TRADING & QUANTITATIVE RESEARCH REPORT

PRICE SPIKES & REVERSALS

Identifying and Exploiting Price Spikes & Reversals in the the Forex Market

In collaboration with:

CENTURY
ANALYTICS

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INTRODUCTION & THEORY

Introduction

This paper is a merge and continuation of two previous investigations which aimed to utilize quantitative methods to identify and exploit non-random patterns following price spikes(PS)[1] and price spike reversals(PSR)[2] in the FX market. Price spikes and price spike reversals occur suddenly and are the result of complex market psychology. Participants of a market tend to act in a way so that a price movement occurs, the movements can be divided into two main scenarios. One, in which participants' behaviour has a great impact in the market which leads to rapid and unpredictable price movements. Two, most often price movements are small continuous movements that contain valuable information about the market. In this paper the secondly mentioned is assumed to be the scenario most frequent and relevant and is used as one of the fundamental pillars.

The definitions on which this paper is based upon suggest that the price will continue in the direction of the PS or PSR during a time frame after it occurred, which is utilized in the strategies. Price movements of the character discussed above are examples of short-term anomalies, by exploiting these one could potentially gain a better understanding of the information it holds and in which direction it drives the movement.

This investigation continues as a collaboration with AI-driven hedge fund Century Analytics, who provided the definitions for price spikes and price spike reversals. The previous reports both resulted in a lack of evidence for non-randomness in their respective investigations. Thus, this project compares two definitions of price spikes in an attempt to find a viable pattern after price spikes and reversals The previously defined trading strategies will be used with the two price spike definitions. The data used to test the trading algorithm is currency pair data provided by Century Analytics for the previous algorithms and sourced from Bloomberg. The data used ranges from 2008 to 2018, in 1-minute resolution for currency pairs EUR/USD. The assumption carries on from previous research that if a pattern is found across different currency pairs, non-randomness in the market has been identified. .

Definitions

This paper deals with two definitions of price spikes and one price spike reversals definition, all provided by Century Analytics in the first investigations, and are as follows:

PS1: A price spike occurs when the absolute value of a 15-minute percentage change (from open to close) exceeds the boundary defined as two-month rolling average plus two standard deviations of 15-minute percentage changes. The spike is identified as the 14 minutes prior to the first minute bar which exceeded the boundary, thus is backward-looking and limits each spike to a length of 15 minutes.

PS2: A price spike occurs the minute bar that the absolute 15-minute percent change is outside the boundary (as defined earlier) and ends the minute bar in which it is no longer outside the boundary. Thus, this definition is forward-looking, and spikes vary in length.

PSR: A price spike reversal occurs when the price returns to the highest [lowest] price of the preceding spike within the following 30 minutes after the spike.

A change to the definitions to note is that for the price spike definitions, the 45-minute interval condition between spikes was removed, as this was originally included to accommodate space for reversals. However, after some conversation with Century, we are treating these two patterns as separate from each other, and thus overlaps are not an issue. This allows us to capture a greater number of spikes and reversals than in the prior investigations.

Visualization

Figure 1 and 2 show spikes and reversals under the two different spike definitions described. The areas highlighted in red represent price spikes, and the ones in blue represent price reversals.

Figure 1 shows the patterns under PS1, and thus the spikes are always limited to 15-minute lengths. As per its definition, the last minute bar of each spike is outside the 2-month plus 2 standard deviation 15-minute change boundary, and the previous 14 minute bars are accounted as the spike pattern. The reversal that follows the second spike in this figure is within 30 minutes after the spike and ends the minute bar that the price returned to the highest price in the previous downward spike, thus an upwards reversal.

Figure 2 shows the patterns under PS2; thus the spike vary in lengths as shown, and every minute bar that make up these spikes are outside of the 2-month plus 2 standard deviation 15-minute change boundary. The reversal that follows is also within 30 minutes of the spikes as in Figure 1, as the reversals follow the common definition PSR.

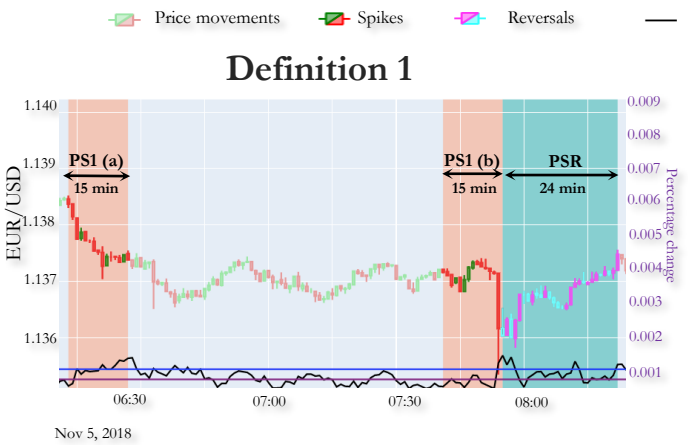

Figure 1. Candlestick visualization of spikes and reversal under spike definition 1 (PS1). Y-axis indicates EUR/USD exchange rate, time on x-axis.

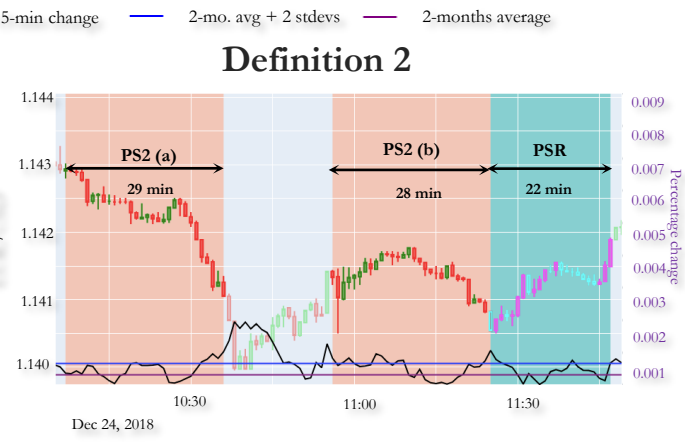

Figure 2. Candlestick visualization of spikes and reversal under spike definition 2 (PS2). Y-axis indicates EUR/USD, time on x-axis.

[1]Nagy, A., Petrov, D., 2019. Algorithmic trading - Price Spikes: An investigation of non-randomness on the foreign exchange currency market.
[2]Kamenická P., Lundgreen E., Örnberg F., 2019. Forex Pattern Trading: Finding and utilizing the occurrence of price spike reversals.

METHOD & DATA

In the previous reports, three separate models (two for price spikes one for reversals) were used to manage the data and detect price spikes and price spike reversals. The data was OHLC-values for bid-prices of the EUR/USD exchange rate between 2008-01-01 and 2018-12-31, in a one minute resolution was used, as in the previous investigations. A deeper analysis on the validity of this data can be found in the previous investigations. The data was manipulated in models built in Python using the libraries pandas, numpy, ploty and seaborn. The goal of this was to identify price spikes and price spike reversals under the definitions describe above. When a spike or a reversal is found, a trade opportunity is created and the minute after this occurrence.

In this investigation, we merge these models into a single Python model for ease of use, faster running times, and adjustability. While the previous price spike reversal model does detect spikes (as they are a prerequisite of reversals), it was lacking the trades after spikes. Further, there were inconsistencies in the definitions of spikes between models as the second definition of spikes was coded late into the previous investigation, and thus lacked validation. Thus, we validate this definition and we rectify inconsistencies in our consolidated model. Greater focus was placed on the analysis and comparison of the outcomes under the two spike definitions in this iteration, as this was missing with the second definition due to its development late in the previous investigation.

STRATEGY

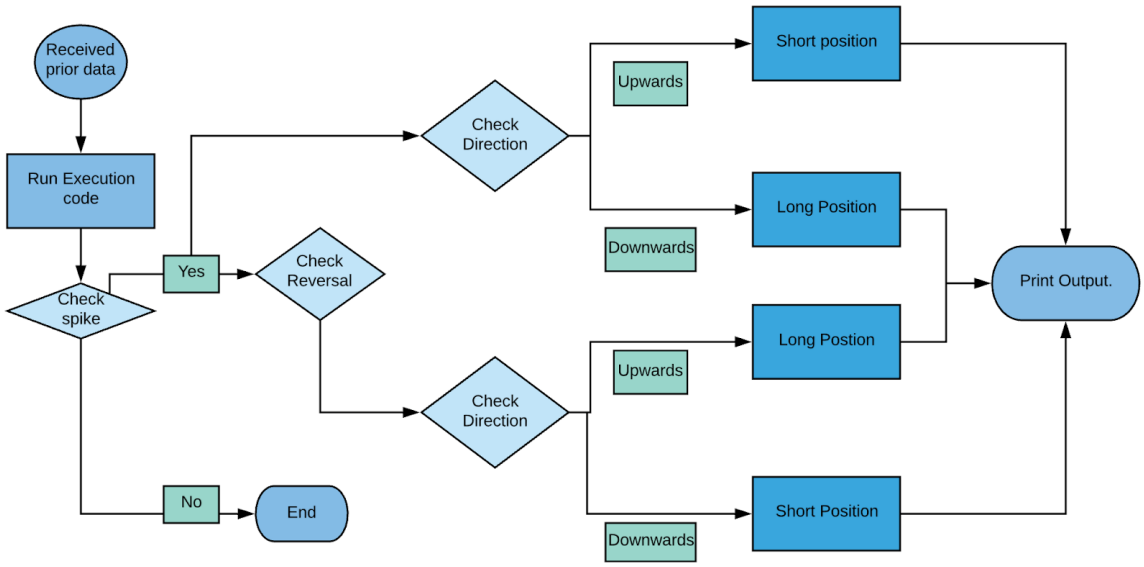

Figure 3. Graphical description of flow of how strategy was constructed.

Following the process in Figure 3, after the preliminary execution code, in which a definition and strategy are chosen, we check for a spike. If that is present, then a reversal is checked for. The direction of spikes and reversals are then checked and determine if a long or short is position entered. If upwards spikes are detected, we assume the short position in the given strategy and vice versa. If upwards reversals are detected, then we assume the long position. Trades are initiated after spikes and reversals, respectively. The following are the four trading strategies used for both spike and reversal trades.

Strategy 1: Target and stop-loss are at equal distance from the opening price of the trade, plus one pip.
Strategy 2: Target and stop-loss are at equal distance from the opening price of the trade, but half the distance as compared to strategy 1, plus one pip.
Strategy 3: Stop-loss is at the same distance from the opening price of the trade as in 1, but the target is at the double distance, + 1 pip.
Strategy 4: Target and stop-loss is at the 15th+1 pip from the opening price of the trade.

Where distance is defined as the range between the minimum [maximum] of a spike [reversal] and the open price of the minute bar after the spike [reversal].

Figure 4 shows an example of strategy 1 under the second spike definition, in which there is a losing short trade after the spike and a an open long trade after the reversal. The targets and stop-loss of each respective trade are shown in different coloured horizontal lines. They are equidistant as per strategy 1, in which that distance is the difference between the maximum and minimum of the spike/reversal pattern.

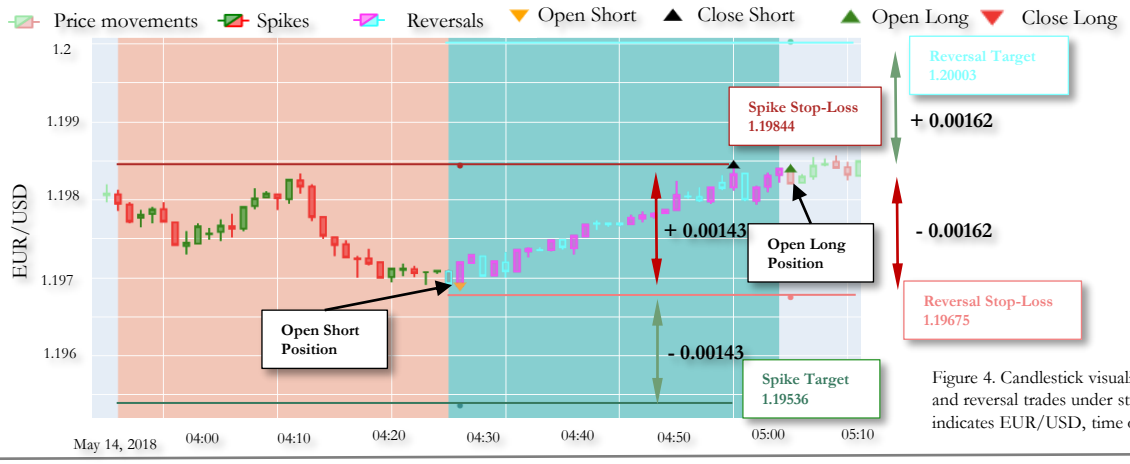

Figure 4. Candlestick visualization of spikes and reversal trades under strategy 1. Y-axis indicates EUR/USD, time on x-axis.

RESULTS

Definition	Days in dataset	Spikes	Reversals	Long trades	Short trades
Spike Definition 1	2 862	22 357	2 129	12 149 [11100, 1049]	12 327 [11247, 1080]
Spike Definition 2		21 569	1 785	11 603 [10 717, 886]	11 751 [10 852, 899]

Definition	Statistic	Strategy 1	Strategy 2	Strategy 3	Strategy 4
Spike Definition 1	Spike win rate	46.7%	46.5%	58.4%	48.3%
	Reversal win rate	48.8%	48.1%	31.4%	48.4%
	Total win rate	46.9%	46.6%	56.1%	48.3%
Spike Definition 2	Spike win rate	48.1%	48.9%	44.9%	48.5%
	Reversal win rate	48.9%	49%	29.8%	49.6%
	Total win rate	48.2%	48.9%	43.8%	48.6%
Spike Definition 1	Spike average return	-0.0032%	-0.002%	-0.0041%	-0.003%
	Reversal average return	0.0046%	-0.0058%	0.0126%	-0.0028%
	Total average return	-0.0025%	-0.0023%	-0.0026%	-0.00283%
Spike Definition 2	Spike average return	0.0004%	-0.0003%	-0.001%	-0.0024%
	Reversal average return	-0.0049%	-0.0041%	0.0081%	-0.0034%
	Total average return	-0.000005%	-0.0006%	-0.0003%	-0.0025%
Spike Definition 1	Spike position time	10 min	2 min	90 min	38 min
	Reversal position time	93 min	17 min	181 min	32 min
Spike Definition 2	Spike position time	90 min	20 min	234 min	38 min
	Reversal position time	105 min	20 min	189 min	31 min

Figure 5: Summary of results for four defined strategies and two spike definitions.

Similarly to the previous investigations no clear correlation between the spike length nor the duration of the position and the return has been found. In order to conclude these results parameters that potentially could explain price movements have been compared to the average return of the relevant occurrence. Mainly the position length and the magnitude of the spike has been analysed. Enabling the analysis to be made are the visualisation of the trades. In Figure 6 the results are shown for spike definition 1, trading strategy 1. Color-coding has been used, green represents trades where a profit has been made, blue represents a losing trade and orange represents suspended trades. Similar graphs have been made for both reversals and spikes for all of the 8 combinations of strategies and definitions. On the following page additional results are presented in text form.

Though direct conclusions are difficult to make, it is of relevance to point out the following. PS2 has a better win rate and higher average return. However, when utilizing the first definition, the reversals have a greater win rate suggesting that a more fluid boundary structure may be beneficial.

We hypothesize that a lot of spikes in the same direction with no reversals could be an indicator of a trend and could be a different way of creating a trading signal, rather than that of an individual spike in itself. Further analysis will require strict comparisons of definition 1 and definition 2.

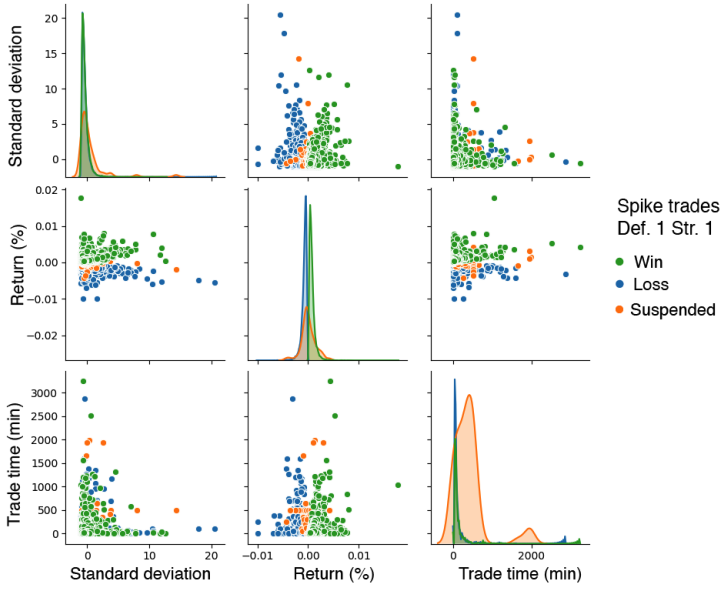

Figure 6. A pairplot of the spike magnitude, the returns and the position duration, results for spike definition 1, trading strategy 1.

RESULTS & CONCLUSION

The next section has been divided into win-rates and returns for trades under each strategy. This has been contrasted between trades under each spike definition, which are followed by their respective reversal trade outcomes. An overview shows us that variations between definitions are due to defining a specific time window i.e. having a definite time window (first definition) is far better than a fluid window.

Strategy 1

PS2 spikes have a better win rate and a higher average return than PS1. Reversals have a marginally higher win rate and average return under PS1. Equidistant target and stop loss strategies with a fluid window of time allows us to capture better overall trades.

PS1: Their respective win rates are: 46.7% for all trades, 46.6% for long and 46.8% for short positions. The average return for all positions are -0.0032%, -0.0041% for long and -0.002% for short positions.
PSR: Their respective win rates are: 48.8% for all trades, 48.70% for long and 48.8% for short positions. The average return for all positions are 0.0046%, 0.0074% for long and 0.002% for short positions.

PS2: Their respective win rates are: 48.1% for all trades, 47.9% for long and 48.3% for short positions. The average return for all positions are 0.0004%, 0.0% for long and 0.0009% for short positions.
PSR: Their respective win rates are: 48.9% for all trades, 49.4% for long and 48.5% for short positions. The average return for all positions are 0.0049%, 0.0071% for long and 0.0027% for short positions.

Strategy 2

For this strategy PS2 spikes have a better win rate and average rate of return than under PS1 and the same behaviour can be stated for the reversals for each definition. Hence, a reduction in distance between target and stop-loss may provide higher win rates overall (in comparison between strategy 2 and strategy 1).

PS1: Their respective win rates are: 46.5% for all trades, 46.4% for long and 46.6% for short positions. The average return for all positions are -0.002%, -0.0025% for long and -0.0015% for short positions.
PSR: Their respective win rates are: 48.1% for all trades, 48.70% for long and 47.5% for short positions. The average return for all positions are -0.0058%, -0.0042% for long and -0.007% for short positions.

PS2: Their respective win rates are: 48.9% for all trades, 48.20% for long and 59.5% for short positions. The average return for all positions are -0.0003%, -0.0018% for long and 0.0011% for short positions.
PSR: Their respective win rates are: 49.0% for all trades, 50.1% for long and 47.9% for short positions. The average return for all positions are -0.0041%, -0.001% for long and -0.0072% for short positions.

Strategy 3

PS1 has better win rates but lower average return. Reversals, as per definition 1, fare better and have higher win rates. Reversals under definition 2 see an overall better average return (40.4%). A higher target with a fixed time window provides better returns.

PS1: Their respective win rates are: 58.4% for all trades, 83.90% for long and 33.0% for short positions. The average return for all positions are -0.0041%, -0.0061% for long and -0.0021% for short positions.
PSR: Their respective win rates are: 31.4% for all trades, 30.4% for long and 32.3% for short positions. The average return for all positions are 0.0126%, 0.016% for long and 0.00940% for short positions.

PS2: Their respective win rates are: 44.9% for all trades, 59.0% for long and 30.9% for short positions. The average return for all positions is -0.001%, -0.0043% for long and 0.0023% for short positions.
PSR: Their respective win rates are: 29.80% for all trades, 30.4% for long and 29.30% for short positions. The average return for all positions is 0.0081%, 0.015% for long and 0.001% for short positions.

Strategy 4

PS1 and PS2 have a similar win rate but on average PS1 has a lower win rate. For the reversals, definition 2 results in a higher win rate.

PS1: Their respective win rates are: 48.3% for all trades, 48.0% for long and 48.6% for short positions. The average return for all positions are -0.003%, -0.0037% for long and -0.0022% for short positions.
PSR: Their respective win rates are: 48.4% for all trades, 48.4% for long and 48.5% for short positions. The average return for all positions are -0.0028%, -0.003% for long and -0.0025% for short positions.

PS1: Their respective win rates are: 48.5% for all trades, 48.4% for long and 48.70% for short positions. The average return for all positions are -0.0024%, -0.0028% for long and -0.0021% for short positions.
PSR: Their respective win rates are: 49.6% for all trades, 51.2% for long and 48.1% for short positions. The average return for all positions are -0.0%, -0.0034% for long and -0.0034% for short positions.

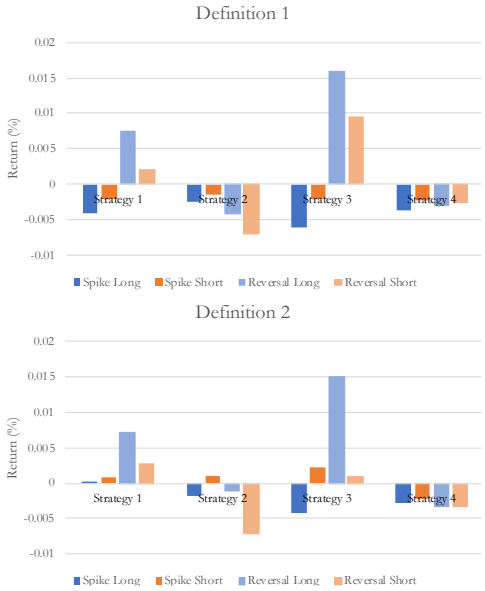

Figure 7. Trade returns under all strategies for definition 1 and 2.

Results have been attained from thousands of spikes and reversals. Whilst changing the definition and the strategy changes our results; they all have shown little or even a negative return, as can be seen in Figure 7, especially under definition 1. Furthermore the listed combinations do show trends, albeit minute. We find that a fluid time window (definition 2) is inversely better for strategies which are distant-dependent where-as a fixed-time window (definition 1) is better for strategies that depend on variation in height between target and stop-loss.

The average time frame for a target to be reached differs immensely, ranging from about 2 minutes all the way till just under 300 minutes. Previously it has been suggested that if the target is reached quickly a new target, further away should be set for the position to close. This theory argues that the market possesses enough momentum for the change to be continuous. When analysing these patterns it is difficult to determine whether the sudden changes in the market are reliable on volatility or momentum in the market. An alternative approach that allows for greater chance of finding when the market carries/or not carries momentum could be to extend the target, if and only if two spikes occur repeatedly without a reversal interpreting, or vice versa. Further, repeated iterations with various data-sets can be run in order to ascertain if the dependence on a time-frame can be isolated in order to build a more cohesive predictive strategy.

Non-randomness is always the ultimate goal to detect when analyzing price movements in a forex market. With more results to underline conclusions one step further has been taken towards finding non-randomness.

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Other