Selecting the Efficient Market Indicators in the Trading System on the Forex Market

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key words: technical indicators, efficiency analysis, trading system,
multicriteria analysis

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2. Rule-based trading system and indicators
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Forex market

- forex (foreign exchange) market is a global, decentralized market with currency pairs as instruments;
- forex is considered as the most liquid market in the world;
- the instrument on the forex market is the currency pair, which represents the ratio of two different currencies to each other;
- the smallest instrument change is called pips and it is equal to 0.0001;
- stock exchange data are often considered as the chaotic data without visible point attractor[*];

[*] Ramasamy R., Mohd Hanif Mohd Helmi, Chaotic Behavior of Financial Time Series-An Empirical Assessment, International Journal of Business and Social Science, Vol. 2 No. 3, 2011.

4 overlapping sessions (Sydney, Tokyo, London, New York)
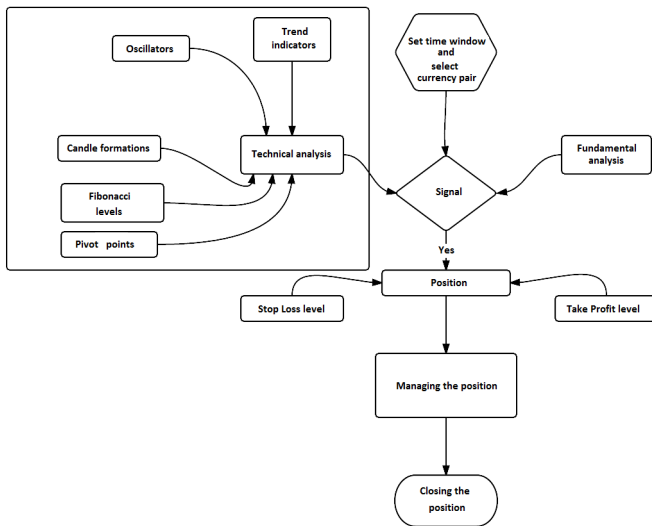
General schema of the trading system

Fully automated system

- allows to perform multiple transactions within seconds;
- emotions are excluded from the trading process;
- complex rules included in the system.

Decision support system

- the system initially estimates the set of instruments potentially interesting for the decision-maker;
- the decision-maker may additionally apply other types of analysis on the market situations;
- the system assures the sovereignty of the decision-maker.

The proposed approach can be used in decision support trading systems and fully automated trading systems.

Trading phases
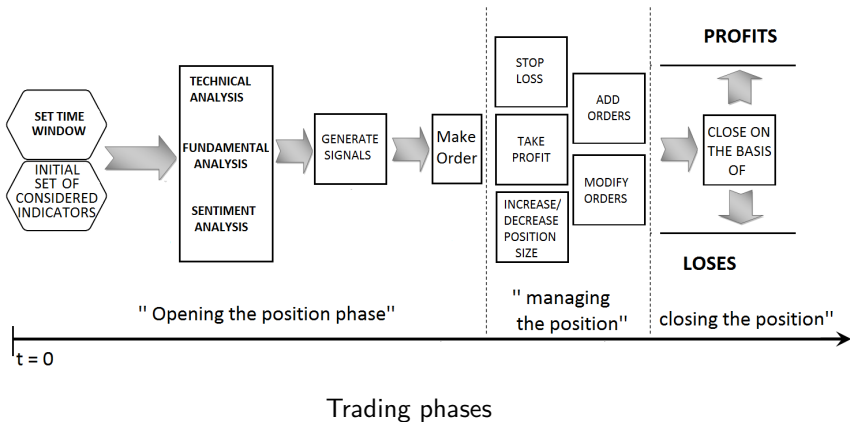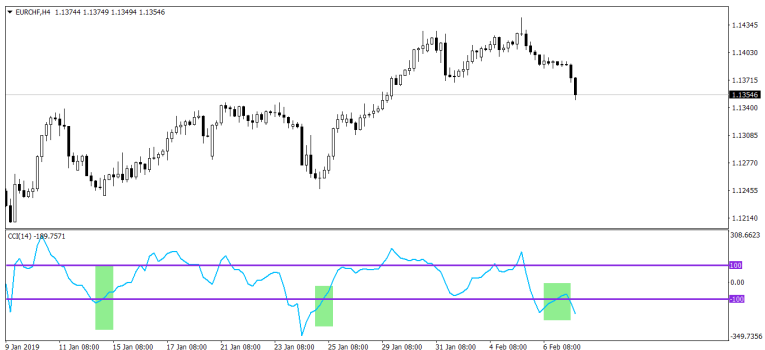
Channel Commodity Index (CCI) indicator and generated signals

$$CCI = \frac{1}{0.015} \cdot \frac{price_{typical} - MA(price_{typical})}{\sigma(price_{typical})}, \tag{1}$$

– $price_{typical}$ is a typical price
– σ is the mean absolute deviation.

Existing problems

- a very large set of instruments available for the decision-maker;
- difficulties to describe the experience of the decision-maker on the forex market as the simple, trading rules;
- lack of agreement related to the efficiency of the automated systems[*].

[*] Cheol-Ho Park., Irwin Scott H. What do we know about the profitability of technical analysis?, Journal of Economic Surveys, Vol. 21, Issue 4 pp. 786–826, 2007.

Motivation

- lack of visible advantage of single indicator (or group of indicators) for the single instrument;
- extending the analyzed time window leads to a visible drop of efficiency for all market indicators (below 40% – 50% of profitable trades);
- trend change affects the efficiency of the trading system;
- selected indicators showed large efficiency of the market for narrow time windows.

Goals

- Providing different efficiency measures;
- Proposals of formal decription of these measures;
- Analyze the efficiency of different market indicators with the use of these measures.

Setting the environment

Let's assume, that for a given time window T, set $U_{i,curr}$ includes all transactions opened on the basis of rules from the indicator i in time window T. The number of profitable transactions for the indicator i and the currency pair $curr$ can be measured as:

$$|U_{i,curr}| = \{u_i \in U_{i,curr} : order(u_i, \delta) > \epsilon\}, \tag{2}$$

where $order(u_i, \delta)$ is the result of the transaction u_i after time window δ, while ϵ is a threshold used to exclude situations, for which the price of the instrument was in a very narrow price channel smaller than ϵ.

System efficiency

The capability of the trading system to derive satisfactory signals to the decision-maker.

Proposed measures

- number of profitable signals derived (as a percentage of the overall number of signals) – called further "accuracy";
- profit or loss achieved in some measurable units (in our case in pips) – called further "profit";
- the maximal observed loss of profit in successive transactions during the whole trading period – called further "max drawdown".

The confusion matrix

The confusion matrix contains information about an object's decision class as well as the class into which this object has been classified.

|	Predicted positive	Predicted negative
Positive examples	True positive (TP)	False negative (FN)
Negative examples	False positive (FP)	True negative (TN)

- True positive for the BUY signal (when the price rises);
- True negative for the BUY signal (when the price drops);
- False negative for the SELL signal (when the price drops) – out of the scope of this article;
- False positive for the SELL signal (when the price rises) – out of the scope of this article.

The accuracy of classification describes the ratio of objects that have been correctly classified to all objects in a class.

$$ev_{acc}(T, S) = \frac{(TP)}{(TP + FP)}$$

where T is the time window and S is the instrument (or set of instruments)

|	Predicted positive	Predicted negative
Positive examples	True positive (TP)	False negative (FN)
Negative examples	False positive (FP)	True negative (TN)
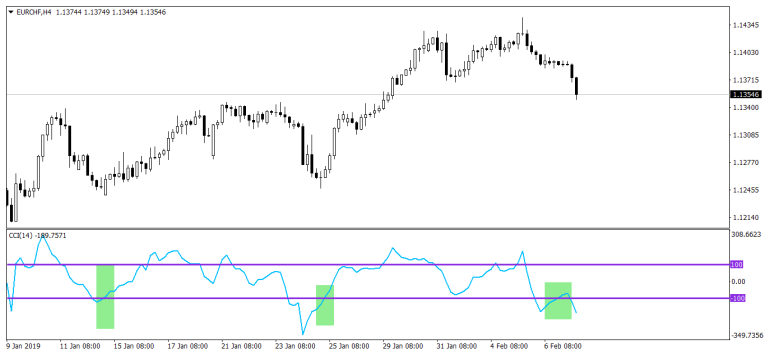
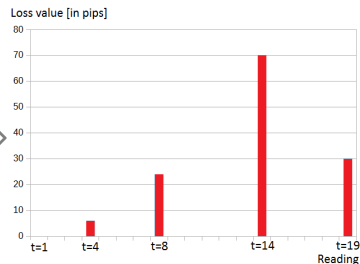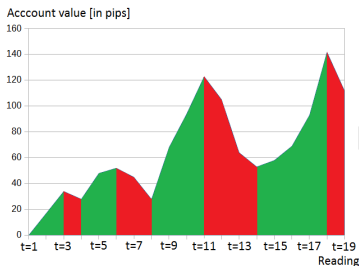Channel Commodity Index (CCI) indicator and generated signals

BUY signal in the classical crisp approach

$$cond_{IND_{Buy}} \text{ if } (IND_n(t-1) < c_1) \wedge (IND_n(t) > c_1), \qquad (3)$$

$IND_p(t-1)$ is the value of the indicator IND in time $t-1$ related to time interval p; c_1 is the given indicator value set as constant.
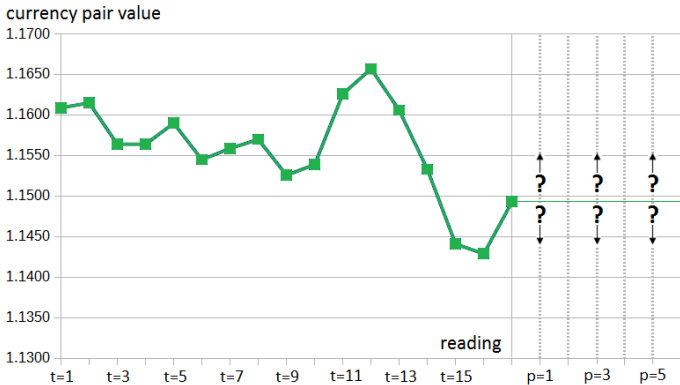
Accuracy measure for different *p* (measuring the profit/loss after *p* readings)

Max drawdown concept presented as the account value in successive signals

$$draw(T) = max(v_1, v_2, ..., v_n), where\ v_i = h_i - l_i, \qquad (4)$$

where h_i is the i-th peak value observed in the account value, while l_i is the lowest value before the new height is derived (the lowest value following directly after the h_i). Thus we select the highest drawdown observed in the whole trading during time span T.

Technical indicators used in the experiments

- CCI (Commodity Channel Index), RSI (Relative Strength Index), DeMarker – oscillators used to estimate potential overbought and oversold levels possibly the most effective during the side trend;

- OsMA (Oscillator – Moving Average) – an indicator used to estimate the difference between MACD (which combines two exponential moving averages) indicator and moving average calculated on the basis of this indicator;

- Bulls power – indicator used to measure the strength of the rising trend.

Experiments – in numbers

- 15 different currency pairs;
- the time span of 9 years from 1st January 2010 to 31st December 2018.
- 5 different market indicators;
- 2 different time windows:
    1. D1 – an overall number of available readings was equal to 2400;
    2. H4 – an overall number of available readings was equal to 12000;
- accuracy measure for 3 different p values and 3 (out of 5 indicators);
- profit measure (described in the article);
- max drawdown measure (analysis for selected cases).

The accuracy of the prediction for the $D1$ time window and three selected indicators

D1	CCI			RSI			DM		
	$p=1$	$p=3$	$p=5$	$p=1$	$p=3$	$p=5$	$p=1$	$p=3$	$p=5$
AUDCHF	63%	16%	21%	74%	10%	19%	68%	40%	43%
AUDJPY	61%	18%	24%	69%	6%	17%	69%	40%	47%
AUDUSD	57%	19%	23%	64%	18%	18%	68%	37%	37%
EURAUD	54%	22%	26%	69%	17%	31%	66%	24%	32%
EURCHF	46%	14%	28%	63%	16%	31%	63%	28%	40%
EURGBP	58%	20%	31%	69%	16%	25%	71%	38%	34%
EURUSD	56%	15%	22%	69%	18%	21%	67%	28%	35%
GBPCHF	56%	14%	18%	70%	20%	36%	70%	23%	35%
GBPJPY	53%	13%	19%	60%	14%	31%	73%	32%	32%
GBPNZD	51%	16%	25%	76%	16%	26%	72%	28%	37%
GBPUSD	54%	23%	25%	68%	8%	29%	69%	25%	39%
NZDCAD	55%	20%	25%	75%	13%	25%	70%	49%	60%
NZDJPY	55%	19%	23%	65%	13%	20%	68%	31%	31%
NZDUSD	55%	17%	23%	47%	12%	21%	64%	38%	46%
USDCHF	57%	17%	22%	66%	16%	13%	68%	31%	30%

The accuracy of the prediction for the $H4$ time window and three selected indicators

H4	CCI			RSI			DM		
	$p=1$	$p=3$	$p=5$	$p=1$	$p=3$	$p=5$	$p=1$	$p=3$	$p=5$
AUDCHF	56%	17%	24%	67%	14%	18%	63%	38%	40%
AUDJPY	55%	17%	25%	71%	17%	24%	64%	34%	37%
AUDUSD	56%	18%	25%	67%	20%	27%	69%	38%	40%
EURAUD	57%	18%	25%	66%	14%	20%	68%	34%	37%
EURCHF	55%	20%	25%	74%	15%	20%	70%	41%	38%
EURGBP	54%	17%	23%	70%	16%	22%	67%	35%	36%
EURUSD	56%	18%	23%	65%	21%	25%	71%	39%	38%
GBPCHF	53%	19%	23%	68%	13%	20%	72%	38%	38%
GBPJPY	54%	15%	21%	69%	17%	26%	69%	34%	34%
GBPNZD	54%	19%	26%	63%	18%	22%	70%	34%	40%
GBPUSD	56%	17%	23%	67%	22%	22%	70%	36%	39%
NZDCAD	55%	19%	27%	72%	19%	29%	67%	39%	41%
NZDJPY	57%	17%	24%	67%	18%	20%	68%	38%	40%
NZDUSD	56%	16%	24%	68%	19%	21%	68%	33%	40%
USDCHF	56%	18%	26%	63%	17%	25%	65%	33%	36%
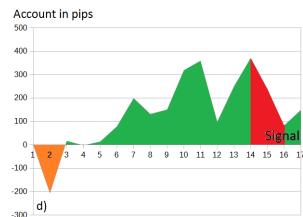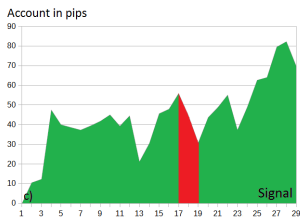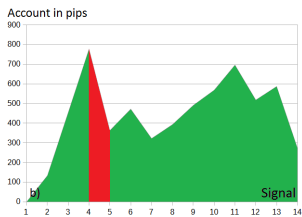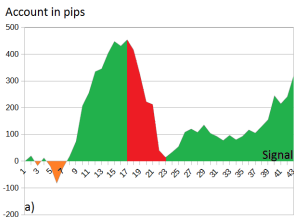
Max drawdown concept presented as the account value in successive signals (in pips)*
(a) Bulls indicator for the EURCHF; (b) OsMA indicator for the EURUSD; (c) Bulls indicator for the GBPCHF; (d) DeMarker indicator for the NZDUSD

* For selected time interval covering approx. 2 years for the currency pair.

Summary

- there is no single market indicator (or group of indicators) capable to derive very good signals in the long-term;
- time of the opened trade is crucial for measuring the efficiency of the trading system;
- different aspects (like accuracy, profit, maximal drawdown) should be included jointly in the efficiency measure (multicriteria approach);
- selecting the proper time window (currency pair in strong trend) is more important, than selecting the market indicator.

Future works

- Construction of a formal definition of efficiency measure based on the multicriteria approach;
- investigating the impact of transaction costs on profits.

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Soft multicriteria computing supporting decisions on the Forex market,

Applied Soft Computing Journal. 96 (2020) 106654, pp.1-12.

R. Cervelló-Royoa, F. Guijarroa, K. Michniuk

Stock market trading rule based on pattern recognition and technical analysis: Forecasting the DJIA index with intraday data.

Expert Systems with Applications, Vol. 42, Is. 14, pp. 5963 — 5975, 2015.

A. Brabazon, M. O'Neill

Evolving technical trading rules for spot foreign-exchange markets using grammatical evolution.

Computational Management Science, Vol. 1, Iss. 3, pp 311-327, 2004.

M. Ozturka, I. Hakki Toroslua,G. Fidan

Heuristic based trading system on Forex data using technical indicator rules

Applied Soft Computing, Vol. 43, pp. 170-186, 2016.

Thank you for your attention