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TRADING & QUANTITATIVE RESEARCH REPORT

BREAKOUTS

*Analysing the application of Average Directional
Index in a breakout trading strategy*

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Introduction & Theory

Technical analysis is a common methodology used for attempting to forecast movements in the financial market by utilising historical market data and previous price movements to identify trends and capitalise on them for profit. This in contrast to fundamental analysis which is performed to measure a security's intrinsic value by examining related economic and financial factors such as balance sheets, macroeconomic indicators and consumer behaviour.

There are several different strategies that are used within the field of technical analysis that aim to indicate where a price will move to next, examples of such are the Average Directional Index (ADX) and Breakouts. ADX is a trend strength indicator based on earlier data values that quantify the strength a trend may have, and breakouts occur when price movement has moved above a resistance line or below a support line (see Figure 1). In this report the potential benefits of utilizing ADX in a breakout trading strategy will be analysed.



Figure 1. An example of a price consolidation followed by a downward breakout, in turn followed by a downward price movement (AUDUSD dataset). The pink lines illustrate the upper edge upper bound and lower edge lower bound. The purple lines illustrate the upper edge lower bound and lower edge upper bound respectively.

Theory

As mentioned before, a breakout is defined as a price movement breaking through a level of support or resistance after a period of consolidation. In this case the support level refers to the area where a downtrend is expected to pause due to a concentration of demand, and resistance refers to the area where an uptrend is expected to pause due to a concentration of supply.

The intuition behind a general breakout strategy is based on the presumption that price movement breaking through the level support or resistance usually results in a continued price movement in the same direction, creating an opportunity to profit from the continued price movement.

Consolidations are generally interpreted as market indecisiveness [1], one example of a consolidation forming could be as a product of professional traders and/or bankers taking profits. This in turn would cause the preceding trend to stop moving up or down. Once the take profit orders have consumed additional orders coming into the market from retail traders a "corridor" will form, illustrated in Figure 1, where the price oscillates for anywhere from a few minutes to several weeks between a higher and lower edge. In this case the area of support refers to the lower edge whereas the area of resistance refers to the upper edge.

When trading a breakout, the most common strategy is to interpret a price movement breaking through the level of resistance as an indicator of a bias forming in the market, and a precursor to a continued bullish (upward) price movement. The same idea applies to a break through on the level of support, which again indicates a bias forming in the market and often precedes a bearish (downward) price movement.

In this report there are fixed parameters defining consolidations that will be used to identify breakout patterns. Namely, the minimum required width (distance between the upper and lower edge) of a specific consolidation must be at least 15 pips. Pip refers to Percentage in point, which is the smallest amount the price for a currency pair can change. Additionally, a consolidation must exist for a minimum of three hours to be considered. These parameters are selected based on analysis conducted in a previous report [2].

[1] J Chen. Consolidation, 2020-11-02, Investopedia
 [2] J Nilsson, M Nowak, V Tiet. Breakout, 2020-05-17, LINC
 LINC, Research & Analysis | See disclaimer at the end

Theory

A consolidation is defined as a period of price movements that meet the following three criteria:

- When the price touches any of the consolidations edges it should either be the thirty-minute high or thirty-minute low point, here low prices for the lower edge and high prices for the upper edge are examined. Should the price touch another edge before 30 minutes have passed since the previous high or low point, the potential consolidation is discarded.
- If the price touches the same edge twice during the consolidation, the price must bounce back to the middle of the consolidation range afterwards.
- Once the price has reached the opposite edge for the first time it should bounce back to at least 80 percent of the difference between the two extreme values within that range, i.e. move 80% of the distance between the width of the consolidation.



Figure 2. Example consolidation in AUDUSD dataset.

These criteria are clarified through Figure 2 which visually illustrates how they are met. Throughout the consolidation there is at least 30 minutes between the price touching the same edge twice, thus the first criteria has been met. After touching the lower edge for the second time (02:30), the price reverts back to the middle of the consolidation range, same goes for the upper edge (02:00). So the second criteria has been met. Following the price registration at the opposite edge from the first (01:00), the price moves at least 80% of the consolidation's width on the way up to its third price registration at the upper edge. Lastly the third criteria has been met.

To determine the strength of a trend and further expand on analysis, the average directional index (ADX) will be used as an indicator. The ADX is derived from 3 indicators, positive and negative DI as well as DX. The information and computations for calculating ADX are primarily from [3], [4]. These indicators are in turn based on positive and negative directional movements, DM. These are simply formed by the previous values (low and high) and current values (low and high),

$$DM_p = \text{Current high} - \text{Previous high},$$

$$DM_n = \text{Current low} - \text{Previous low}.$$

Another variable that need be introduced in order for ADX to be calculated is a volatility indicator, namely the average true range, ATR. ATR is just what it sounds like, the averaged true range for a certain period, the true range in turn is calculated by,

$$TR = \text{Max}[(H - L), \text{Abs}(H - C_p), \text{Abs}(L - C_p)].$$

Here H and L denotes high and low, Abs the absolute value and C_p the current price. The period chosen to compute the ATR and in turn ADX is 14 time periods, as most literature recommends this time interval. Now positive and negative directional index is formed by the following formulas,

$$DI_n = \left(\frac{\text{SmoothedDM}_n}{ATR} \right) 100,$$

$$DI_p = \left(\frac{\text{SmoothedDM}_p}{ATR} \right) 100,$$

$$DX = \left(\frac{|DM_p - DM_n|}{|DM_p + DM_n|} \right) 100.$$

Smoothed in this context is just a way of summing the previous directional movements, and removing the average of the previous 14 DM's,

$$\text{SmoothedDM} = \sum_1^{14} DM - \left(\frac{\sum_1^{14} DM}{14} \right) + CDM.$$

Here CDM denotes the current directional movements, and the sum are based on the previous 14 points prior to the current one. Finally, the ADX is described as,

$$ADX = \frac{\text{Prior 13 ADX} + \text{Current ADX}}{14}.$$

[3] C Schaap. ADX: The Trend Strength Indicator, 2020-09-17, Investopedia

[4] C Mitchell. Average Directional Index, 2020-10-13, Investopedia

Theory & Method

As mentioned before, the use of ADX is to determine the strength of a trend. ADX has a built-in indexing system from 0 to 100 which says how “strong” or “weak” the trend is, this indexing will be used in sorting breakouts.

ADX Value	Trend Strength
0-25	Weak
25-50	Strong
50-75	Very strong
75-100	Extremely strong

Figure 3. ADX indexing system.

In this report the effects of a strong trend (ADX>25) preceding the development of a consolidation will be analysed.

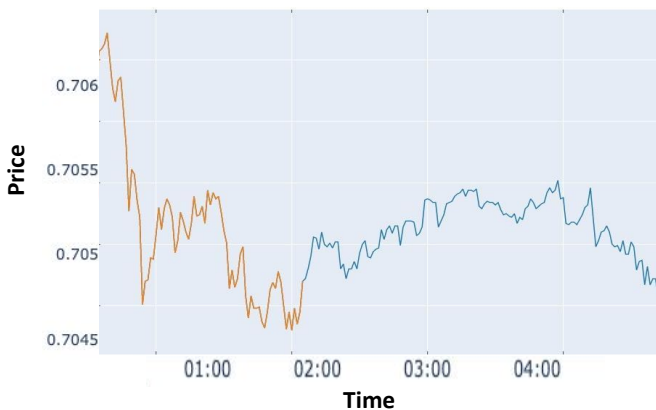


Figure 4. A visualisation of the ADX indicator calculated on the previous 14 values. The areas colored orange represent an ADX value greater than 25, indicating a strong trend.

NOTE: This is only illustrative, not a real dataset.

Method

To analyse and conduct testing, one year of 1-minute price data from the EUR/GBP currency pair was used. The data ranged from October of 2017 to December of 2018.

To establish where consolidations appeared, a python algorithm was used. In order to decide what interval a consolidation width should be within in order to be considered, different intervals were tested. Larger intervals, for example 12-35 pips had a greater difficulty meeting the previously stated criteria, which led to a substantial decrease in the amount breakouts that were identified. Smaller intervals, for example 6-10 pips experienced a similar decrease in the number of breakouts identified, since price movements remaining within an interval of this size for an extended period of time is rare. This led to the interval 8-15 pips being chosen considering the loss of breakouts in other cases. However, further analysis is required to fully optimise this parameter.

A “standard” breakout strategy would be to, in the event of a bullish breakout, take a long position. Meaning that the currency is bought and sold once the price reaches a target price. Inversely, when a bearish breakout occurs, a short position is taken, where the underlying currency is sold to later be bought for a profit at a lower target price. This strategy will in the future be referred to as the “standard” strategy and be used as a benchmark to compare strategies. In this report, the standard strategy will utilise a target/stop-loss ratio of 1:1, meaning the distance from buy-price to target is identical to the distance from buy-price to stop-loss.



Figure 5. An illustrative example of a short position being taken following a downward breakout with a 1:1 target/stop-loss ratio.

Method

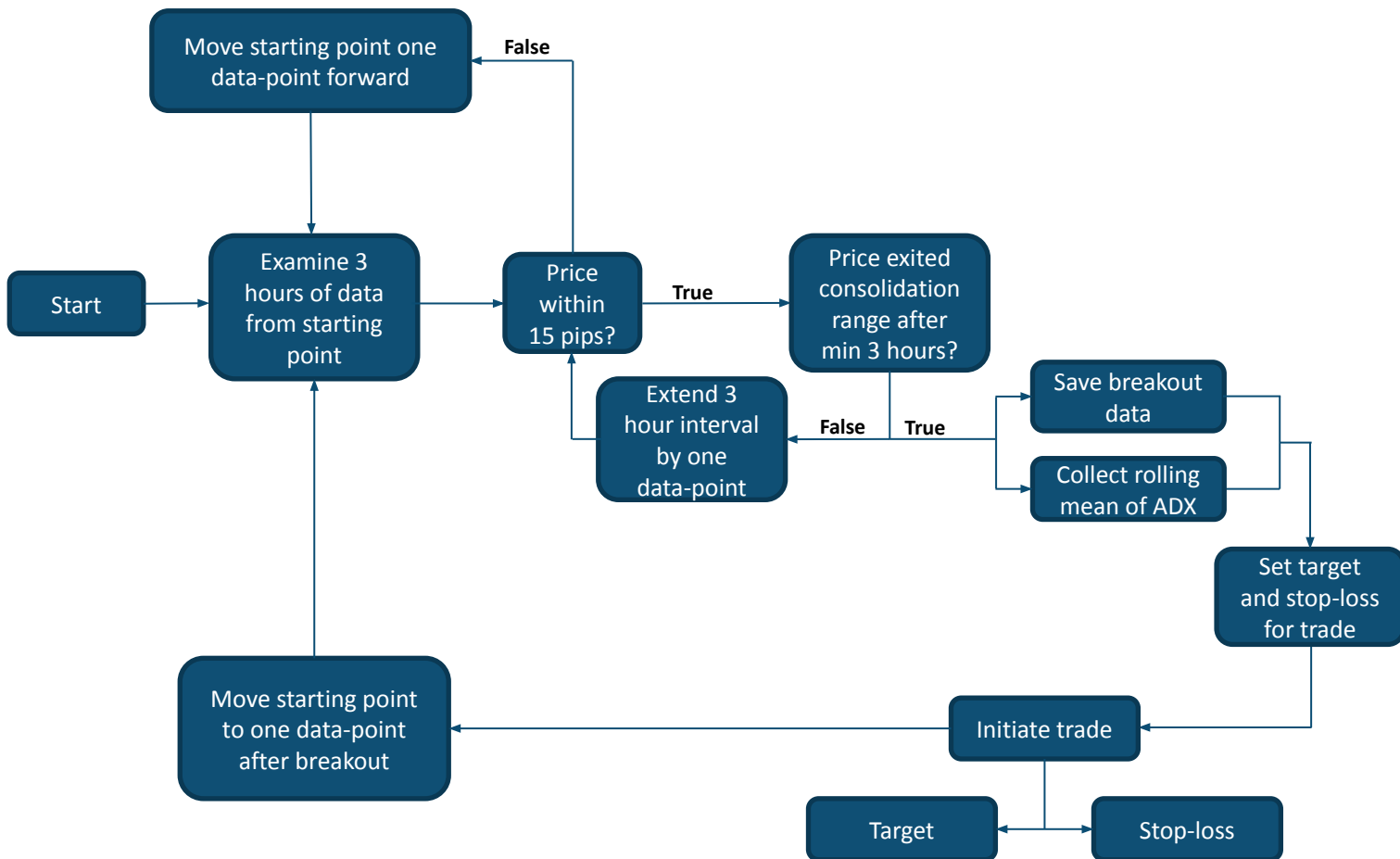


Figure 6. A flowchart for the algorithm used in the project.

To analyse whether ADX had a significant impact on trading strategies or not, several strategies were tested. The trading strategies are comprised of a target and a stop-loss. A stop-loss decides when a trade is aborted, and the trade is deemed unsuccessful. The loss here being the difference in pips between where the trade is initiated and at the stop-loss. The stop-loss is placed at the opposite edge of the consolidation from the breakout. The target is the sought-after price which when reached a trade is stopped and deemed successful, the profit here being the difference in pips.

In order to analyse the impact ADX has on breakouts, a script was written in python which categorised consolidations based on the ADX's behaviour preceding a consolidation being formed. Breakouts were categorised on a scale of 1-100 representing the value of a rolling mean of ADX based on 10% of the following consolidations length. The rolling mean of ADX was used in order to establish a more general perspective of the ADX preceding a consolidation.

The win rates of different breakouts was thereafter analysed, in order to find a correlation between the strength of the trend preceding the consolidation, and the likelihood of the trade taken after the breakout being successful. The results of this testing is in turn used to justify formulating a new strategy. This strategy will be analysed in order to measure the profitability of a breakout trading strategy that capitalises on a trend preceding a consolidation.

Strategy & Results

To utilise the trend strength indicator, values of ADX prior to a consolidation were observed. This was done to analyse if setting targets based on the rolling mean of this trend strength indicator would be a more profitable strategy than using fixed targets. A higher win percentage among trades taken with a high preceding ADX value would indicate that a higher proportion of trades taken with a strong trend preceding a consolidation would surpass the set target in comparison to trades taken with a weaker or non-existent trend preceding a consolidation.

In order to test and visualise this, heat maps were created which categorised trades taken by their preceding ADX as well as the width of their consolidation (see Figure 7 and 8). The width was used as a category in order to divide the trades along an additional axis since the stop-loss and target are directly dependent on the consolidation's width. The win rate is measured on a scale from 0 to 1 with 0 representing a 0% win rate and 1 representing 100% respectively.

When the target for all trades was increased, a higher proportion of trades taken with a lower ADX value decreased in win-rate, in comparison to trades taken with a higher ADX value. This indicates that adjusting the standard strategy accordingly and testing its profitability may be worthwhile.

In order to apply these results to a breakout-trading strategy, the standard strategy is adjusted to take ADX into account.

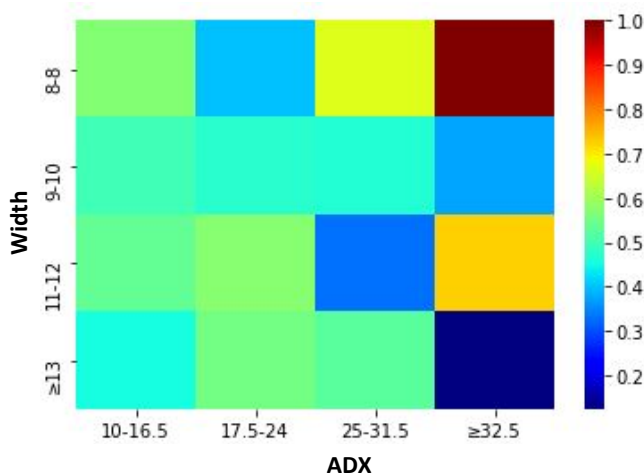


Figure 7. Target the same size as the consolidation's width.

This is done by making the target variable directly dependent on the ADX value preceding the consolidation. This was done in two ways:

- One strategy was created in which a threshold was set at an ADX of 25 (indicating a strong trend), where any breakouts with an ADX value above this would have a target set for 1.5 times the size of the consolidation's width, and breakouts with an ADX value below 25 would have a target 0.5 times the consolidations width. This strategy was created specifically in order to test the performance of a strategy that issues a higher blanket target for all trades taken that are considered to have a strong trend preceding them. The targets 1.5 and 0.5 were chosen in order to "centre" the strong and weak trades around the previous target of 1.0 used in the standard strategy. For simplicity's sake this strategy will be referred to as the "discrete" strategy in the analysis section.
- The second strategy utilised a linear correlation between ADX and the multiplier variable, where the target would be set to $(ADX/25)$ times its width, 25 is chosen here as it is deemed a strong trend when surpassing an ADX of 25. This strategy was created in order to examine the performance of a strategy in which the target directly reflected the ADX value preceding a consolidation. The strategy's performance should indicate whether there exists some sort of linear correlation between the ADX value and what target the price is able to reach after a breakout. This strategy will later be referred to as the "linear" strategy.

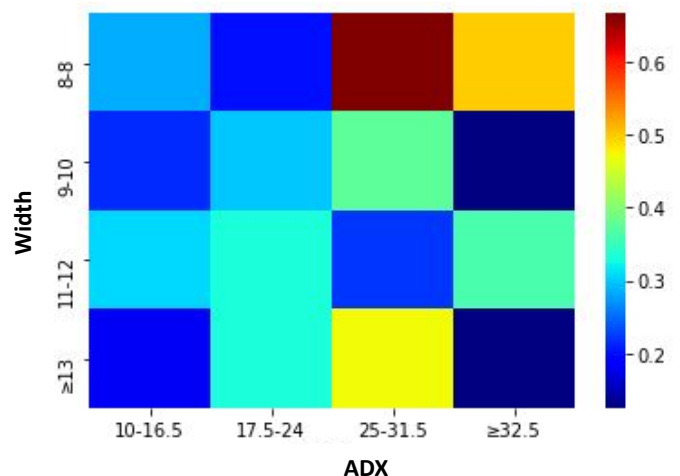


Figure 8. Target twice the consolidation's width.

Results & analysis

To finalise the analysis, the strategies created based on the results of the testing conducted on previous datasets were evaluated on 15 months of data from a previously unused GBP/USD currency pair. The strategies were analysed on a new, untested dataset in order to avoid over-fitting and creating a strategy optimised solely to one or few datasets.

In order to analyse the different strategies' performance, different metrics were measured. First, in the figure below, the cumulative returns in terms of pips for the different strategies was measured relative to the number of total trades. A clear difference between the discrete and linear strategy vs. the original strategy is visible. While the first 30 trades appear to have similar performance across all three strategies, the two new ADX based strategies clearly outperform the standard strategy in the remaining trades taken. This seems to indicate that the trend preceding a consolidation may in fact be predictive of the outcome of a trade.



Figure 9: Blue: Standard strategy. Green: Linear strategy. Orange: Discrete strategy.

Index	Profitable trades	Non-profitable trades	Average gain	Average loss	APPT	Total profit
Standard	159	168	14.005	-13.9601	-0.363	-118.5
Linear	169	158	13.7997	-14.0196	0.358	117.052
Discrete	183	144	11.3495	-13.9347	0.215	70.35

Figure 10: Relevant data of trades. APPT: Average profit per trades.

In the table above different statistics comparing the strategies have been gathered. In terms of total profit the two new strategies made a profit, while the standard strategy had a negative total return. However, there is once again a clear difference between the ADX based strategies and the original one. Despite the original strategy exhibiting both a larger average win size and similar average loss size compared to the ADX-strategies, the ADX-strategies have both a higher amount of profitable trades taken during the time-period, and a substantially higher average profit per trade.

Analysis & Discussion

By reducing the target for trades taken with a weak preceding trend, the discrete and linear strategies are able to reach their target and make a profit more consistently when the outcome of the price movement following a breakout is uncertain. Similarly, by predicting a strong continued price movement following a breakout, the strategies capitalise on when the ADX value is high preceding a consolidation. This is done by aiming for a higher as well as riskier target when it is believed that the price will travel further than in the case of a weak trend. The results above indicate that combining the safer approach in the case of weak trends and opting for riskier trades in the case of strong trends is profitable.

Discussion

These results seem to indicate that setting a higher target for breakouts with a strong trend preceding their consolidation can lead to increased profits. However, one must always be sceptical of such results. Despite the new strategies showing higher profits in terms of pips, their profitability can be disputed in a real-life setting. This since transaction costs have not been considered when calculating the profits of trades. Since a lot of trades being taken where the ADX under 25 will have relatively small targets, it is unclear if the profits from these smaller trades will cover the transaction costs associated with them. If a large amount of trades with low targets were instead classified as losses should they not cover their transaction cost, the results may vary. For example, if one were to use the IG broker to execute trades, where the minimum spread paid for each trade is one pip, both strategies would most likely lose their profitability [5]. Since the average profit per trade for both strategies is below one pip, paying one pip per trade on average (a generous assumption) would instead lead to an average profit per trade of around -0.7 / 0.8 pips.

While both ADX-based strategies exhibit similar performance, it seems that the discrete strategy slightly outperforms the linear strategy from the 100th trade to the 250th.

This is a possible indication that the correlation between ADX and what target the price reaches after a breakout is in fact non-linear. Though it still indicates that breakouts with an ADX greater than 25 preceding their consolidation reach a higher target in general. Further analysis of the correlation between ADX and how far the price travels after a breakout is required in order to precisely quantify the relationship between these two variables.

Though the strategies' profitability is disputable, this report indicates a possible connection between ADX and price behaviour following a breakout. In future analysis, more testing regarding the "cut-off" of ADX = 25 in the discrete strategy may be worthwhile. Despite an ADX value of 25 or greater being generally defined as an indicator of a strong trend being present, increasing the target for trades taken above a different ADX value may yield greater returns.

Additionally, some losing trades seemed to follow a pattern where the price movement reversed shortly after breaking out from the consolidation range. This is commonly referred to as a "false breakout". A possible usage of ADX to avoid losses accumulated from false breakouts may be to utilise the ADX indicator as a sort of confirmation in the moments leading up to/shortly after a breakout. This way, the ADX indicator can confirm if the price movement breaking out of the consolidation has a significant trend behind it, which may decrease the risk of trading a false breakout. However, one must be aware of the trade-off between this type of confirmation and possible extra profits being lost. For each data point used following a breakout to confirm a trend being present, there is less time to capitalise on the continued price movement after a breakout. It is possible that the trade-off between certainty and profit can be optimised and used to create a profitable breakout strategy, provided further analysis is conducted.

[5] Forex Trading Costs, 2019-04-26, IG.

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