirements concerning security deposits. Considering that even insignificant prices movement can cause the loss of the whole deposit or at least its considerable part, the precision of concluding the transaction is extremely important.

Most indices of the technical analysis are used to investigate the market trend, that is a direction towards which the market follows. They enable to identify trends but also their turning points (Elder 1998, p. 146). Therefore, a character of the trend depends on how the prices establish following maximums and minimums. These turning points are described by the technical analysis as supports¹ and resistances². Supports and resistances are significant from the point of view of the trend analysis itself. In case of the downward trend, prices break away from supports and then continue their movement down. Whereas, in case of the upward trend, resistances stop the market for a while and then it moves up. The main advantage of using support and resistance levels consists in grasping the moment when the trend is not able to underbid the support or the resistance. It is the warning sign that the market is not able to

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¹ Support is a price level on which the demand occurs. The demand is able to stop a down trend or even cause its reversal.
² Resistance is a price level where the supply is strong enough to stop the upturn or cause its reversal.
continue the movement, which in practice means either reversion of the trend or turning into stabilization, that is the horizontal trend. Among others, indices of the technical analysis are to point out the process.

Indices of the technical analysis are not an ideal tool nevertheless, it is assumed that some of them are useful on markets of strong trends and other enable to identify turning points. They can be divided into (Elder 1998, p. 147):

- indices tracing the trend – they give clear signals if a market is in the trend whereas, they give erroneous ones in side trends. Here, we can mention: moving averages, MACD, directional system;
- oscillators – they give the best signals in relation to turning points on flat markets but they give premature ones on the market which begins to move in the trend. Here, we can mention: Stochastic, Rate of Change, Momentum, Relative Strength Index /RSI/;
- sentiment indices – they enable to check investors’ moods. Here, we can mention: New High – New Low Index, Advance/Decline Index, TRIN.

They are universal and widely applied indices. They are mainly used for analysing the market comprehensively giving, at the same time, the basis for making investment decisions.

2. METHODICAL APPROACHES OF THE STUDY

The interest in tools of the technical analysis is strictly connected with the problem of their efficiency on markets. In order to attain it investment systems are created. Investor’s behaviour on the market is connected with the assumed investment system. The system is a precise plan of the investor’s actions on the market. It can be built on the basis of some of indices of the technical analysis. It is connected with opening and closing items, taking into account the duration of the transaction. Within the scope of the application of investment systems on futures markets, it is recommended to define the following issues:

- the selection of futures markets,
- the recognition of the trend,
- the selection of the item’s opening moment,
- the selection of the item’s closing moment.

The paper aims at attempting to evaluate the efficiency of the most popular and the simplest indices of the technical analysis used in investment systems, with reference to the analysis of futures markets. However, the most of professionally built investment systems are based on several parameters and have the risk level (stop loss) assumed in advance. It means that the tests mentioned below reflect only the efficiency of tested tools not excluding their usefulness while building the investment strategy.
The evaluation is based on testing conducted by means of indices of the technical analysis with the use of examples of futures contracts quotations on the basis of stock-exchange indices, goods and currencies prices. The attempt to verify the usefulness of systems based on some indices was conducted with reference to:

- indices tracing the trend, which are represented by steping averages, MACD and directional system,
- oscillators represented by Relative Strength Index (RSI) and a stochastic oscillator.

The usefulness of futures contracts on the following markets was evaluated (every index was tested on each mentioned market):

- WIG 20 Futures,
- Gold Futures,
- FTSE 100 Futures,
- CAC 40 Futures,
- S&P E-mini Futures,
- NASDAQ 100 E-mini Futures,
- CRB Futures,
- EUR/USD Futures.

Conducted investigations were to enable to evaluate usefulness of purchase and sale signals generated by indices of the technical analysis. These signals included information about making profits from concluded transactions and their profitability. Indices' usefulness testing consists in evaluating results attained from the adjustment of investors' reaction to signals these indices reveal.

We used empirical materials concerning prices of futures contracts coming from official results of sessions of particular stock exchanges (Warsaw, London, Chicago). Data were obtained from the stock-exchange website www.akcje.net. They included the period of two years (1.03.2001–1.03.2003).

Obtained material was tested by means of computer techniques enabling to evaluate the efficiency of some indices of the technical analysis quite comprehensively.

All analysed transactions are concluded by means of only one futures contract (it makes the index' evaluation easier). Made profits are not reinvested, which means that only the initial capital is used. Tests' results, with reference to value approaches are expressed in points depicting the financial result (profit or

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3 Sentiment indices cannot be tested in terms of efficiency.

4 Included parameters were nominated in various designations. In order to obtain better clarity of presented data, they were unified. It is necessary to emphasise that comparisons concern only assessment criteria relating to the particular contracts since there are no relations between them.
loss). These points enable to pre-verify specific signals coming from indices of the technical analysis.

The evaluation of the usefulness of particular indices was based on criteria including: the proportion of profitable transaction, the proportion of unprofitable transactions, net profit, the average profit of the transaction, the average loss of the transaction, the ratio of average profit/loss, the biggest unit profit, the biggest unit loss.

3. TESTING SOME INDICES OF THE TECHNICAL ANALYSIS

As it was mentioned above, testing was conducted on the basis of indices tracing the trend and oscillators.

3.1. Indices tracing the trend

Indices tracing the trend are the most popular indices of the technical analysis. They are used to snatch movements on the market. They aim at generating signals of purchase in the initial trend’s phase as well as sale as soon as it is reversed. It is assumed that they are particularly important on markets located in clear-cut trends.

3.1.1. Steping average

Investment systems based on stepping averages are used most often. The stepping average is one of the most popular indices of the technical analysis. It is a universal and commonly used method. It is used to investigate existing trend as well as recognize and indicate its changes. The average analysis enables to identify the trend but also it can generate clear signals of the purchase and the sale.

The basic rule of using the stepping average is the purchase if closing prices cut the average from the bottom and the sale if they cut it from the top.

Exceeding the average of the “x” session by the closing price from the bottom is assumed to be the signal of the sale in case of using one stepping average. Cutting the stepping average of the “x” session by the closing price from the top is the signal of the purchase. For our test we made the assumption that the signal of the purchase is cutting the stepping average of 15 sessions calculated by means of the arithmetic method by the closing price from the bottom. Whereas, the signal of the sale is cutting the calculated arithmetically average of 15 sessions by the closing price from the top.
Results are presented in Table 1. Using this index was profitable in case of five out of all tested contracts: WIG 20 Futures, Gold Futures, S&P, NASDAQ 100 Futures and EUR/USD Futures. The loss was noticed in case of contracts for main European indices FTSE 100 Futures and CAC 40 Futures but also index CRB.

Taking into account profitability of the investment, the system based on 15-session average got very poor results. In none of tested cases it made the profit even in 4 out of 10 transactions (see Table 1). The best profitability was obtained in case of futures contracts for NASDAQ – 37%. The worst results were obtained by futures contracts for FTSE and CRB with the profitability less than 20%.

Quite poor results relating to the number of profitable transactions the system compensated with the ratio of the average profit to average loss. Actually, only in case of contracts for the main index of Paris Stock Exchange it did not exceed the rate 2. In case of contracts for S&P and CRB, the rate even exceeded the value 3 (see Table 1).

Table 1. Results of the system based on the stepping average

<table>
<thead>
<tr>
<th>Criteria of evaluation</th>
<th>Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WIG 20 Futures</td>
</tr>
<tr>
<td>Number of transactions in total</td>
<td>56</td>
</tr>
<tr>
<td>Share of profitable transactions in %</td>
<td>30</td>
</tr>
<tr>
<td>Share of unprofitable transactions in %</td>
<td>70</td>
</tr>
<tr>
<td>Profit/Loss in points</td>
<td>189</td>
</tr>
<tr>
<td>Average profit in points</td>
<td>63</td>
</tr>
<tr>
<td>Average loss in points</td>
<td>23.4</td>
</tr>
<tr>
<td>Ratios average profit/loss</td>
<td>2.69</td>
</tr>
<tr>
<td>The biggest profit in points</td>
<td>188</td>
</tr>
<tr>
<td>The biggest loss in points</td>
<td>62</td>
</tr>
</tbody>
</table>

Source: [www.akcje.net](http://www.akcje.net). Own calculations for all tables.

Only profits made in case of contracts for S&P, NASDAQ and EUR/USD can be considered satisfying. In remaining cases profits were made irregularly and in the period of two years they did not even exceeded the profit of the maximum transaction.
Although, the system yielded profits, it cannot be considered very efficient mainly in terms of a very small number of successful transactions. That is because there is no guarantee that short-term trends will occur on markets in the future and, as the examples in the table 1 show it, the number of missed transactions in side trends is very big.

### 3.1.2. MACD

MACD is an index based on averages and, to be precise, exponential averages. It is also known as the index of the analysis of convergence and discrepancy of moving averages. MACD performs best on markets located in strong and medium-term trends.

Its classic, initial form is based on 3 exponential averages which are presented in the form of two lines (Beau, Lucas 1998, p. 107). The first one represents the difference between the average of 26 periods and the average of 12 ones. The second one, called the signal line is the 9-session exponential average from the first line.

Signals generated by MACD occur when this index exceeds its average. When it exceeds it from the top, then we have to do with the sale signal, whereas exceeding it from the bottom indicates the purchase signal. Generating the signal on this index means concluding the purchase or sale transaction on the session’s closing.

**Table 2. Results of the system based on the MACD**

<table>
<thead>
<tr>
<th>Contract</th>
<th>WIG 20 Futures</th>
<th>Gold Futures</th>
<th>FTSE 100 Futures</th>
<th>CAC 40 Futures</th>
<th>S&amp;P E-mini Futures</th>
<th>NASDAQ 100 E-mini Futures</th>
<th>CRB Futures</th>
<th>EUR/USD Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria of evaluation</td>
<td>Number of transactions in total</td>
<td>36</td>
<td>32</td>
<td>48</td>
<td>40</td>
<td>36</td>
<td>36</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Share of profitable transactions in %</td>
<td>38</td>
<td>43</td>
<td>27</td>
<td>37</td>
<td>38</td>
<td>33</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Share of unprofitable transactions in %</td>
<td>62</td>
<td>57</td>
<td>73</td>
<td>63</td>
<td>62</td>
<td>67</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Profit/Loss in points</td>
<td>28</td>
<td>25.7</td>
<td>-1453</td>
<td>-220</td>
<td>8.75</td>
<td>-90</td>
<td>-31.5</td>
</tr>
<tr>
<td></td>
<td>Average profit in points</td>
<td>65</td>
<td>8</td>
<td>187</td>
<td>248</td>
<td>42</td>
<td>109</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Average loss in points</td>
<td>41</td>
<td>6.5</td>
<td>108</td>
<td>154</td>
<td>29</td>
<td>62</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>Ratios average profit/loss</td>
<td>1.5</td>
<td>1.23</td>
<td>1.73</td>
<td>1.61</td>
<td>1.44</td>
<td>1.75</td>
<td>3.37</td>
</tr>
<tr>
<td></td>
<td>The biggest profit in points</td>
<td>228</td>
<td>29</td>
<td>506</td>
<td>628</td>
<td>143</td>
<td>388</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>The biggest loss in points</td>
<td>118</td>
<td>17</td>
<td>108</td>
<td>390</td>
<td>29</td>
<td>163</td>
<td>5.15</td>
</tr>
</tbody>
</table>
Table 2 presents results of the test. The system based on MACD has the result similar to the one from the previous system. Tests revealed that, positive results were attained in case of four contracts: WIG 20, Gold, S&P and CRB. The number of transactions oscillated around 40, which means that the system based on MACD can be considered medium-term.

The system attained a very low index of the average profit in relation to the average loss. Only in case of contracts for CAC index, it exceeded the level of 2. In other contracts the index was located somewhat above the level of 1, which is not a very good result as for the tool following the trend.

Small discrepancies in particular contracts occur with reference to the number of profitable transactions. Generally, 6–7 out of 10 transactions were closed with the loss. The best result was attained in futures contracts for Gold where on average, the system succeeded in 4, 3 out of 10 transactions (see table 2).

There is no doubt that the best results were attained for Gold Futures. Unfortunately, taking into account the fact that in one out of 32 transactions in total, a bigger profit than in all remaining ones was made (using the system within 2 years), we cannot express a positive opinion about MACD.

Therefore, we cannot consider this tool efficient from the point of view of the investor either. Similarly to the stepping average, it does not guarantee that we will make profits. Even though it generates quite stable number of correct signals as for technical tools, the ratio of the average profit to the average loss is very low. In all likelihood, in the long term it will make attaining the stable rate of return impossible.

### 3.1.3. Directional system

The directional system is a method of the trend analysis. It identifies the trend but also shows what dynamics is characterized by and whether it is worth participating in it.

The basis of calculating the directional movement is the assumption that during the upward trend existence, the maximum of the following session should be located above the maximum of the previous one (Beau, Lucas 1998, p. 40). Whereas, in case of the downward trend, the minimum of the following session should be located below the minimum of the previous one.

The difference between the maximum price of the particular day and the maximum price of the previous one is called the directional movement $+\text{DM}$. The difference between the minimum price and the one of the previous day is $-\text{DM}$. Values $+\text{DM}$ and $-\text{DM}$ are averaged out and divided by the average from the real range of changes TR. It is defined as the biggest value from among:

- daily distance between the high and the low,
- the distance between the maximum and the closing from the previous day (the absolute value),
- the distance between the minimum and the closing from the previous day (the absolute value),

Listed indices enable to calculate the index of the directional movement line DI. It can take the positive or negative values.

\[ +DI = -DM/TR \quad -DI = -DM/TR \]

We tested the system DMI, which is the most popular in case of the directional system. It is the system in which signals are generated by cutting curves +DI/-DI. The signal of the purchase is exceeding the line -DI by +DI. In case of the tested system, it was assumed that both quantities are calculated on the basis of data coming from 14 sessions.

Results of the system were presented in Table 3. The number of transactions on particular markets differed significantly. The most transactions were concluded for FTSE whereas, the least for S&P, NASDAQ and CRB. The profit was made in case of 4 contracts: Gold, S&P, NASDAQ and CRB. The ratio of the average profit to the average loss turned out to be very high. In case of futures contracts for Gold, it reached the level of as many as 4. In none of the contracts it was lower than 1.5. Taking into account the fact that the system is based on indices following the trend, we can regard it as a very good result.

However, profitability of the system in tested cases is not very high. In case of contracts for WIG 20, Gold and CAC it reached the rate below 20%. Curiously enough, in case of Gold Futures it enabled to make the final profit.

Table 3. Results of the system based on the directional system (DMI)

<table>
<thead>
<tr>
<th>Criteria of evaluation</th>
<th>Contract</th>
<th>WIG 20 Futures</th>
<th>Gold Futures</th>
<th>FTSE 100 Futures</th>
<th>CAC 40 Futures</th>
<th>S&amp;P E-mini Futures</th>
<th>NASDAQ 100 Futures</th>
<th>CRB Futures</th>
<th>EUR/USD Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of transactions in total</td>
<td>45</td>
<td>40</td>
<td>47</td>
<td>36</td>
<td>26</td>
<td>28</td>
<td>39</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Share of profitable transactions in %</td>
<td>17</td>
<td>17</td>
<td>25</td>
<td>19</td>
<td>30</td>
<td>42</td>
<td>35</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Share of unprofitable transactions in %</td>
<td>83</td>
<td>83</td>
<td>75</td>
<td>81</td>
<td>70</td>
<td>58</td>
<td>65</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Profit/Loss in points</td>
<td>-142</td>
<td>16.8</td>
<td>-537</td>
<td>-89</td>
<td>306</td>
<td>447</td>
<td>6.35</td>
<td>-402</td>
<td></td>
</tr>
<tr>
<td>Average profit in points</td>
<td>90</td>
<td>14</td>
<td>183</td>
<td>429</td>
<td>46.25</td>
<td>104.5</td>
<td>4.8</td>
<td>238</td>
<td></td>
</tr>
<tr>
<td>Average loss in points</td>
<td>24.5</td>
<td>3</td>
<td>84</td>
<td>112.7</td>
<td>18</td>
<td>59</td>
<td>2.6</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>Ratios average profit/loss</td>
<td>3.6</td>
<td>4.66</td>
<td>2.17</td>
<td>3.8</td>
<td>2.56</td>
<td>1.77</td>
<td>1.84</td>
<td>2.24</td>
<td></td>
</tr>
<tr>
<td>The biggest profit in points</td>
<td>194</td>
<td>32</td>
<td>1033</td>
<td>1431</td>
<td>178.25</td>
<td>343.5</td>
<td>12.55</td>
<td>1063</td>
<td></td>
</tr>
<tr>
<td>The biggest loss in points</td>
<td>66</td>
<td>8.6</td>
<td>225</td>
<td>241.5</td>
<td>34.75</td>
<td>154.5</td>
<td>6.2</td>
<td>226</td>
<td></td>
</tr>
</tbody>
</table>
Despite the fact that the system brought quite decent results in particular contracts, we cannot consider it a very useful tool on financial markets. A high ratio of the profit to the loss proves that indices -DI and +DI are perfect when it comes to “discerning medium-term trends”. They can become an element of the wide transaction system. However, the tested version brings big losses in side trends.

3.2. Oscillators

Another group of indices of the technical analysis are oscillators. They are used to search for turning points on the market. They give the best signals on markets which are characterized by the lack of the unambiguous tendency. Most of oscillators have two charts of levels which are essential to analysts. These are buyout and sale. When the index reaches the position below the buyout level, it indicates the possibility of the markets turnabout down. The drop of the oscillator below the sale level indicates the possibility of the turnabout up. Generally, exceeding the sale level by the index from the bottom is considered the signal of the purchase. Unfortunately, oscillators give premature signals when the new tendency begins or during freeing from the consolidation. Therefore, they are considered auxiliary tools most often.

3.2.1. Relative Strength Index (RSI)

The oscillator RSI was constructed by W. Wilder (Murphy 1995, p. 295). It is the index which moves in the defined in advance area from 0 to 100 points. We use the following formula to calculate it:

\[
\text{RSI} = 100 - \left(\frac{100}{1+\text{RS}}\right)
\]

\text{RS} – the average value of the increase in closing prices from n days (the average value of the decrease in closing prices from n days)

The average value of the increase/decrease is the sum of the increase/decrease from the assumed period divided by their amount.

In case of the oscillator RSI, cutting the level of 30 from the bottom is considered the signal of the purchase whereas, cutting the level of 70 from the top – the signal of the sale. For our test it was assumed that RSI is calculated for seven sessions. Transactions are concluded with closing prices at the day of the signal occurrence.

Table 4 presents results of the test. This system is one of those playing against the trend. It is to notice when the particular instrument is “expensive” or “cheap” in other words, when market’s participants follow their emotions and a transaction is concluded exactly while prices turn back intensely.
### Table 4. Results of the system based on RSI

<table>
<thead>
<tr>
<th>Criteria of evaluation</th>
<th>Contract</th>
<th>WIG 20 Futures</th>
<th>Gold Futures</th>
<th>FTSE 100 Futures</th>
<th>CAC 40 Futures</th>
<th>S&amp;P E-mini Futures</th>
<th>NASDAQ 100 E-mini Futures</th>
<th>CRB Futures</th>
<th>EUR/USD Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of transactions in total</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Share of profitable transactions in %</td>
<td>73</td>
<td>53</td>
<td>70</td>
<td>62</td>
<td>66</td>
<td>53</td>
<td>60</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Share of unprofitable transactions in %</td>
<td>27</td>
<td>47</td>
<td>30</td>
<td>38</td>
<td>34</td>
<td>47</td>
<td>40</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Profit/Loss in points</td>
<td>163</td>
<td>-42.7</td>
<td>-1549</td>
<td>-1954</td>
<td>-172</td>
<td>-734</td>
<td>-12.6</td>
<td>-874</td>
<td></td>
</tr>
<tr>
<td>Average profit in points</td>
<td>67</td>
<td>10</td>
<td>108</td>
<td>107</td>
<td>34</td>
<td>74</td>
<td>5.8</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>Average loss in points</td>
<td>138</td>
<td>21</td>
<td>680</td>
<td>760</td>
<td>91</td>
<td>228</td>
<td>11.8</td>
<td>262</td>
<td></td>
</tr>
<tr>
<td>Ratios average profit/loss</td>
<td>0.48</td>
<td>0.47</td>
<td>0.15</td>
<td>0.22</td>
<td>0.37</td>
<td>0.35</td>
<td>0.49</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>The biggest profit in points</td>
<td>126</td>
<td>17</td>
<td>148</td>
<td>167</td>
<td>63.5</td>
<td>159</td>
<td>11.55</td>
<td>307</td>
<td></td>
</tr>
<tr>
<td>The biggest loss in points</td>
<td>300</td>
<td>39</td>
<td>1138</td>
<td>1421</td>
<td>189</td>
<td>421</td>
<td>21.35</td>
<td>859</td>
<td></td>
</tr>
</tbody>
</table>

In case of this system, the number of transactions was very small and ran at about 10. The system based on RSI gave disastrous results for all contracts except for the index of WIG 20.

The number of false transactions departs from the scheme which is presented by systems following the trend. In all tested contracts, the profitability of the system reached over 50% and in case of contracts for FTSE even 70%. However, it does not bring expected benefits for investors.

The ratio of the average profit to the average loss turned out to be the opposite of results achieved by means of systems following the trend. In none of investigated contracts it exceeded 1, which means that the average loss was always bigger than the average profit. Such a result must be judged negatively even as for the system playing against the trend. In all cases also the biggest loss exceeded the biggest profit several times within investigated period.

The system based on the oscillator RSI itself turns out to be useless. In all contracts which moved in trends for a long time, it brought huge losses.

### 3.2.2. Stochastic Oscillator

Using the Stochastic Oscillator aims at defining the relation between the closing price and the range of prices fluctuations of the given period. It consists of two lines: % K and % D. The formula for the line K is as follows:
\[ %K = \frac{(C_D - L_n)}{(H_n - L_n)} \times 100, \]

where:
- \(C_D\) – the price of the particular day,
- \(H_n\) – the biggest price in assumed time range,
- \(L_n\) - the smallest price in assumed time range,

\(\% D\) is created by smoothing \(\% K\). Its formula is as follows:

\[ \% D = \frac{3 \text{ daily sum } (C_D - L_n)}{3 \text{ daily sum } (H_n - L_n)} \times 100. \]

Similarly to RSIP, the Stochastic Oscillator is designed so that fluctuations run from 0 to 10. In case of this index, exceeding the level of 25 points is assumed to be a signal of the purchase whereas, exceeding the level of 75 points – the signal of the sale. The transaction is concluded on the closing of the session during which the signal was generated. Table 5 presents results of the test.

Taking into account the fact that the system based on the Stochastic Oscillator is, similarly to the one based on RSI, the system playing against the trend, we can expect approximate results.

The system generated about 20 transactions on all markets and that is why it can be considered the medium-term one. When it comes to the number of false transactions, we must state that in case of most of tested contracts, the system committed about 4–5 errors in 10 signals. Only futures contracts for NASDAQ index where the profitability reached merely 35% were exceptional (see Table 5).

**Table 5. Results of the system based on Stochastic Oscillator**

<table>
<thead>
<tr>
<th>Assessment criteria</th>
<th>Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WIG 20 Futures</td>
</tr>
<tr>
<td>Number of transactions in total</td>
<td>25</td>
</tr>
<tr>
<td>Share of profitable transactions in %</td>
<td>68</td>
</tr>
<tr>
<td>Share of unprofitable transactions in %</td>
<td>32</td>
</tr>
<tr>
<td>Profit/Loss in points</td>
<td>549</td>
</tr>
<tr>
<td>Average profit in points</td>
<td>62.5</td>
</tr>
<tr>
<td>Average loss in points</td>
<td>60</td>
</tr>
<tr>
<td>Ratios average profit/loss</td>
<td>1.04</td>
</tr>
<tr>
<td>The biggest profit in points</td>
<td>192</td>
</tr>
<tr>
<td>The biggest loss in points</td>
<td>149</td>
</tr>
</tbody>
</table>
Only transactions for Gold Futures and WIG 20 were profitable. In case of other contracts we could observed regular losses. Only in case of one contract, the ratio of the average profit to the average loss was higher than 1. The worst result gave the contract for the index of French Stock Exchange CAC. It reached merely the level of 0.27. The analysis of the Stochastic Oscillator shows its poor efficiency. It is the index which gives many good indications in side trends but unfortunately, in case of strong and dynamic tendencies, it may bring heavy losses. Independently used is an inefficient tool which makes investors suffer defeat.

4. FINAL REMARKS

Conclusions relating to efficiency of tools of the technical analysis are not very positive. Only one of tested tools namely, the system based on one stepping average yielded profit. All remaining although based on the most popular tools of the technical analysis, brought losses within the investigated period.

It is necessary to draw our attention to the fact that the situation could have been even less favourable for investors if they had concluded transactions with the biggest loss generated by the system (it did not happen in described cases). Under such circumstances, investors would not be able to undo the loss which would bring even worse results than those presented in analyses.

Analyses included the transactions’ cost, that is commissions. It seems that this is only the part of the profit but penetrating analysis of a few dozen of transactions proves that they can even cover 50% of profits made in particular contracts in the period of two years. Investors have to do with similar situation in case of losses as well.

Conducted tests did not include the price slippage which is one of significant elements of transactions. It is the difference between the level of signal generating and the level of concluding the transaction. The best example can be the signal generated on the closing, that is when the investor cannot conclude the transaction until the next session is open. Losses caused by the price slippage are similar to commission costs (Zalewski 2000, p. 39).

It is commonly assumed that the investor concluding 40% of successful transactions but of the relation between the risk (defined as the distance of the stop order) and the profit 1:3, is able to remain on the market quite long. Results of tools such as averages, MACD and freeing from the canal suggest that reaching such results by means of only basic tools of the technical analysis is impossible. None of the methods following the trend give such results in none of
tested futures contracts over a span of two years. From the other hand, generating more correct signals, oscillators lose so many advantages in dynamic trends that basing transactions on their signals means bankruptcy.

It turns out that it is impossible to state objectively that transactions based on tools of the technical analysis are able to bring satisfactory investment results. On the basis of obtained results we can state that usefulness of applied tools is troublesome. Credibility of such an opinion has its basis both in the number of tested contracts and duration of tests conducting.

However, obtained results require careful treatment since all methods were tested on the basis of assumed parameters. For example, if tests were based on the 21-session exponential average, we could get different results. Many experts in investment system creating emphasise that markets have their own specificity. It is often assumed that for some markets, averages of the length above 20 time units but on others – below 10 ones turn out to be useful. However, these are approaches worked out only on the basis of historical data and they have nothing to do with the reality of financial markets.

The technical analysis has been the basis for many analytical tools for years. It has developed and surely it is going to develop together with the development of futures markets, their globalization and tightening financial bonds among supranational economic groups, such as the European Union.

However, most probably, considering its subjectivism and more and more widespread application of computer techniques while making investment decisions, its development is going to head towards full automation of investment signals. In such a form, the role of the classic charts analysis is going to be gradually replaced by the analysis of technical indices decreasing the subjective reading of formations to the advantage of clear signals of purchase and sale generated by the particular indices.

The essential factor of the development of all forms of analyses is the development of futures markets themselves. Nowadays, considering progressive globalization, we have to do with the concentration of contracts turnover on a few most important stock exchanges in the world. As a result, they offer floating products of high variability and low commissions which create good conditions for using the technical analysis. Less favourable situation occurs on floors where the liquidity is not very big.

The demand for analytical tools will depend on the development of the particular futures markets supported by the introduction of modern financial products. The technical analysis, despite its imperfection, is still one of the most popular financial products. However, its development will be connected with the progress in creating more useful and more effective solutions relating to its particular instruments.
REFERENCES


Janusz Zrobek, Piotr Zrobek

PRZYDATNOŚĆ WYBRANYCH INSTRUMENTÓW ANALIZY TECHNICZNEJ NA RYNKACH TERMINOWYCH

Wzrastająca dostępność finansowych rynków europejskich w ramach UE wzmaga zapotrzebowanie polskich inwestorów na narzędzia, umożliwiające uniwersalne podejście do każdego rynku oraz stanowiące podstawę budowania strategii inwestycyjnej. Celem artykułu jest próba oceny efektywności takich narzędzi, tj. najpopularniejszych wskaźników analizy technicznej, wykorzystywanych w systemach inwestycyjnych w odniesieniu do wybranych rynków kontraktów terminowych. Przeprowadzono badanie, mające pomóc ocenić przydatność generowanych przez wskaźniki analizy technicznej sygnałów kupna i sprzedaży do osiągania zysków z zawieranych transakcji.