– Independent Work Report Spring, 2022 –

Technical Analysis of Cryptocurrencies

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Abstract

This paper details the application of technical analysis methods in the cryptocurrency market. The analysis deals with 37 indicators, as well as various combinations of indicators that are historically proven to be the most reliable and accurate. This project seeks to provide basis for the use of these methods in the cryptocurrency market, since they were historically crafted only for use in the stock market. Given that the cryptocurrency market is still new and based on something entirely different than the stock market, it is not guaranteed that these methods will work as reliably as they do in the stock market.

1. Introduction

Technical analysis methods are a group of techniques used in stock market price analysis that allow a trader to predict the general price movement of an asset, based on statistics such as volume traded and historical price. There are 4 broad categories of technical analysis methods: Volatility, Volume, Trend, and Momentum. Given that these technical analysis methods have been crafted for use in the stock market, it is not guaranteed that these methods will directly translate and work in the cryptocurrency market, which is still new, emerging, and based on something entirely different than the stock market. This project seeks to provide basis for the use of these methods in the cryptocurrency market, by testing these indicators on Bitcoin and Ethereum data from 2020. Past related work has fallen short by not examining all applicable categories, not conducting extensive testing of methods, and not directly testing which methods can be reliable or not.

2. Problem Background and Related Work

In their paper, Tzaferi and Fousekis [1] argue that in the cryptocurrency market, there is a much stronger correlation between returns and volume traded, while also claiming that utilizing volume-based information in technical analysis results in higher profit. They also claim that utilizing trend based technical analysis is done by uninformed traders and is not as effective. As demonstrated by this project, not only are trend-based indicators relatively successful in predicting price movement, but even other types of indicators, such as volatility and momentum-based ones, can be seen as reliable. Therefore, the major shortcoming of this work is that it fails to address the potential of any other indicators besides volume-based ones being accurate.

In the next paper, Mikhaylov [2] addresses that the cryptocurrency market varies drastically from the stock market, and that because of this large difference, volatility based technical analysis methods are crucial in predicting the future of cryptocurrency markets. They also present the idea that technical indicators specific to the cryptocurrency market, such as the Bitcoin Dominance Index, may need to be developed in order to account for this newfound volatility. They also introduce the idea that standard stock market technical analysis methods may not be directly applicable to the cryptocurrency market. Therefore, the major shortcoming of this work is that it claims that standard technical analysis methods cannot be applied to the cryptocurrency market, without testing it.

In the final paper, Urquhart and Hudson [3] examine 5 classes of technical analysis techniques and their applicability in the cryptocurrency market. However, these 5 classes are not all encompassing with regards to actual technical analysis methods; instead, these classes are much more specific and by extension do not have as broad of a scope as the traditional 4 category methods do. Therefore, the major shortcoming of this work is that is it limited in terms of the individual methods it tests and is not extensive enough.

This project seeks to address all the aforementioned shortcomings by including all categories of technical analysis indicators in its analysis and extensively testing each indicator and its reliability in the cryptocurrency market in order to create the most cohesive data.

3. Approach

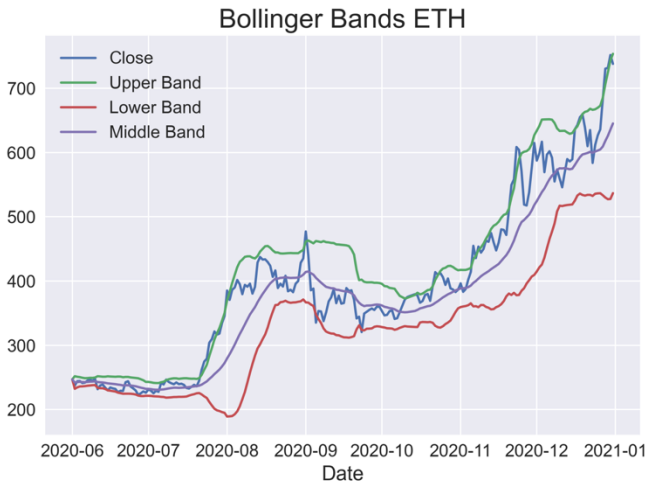
My approach primarily deals with using the ta Python library [4] to apply a wide variety of technical indicators to my Bitcoin and Ethereum datasets. The ta library provides 4 broad categories of analysis: volume, volatility, trend, and momentum. In total, there are 37 indicators and technical analysis methods that can be applied to my datasets. Once I applied each indicator to my selected time period, I conducted a general analysis of the chart, depending on how each indicator is intended to be used. Afterwards, I ranked each method on its effectiveness as a standalone technical indicator, on a scale of not reliable, reliable, and very reliable. I then proceeded to test the most well-known, historically accurate combination of indicators to deduce whether these have more merit and reliability when used together than as individual indicators.

4. Implementation

The Bitcoin [5] and Ethereum [6] datasets were filtered to 2020, roughly from June to December; they contained data such as the current Date, Open, High, Low, Close, and Volume. The main reason I filtered the dataset to those dates is due to the operating hours of the stock market. The stock market operates for 220 days of the year, whereas the cryptocurrency market operates for 365 days a year. By limiting the data to these months (roughly 214 days), I hoped to lessen the disparity between the nature of the two markets. It was also especially important to include the end of year holidays such as Christmas and Thanksgiving; given that people are traveling and meeting with family and friends and spreading news about new cryptocurrencies, volume in the market generally peaks at these times.

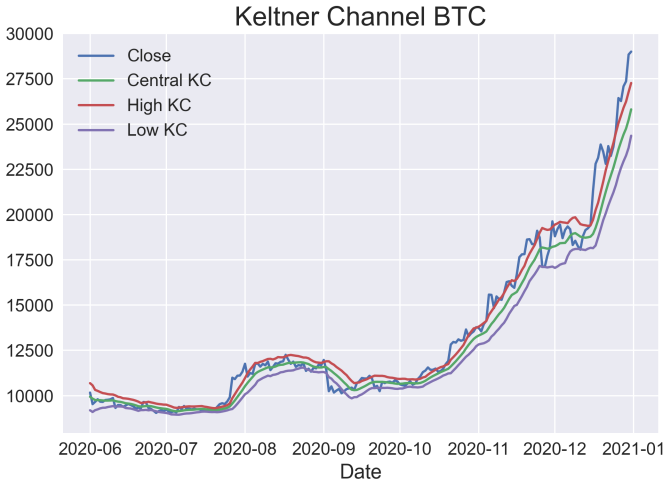
4.1 Volatility Indicators

Bollinger Bands: Bollinger Bands are a technical analysis tool defined by using three trendlines: an upper band, a lower band, and a moving average band. The closer the prices move to the upper band, the more overbought the market is, and the closer the prices move to the lower band, the more oversold the market is. If the price breaks the lower band, this signals a downtrend, and the price is considered cheap. This is generally considered a buy signal. However, as shown by the graphs, when the price crossed the lower band, it tended to stay below it for quite some time. Therefore, this is an unreliable standalone method.

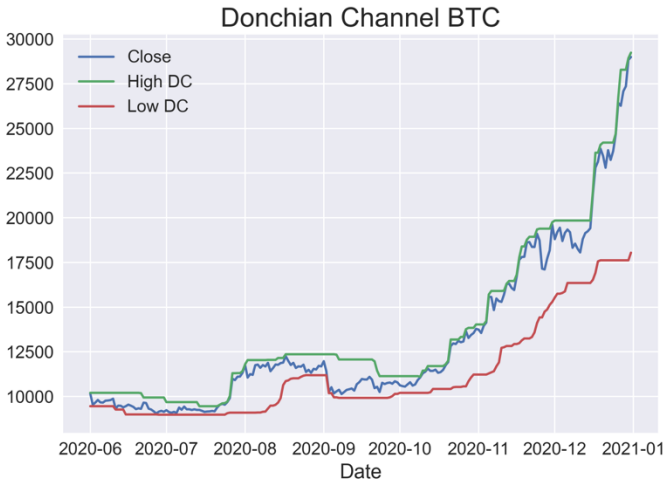


Keltner Channels: Keltner Channels are volatility-based bands that are placed on either side of an asset's price and can aid in determining the direction of a trend. They have many general uses: predicting trend direction, uptrend capturing, and detecting price weakness. When the price is reaching the upper Keltner Channel band, it is bullish, whereas reaching the lower band is bearish. The angle of the Keltner Channel also aids in identifying the trend direction. The price may also oscillate between the upper and lower bands, which can be interpreted as resistance and support levels. One of the most common applications of Keltner Channels is mean reversion, which is to buy once the market closes under the lower band. However, there are several cases

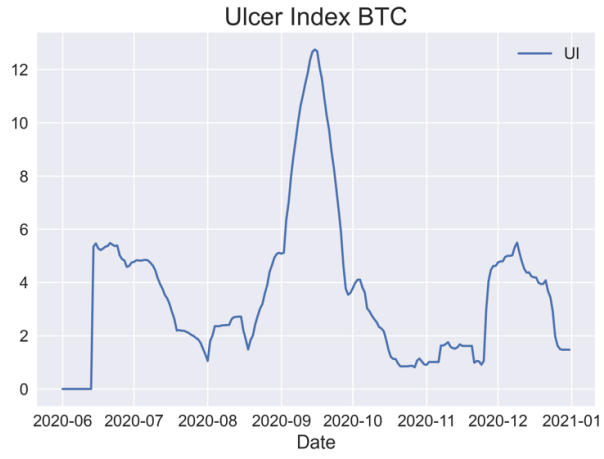
where the price crosses the lower band and remains in that territory for quite some time. Therefore, this is an unreliable standalone method.



Donchian Channels: Donchian Channels are a technical indicator that seek to identify bullish and bearish extremes that favor reversals as well as higher and lower breakouts, breakdowns, and emerging trends. The top line identifies the extent of bullish energy, the center line identifies the median or mean reversion price for the period, and the bottom line identifies the extent of bearish energy. When prices fall to the lower Donchian Channel boundary, traders are likely to begin entering long positions as a way to benefit from a potential upward rebound. Traders are likely to enter short positions when prices move toward the upper boundary because it is likely that the uptrend will continue further. In both examples, the price crossed the upper bound and remained in a brief uptrend until crossing the lower bound, where it stayed stagnant around that price until going into an extreme uptrend. Therefore, this is a reliable standalone method.

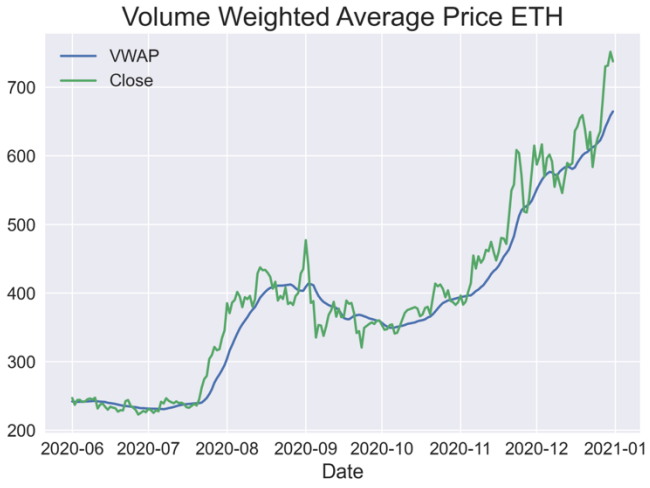


Ulcer Index: The Ulcer Index is a technical indicator that measures downside risk in terms of both he depth and duration of price declines. The greater the value of the Ulcer Index, the longer it takes for a price to get back to the former high. It is designed as a measure of volatility exclusively on the downside. Watching for spikes in the Ulcer Index that are beyond normal can also be used to indicate times of excessive downside risk, which investors may wish to avoid by exiting long positions. Charts contain a huge spike in the Ulcer Index, which immediately corresponded with a heavy dip in the price and extreme volatility afterwards. When the Ulcer Index dropped to normal levels, there was a consistent uptrend. Therefore, this is a reliable standalone method.

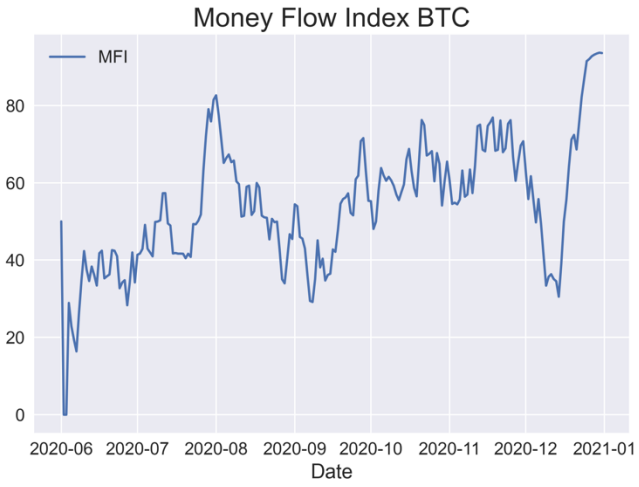


4.2 Volume Indicators

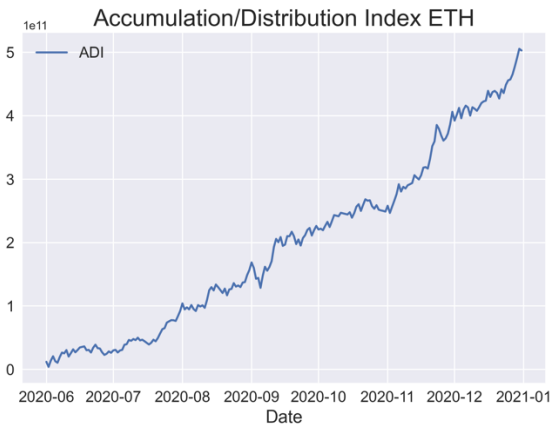
Volume Weighted Average Price: The Volume Weighted Average Price provides traders with insight into the relation between volume and value of a commodity. It is generally suggested to buy when the price is below the Volume Weighted Average Price and sell when the price is above it. This is generally correct in terms of the dataset, but this method is primarily used for short term, intra-day trading. Therefore, this is an unreliable standalone method.



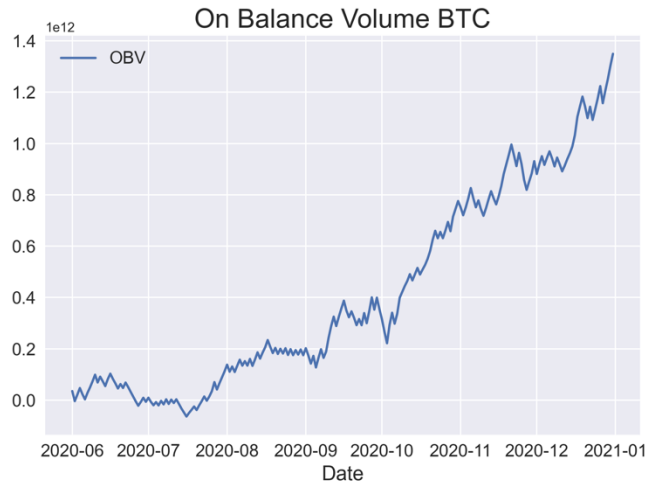
Money Flow Index: The Money Flow Index uses price and volume data for identifying overbought or oversold signals in an asset. An MFI reading above 80 is considered overbought, and an MFI reading below 20 is considered oversold, although levels of 90 and 10 can also be used respectively. A divergence between the indicator and price is important to note; if the indicator is rising while the price is falling or flat, the price could then begin rising. This is generally treated as a buy signal. Coupled with the ways of interpreting this indicator, this is generally not accurate, as there are several instances where the Money Flow Index reaches levels near 80 yet the price continues rising. The same happens around 20. Lastly, if the indicator was rising while the price was falling, it generally continued falling. Therefore, this is an unreliable standalone method.



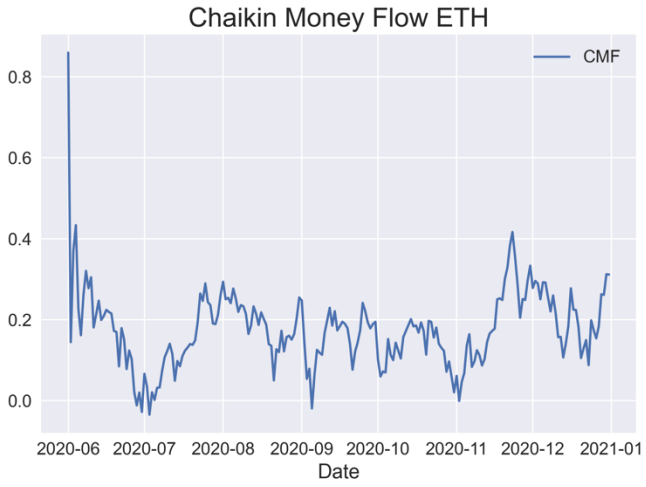
Accumulation Distribution Index: The Accumulation Distribution Index indicator is a cumulative indicator that uses volume and price to assess whether a commodity is being accumulated or distributed. The Accumulation Distribution Index seeks to identify divergences between the stock price and the volume flow. If the price is rising but the indicator is falling, then it suggests that buying volume may not be enough to support the current price rise and a decline could be expected. In general, a rising Accumulation Distribution Index line confirms a rising price trend, while a falling line helps confirm a price downtrend. This is generally not the vase, as even on heavy dips of the price, the line remained on a general uptrend and never significantly dropped. Therefore, this is an unreliable standalone method.



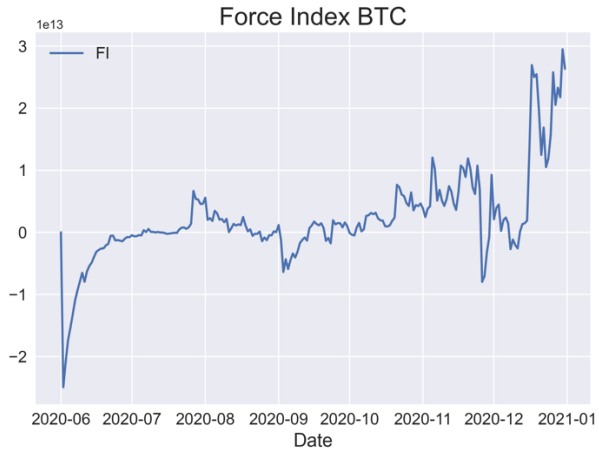
On Balance Volume: On Balance Volume is a technical indicator that uses volume flow to predict changes in stock price. It was initially proposed that when the volume increases sharply without a significant change in the price, the price will eventually jump upward or fall downward. This is generally true; this proved to indicate either a heavy dip or an extreme rise in the price. Therefore, this is a reliable standalone method.



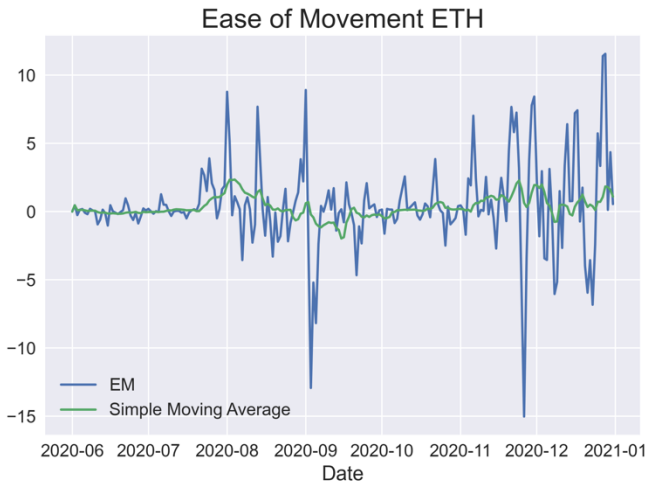
Chaikin Money Flow: When the Chaikin Money Flow indicator is below 0, it suggests that the market is in a downtrend and is a sign of overall weakness in the market. Conversely, when the indicator is positive, it suggests an uptrend and is a sign of overall strength in the market. The principle behind this is that the nearer the closing price is to the high, the more accumulation has taken place. Conversely, the nearer the closing price is to the low, the more distribution has taken place. It is interesting to note that over the entire course of the dataset analysis period, the Chaikin Money Flow was almost never negative. If so, it was only for a very small amount of time and it was almost negligible. This suggests that for the entire 220 days, the price was generally in an uptrend, which is true. However, this implies that the Chaikin Money Flow would not be very helpful in making day to day trades. Therefore, this is an unreliable standalone method.



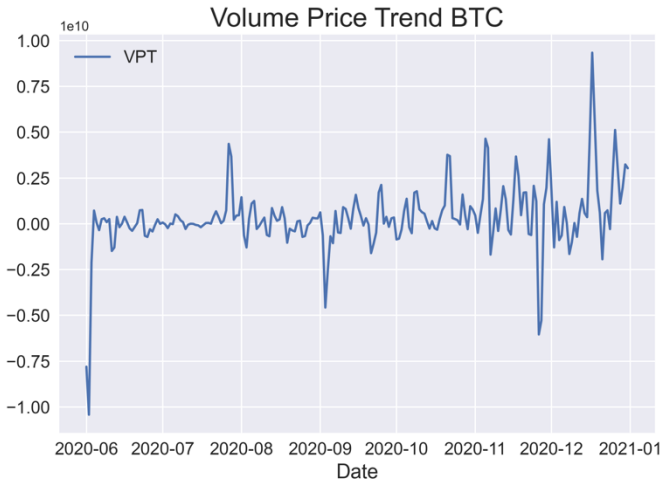
Force Index: The Force Index is a technical indicator that measures the amount of power used to move the price of a commodity. A rising Force Index helps confirm rising prices. Similarly, a falling Force Index helps to confirm falling prices. An extreme spike (upward or downward) in the Force Index helps confirm a breakout in the price. If the Force Index is making lower swing highs while the price is making higher swing highs, this is a bearish divergence and indicates that the price may soon decline. If the Force Index is making higher swing lows while the price is making lower swing lows, this is bullish divergence and indicates that the price may soon rise. Generally, all of these cases are true in their own respective situations. Therefore, this is a very reliable standalone method.



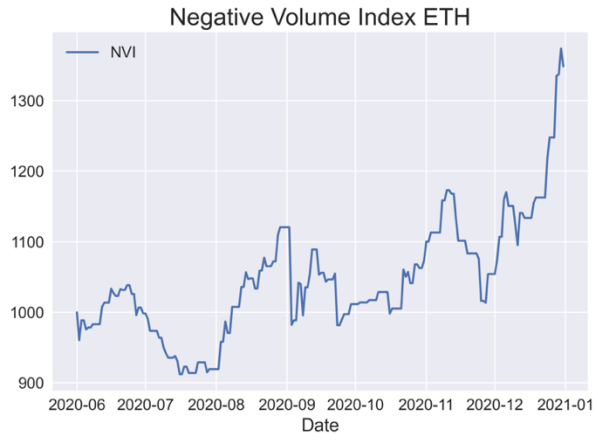
Ease of Movement: The Ease of Movement indicator shows the relationship between price and volume, and it is often used to assess the strength of an underlying trend. This indicator calculates how easily a price can fluctuate. If the indicator is greater than 0, this indicates that the commodity is being purchased a lot, while if it is below 0 it indicates that it is being sold a lot. Generally, this is not accurate across a wide variety of instances. Therefore, this is an unreliable standalone method.



Volume Price Trend: The Volume Price Trend indicator helps determine a commodity's price direction and overall strength of a given price change. It is displayed along a signal line: if the Volume Price Trend line crosses above the signal line, this is generally treated as a buy signal and indicates that the price might rise. If the Volume Price Trend line crosses below the signal line, this is generally treated as a sell signal and indicates that the price might fall. In short term trades, these rules generally uphold and can be considered consistent. However, in the overall course of the dataset, this is not as consistent. Therefore, this is an unreliable standalone method.

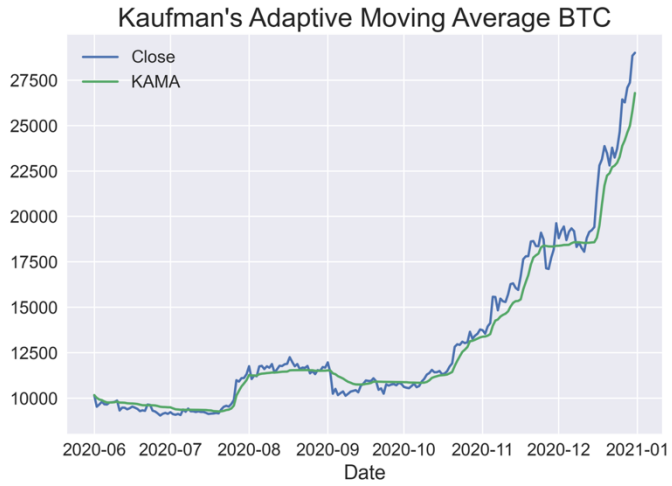


Negative Volume Index: The Negative Volume index is a technical line that integrates volume and price to graphically show how price movements are affected by days with decreased volume. If the Negative Volume Index is higher, it means that the price is increasing while volume is decreasing, which is a sign of strength in the current price and indicates it can remain at that level. If the Negative Volume Index is lower, it means that the price is decreasing while the volume is decreasing, which is a sign of weakness in the current price and indicates that it can be expected to fall. However, typically the opposite tends to happen when analyzing this indicator applied to the dataset, which can be due to any number of unaccounted for reasons. Therefore, this is an unreliable standalone method.



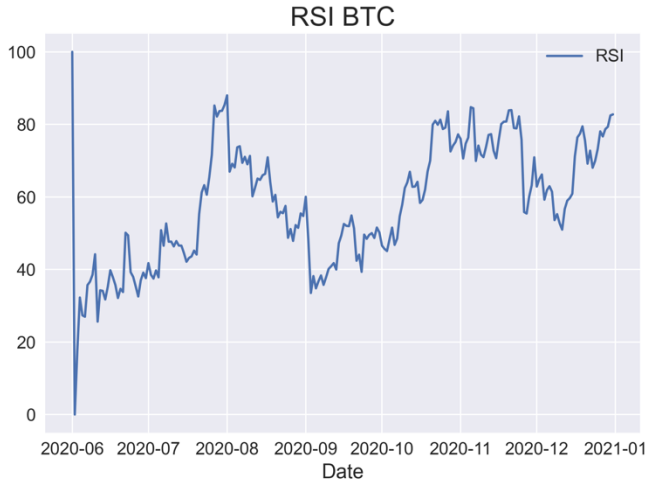
4.3 Momentum Indicators

Kaufman Moving Average: The Kaufman Moving Average is a suggested to be used best as a long-term momentum indicator. This is because the indicator generates fewer false signals, due to the fact that it does not respond to short term price movements if they are deemed insignificant. When the market volatility is low, the Kaufman Moving Average should remain near the current price, while when the volatility is high, it should lag behind the price. When the indicator is moving lower, it indicates the presence of a potential downtrend. Conversely, when the line moves higher, it predicts an uptrend. All the movements of the indicator seem to properly correspond with the correct price movements in the dataset. Therefore, this is a reliable standalone method.

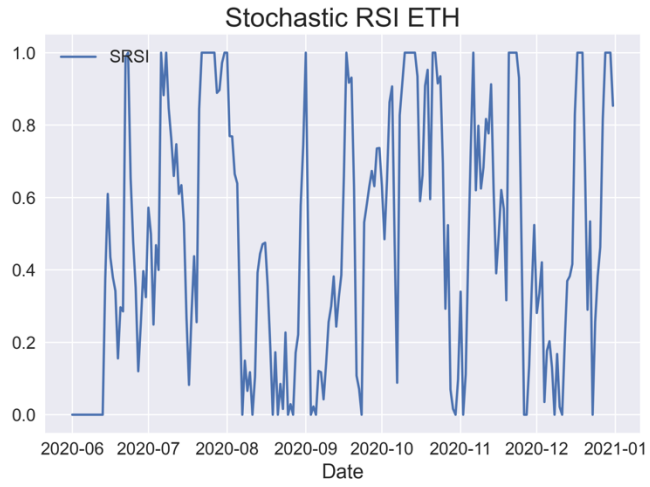


RSI: Generally, the Relative Strength Index is a better performer in a bullish market, whereas the Stochastic Relative Strength Index (mentioned next) is a better performer during stagnant or choppy markets. This indicator is used in technical analysis to measure the magnitude of recent price changes to evaluate overbought or oversold conditions in the price. Traditional interpretation of the Relative Strength Index is that values over 70 indicate that a commodity is overbought/overvalued and is estimated to undergo a pullback in price, and that values under 30

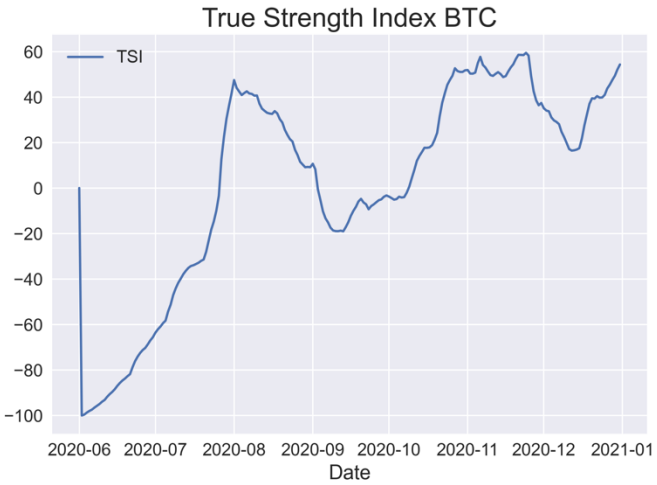
indicates it is oversold/undervalued and may be estimated to undergo a spike in price. This is generally consistent with the dataset. Therefore, this is a reliable standalone method.



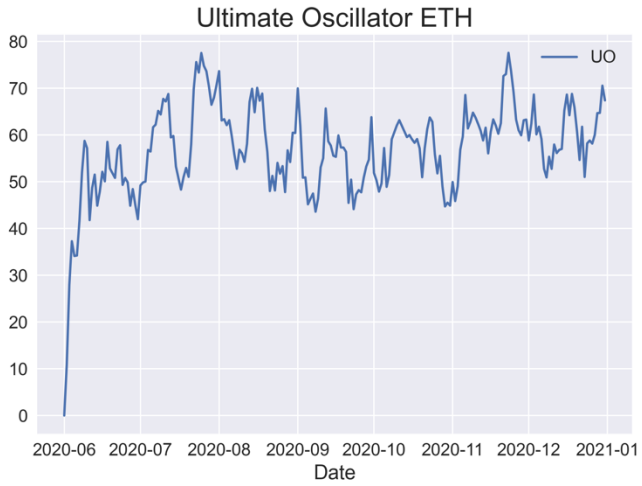
Stochastic RSI: The Stochastic Relative Strength Index is best used in choppy/detrending markets. A Stochastic RSI reading above 0.8 is considered overbought and indicates that the price may start decreasing, while a reading below 0.2 is considered oversold and indicates that a price could be primed to start climbing again. A reading of zero means that the Stochastic RSI is at the lowest level in the period examined, while a reading of 1 means that it is at the highest level in the period examined. In addition, when the reading is above 0.50, the price may be seen as trending higher, while when it is below 0.50 the opposite is true. The Stochastic Relative Strength Index is generally much more volatile than the regular Relative Strength Index, and because of this it is more difficult to use it as a metric to predict price movement. It is generally much less accurate when analyzing the dataset. Therefore, this is an unreliable standalone method.



True Strength Index: The True Strength Index is a technical momentum oscillator that is primarily used to identify price trends and reversals. The True Strength Index fluctuates between positive and negative areas: if it is positive, it means that the price is generally bullish, whereas if it is negative, it means that the price is generally bearish. When the indicator diverges with the price, the True Strength Index may be signaling that the current price trend is weakening and may reverse. Extreme change in the True Strength Index may correlate to a direct reversal. This is generally accurate when analyzing the dataset. Therefore, this is a reliable standalone method.

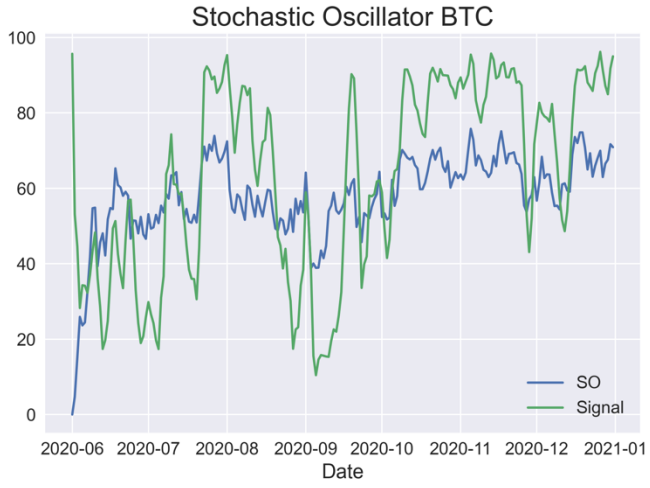


Ultimate Oscillator: The Ultimate Oscillator is a technical indicator used to measure the price momentum of an asset across multiple timeframes. There is a three-step method in order to deduce whether the current movement is a buy signal or a sell signal. In order to generate a buy signal, a bullish divergence must form. This occurs when the price makes a lower low, but the indicator is at a higher low. Second, the first low in the divergence must have been below 30; this indicates that the divergence is more likely to result in a reversal. Lastly, the oscillator must rise above the divergence high, which is the high point between the two lows of the divergence. Similarly, for sell signals, a bearish divergence must form, and the first high in the divergence must be above 70. Lastly, the oscillator must drop below the divergence low, which is the low point between the two highs of the divergence. This is a very complex indicator to read, however even when read properly false positives and negatives are fairly common, which results in false buy and sell signals. Therefore, this is an unreliable standalone method.

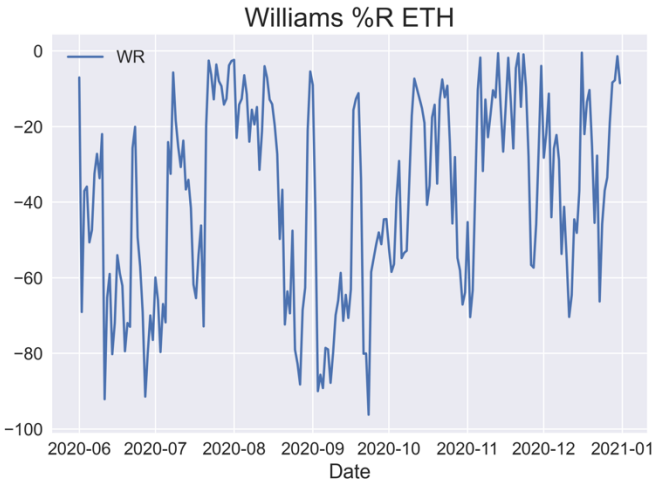


Stochastic Oscillator: The Stochastic Oscillator is a popular technical indicator for generating overbought and oversold signals, and it used to gauge momentum based off historical price. The Stochastic Oscillator tends to vary around a mean price level, given that they are calculated via an asset's price history. The main limitation of this indicator is that it is known to produce false

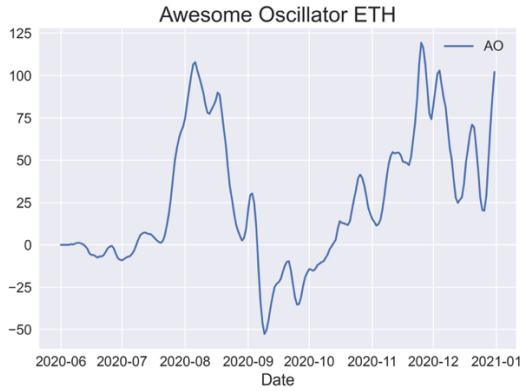
signals. During volatile market conditions, it is especially expected for false signals to occur. The scale of the index is from 0-100; like other momentum indicators, if the value is 80 or above then the asset is considered overbought, whereas if it is 20 and below then it is considered oversold. You can also compare the Stochastic Oscillator value to previous records within the same time period and try to generalize where the price will head based off its historic pattern. This is generally accurate when used with the dataset. Therefore, this is a reliable standalone indicator.



Williams %R: The Williams %R indicator is best used to find entry and exit points within the market. It has a scale of 0 to -100, with above -20 being overbought and below -80 being oversold. It is also frequently used to generate trade signals when the price and indicator both move out of overbought and oversold territory, rather than relying solely on the indicator. During an uptrend, if the indicator moves below -80 this is generally treated as a buy signal, and this indicates that the uptrend has more momentum to continue. Similarly, this method can also be used to detect faltering momentum; during an uptrend, if the indicator reaches -20 or above and falls, this signals a decline in the price will follow. Like the previous indicator, the Williams %R seems to be too volatile to use as a reliable metric for trading given the dataset. Therefore, this is an unreliable standalone method.

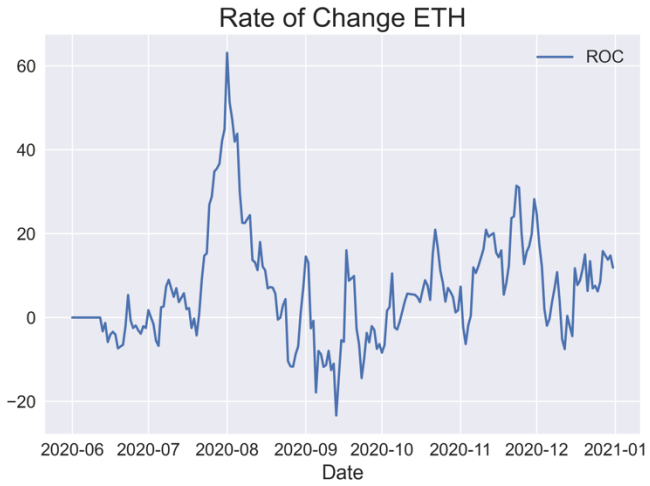


Awesome Oscillator: Like other momentum indicators, the Awesome Oscillator's primary use is to measure overall market momentum, as well as affirm price trends and even anticipate potential price reversals. This is more useful compared to other oscillators because it utilizes standard momentum oscillators and adjusts the calculation in order to strengthen a common weakness between them. However, it tends to not be extremely accurate given the dataset. Holding a constant price territory causes the oscillator to vary frequently and almost appear random, which is most likely associated with the extreme volatility and near independence from volume of the cryptocurrency market. Therefore, this is an unreliable standalone method.



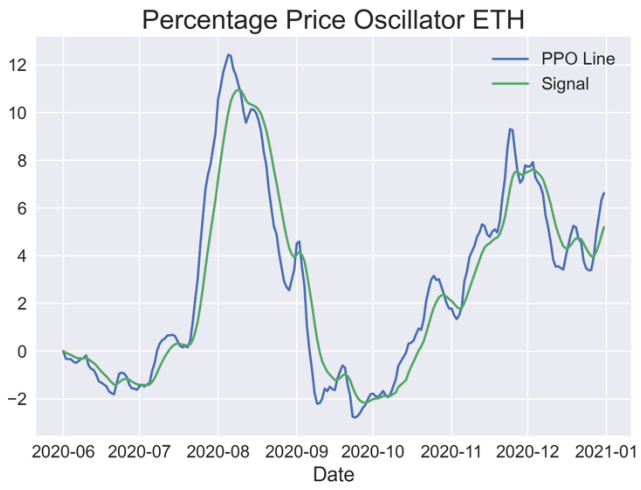
Rate of Change: The Rate of Change indicator displays an asset's rate of change. An asset with high momentum correlates to having a positive Rate of Change, and this indicates that it may

outperform the overall market in the short term. Conversely, an asset with a low or negative Rate of Change is likely to decline in price. This is generally true with the dataset; a rise in the Rate of Change indicator above 0 correlates to a positive price increase. Therefore, this is a reliable standalone method.

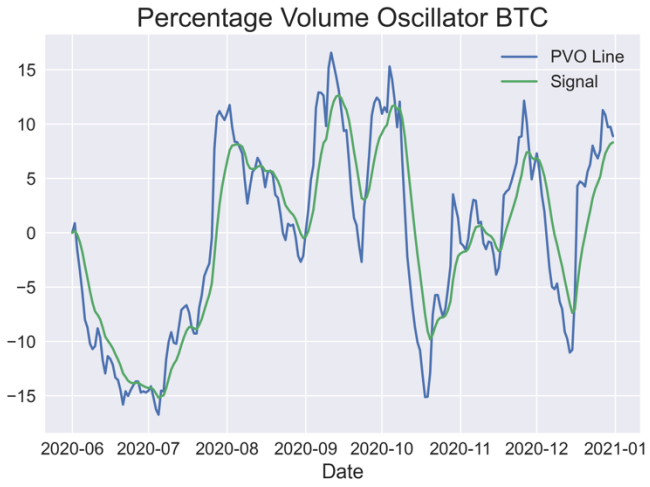


Percentage Price Oscillator: The Percentage Price Oscillator is a momentum indicator that shows the relationship between exponential moving averages given two different periods in the dataset timeframe. The oscillator is mainly used to compare asset price and volatility, signal price divergences that could result in reversals, confirm trend direction, and generate trading signals. The Percentage Price Oscillator graph contains two lines: the oscillator line itself, and a signal line which is an exponential moving average of the oscillator line. If the oscillator line crosses above the signal line from below, this is treated as a buy signal. If the oscillator line crosses below the signal line from above, this is treated as a sell signal. In addition, when the Percentage Price Oscillator is above 0, this indicates that the asset is in an uptrend. Similarly, when the oscillator is below 0, this indicates that the asset is in a downtrend. This is visualized via a histogram that is graphed along with the oscillator line and the signal line. You can combine the ways of trend analysis with the buy and sell signals, in order to generate even more accurate

trading strategies. When combining all the ways to read this indicator, it provides a very consistent method to predict the prices in our dataset. Therefore, this is a very reliable standalone method.

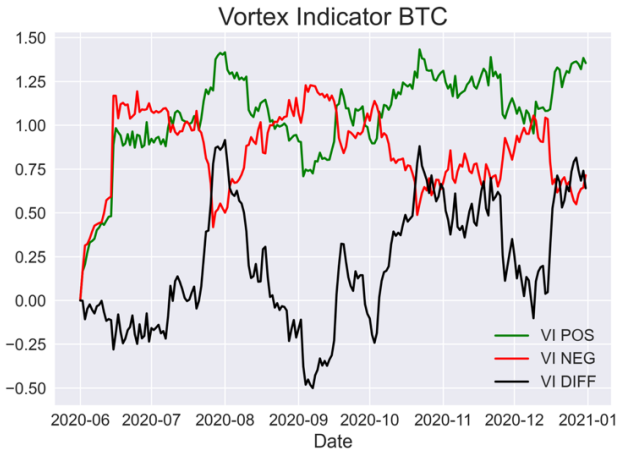


Percentage Volume Oscillator: The Percentage Volume Oscillator measures the difference between two volume-based exponential moving averages as a percentage of the larger moving average. The Oscillator is positive when the shorter volume moving average is above the larger volume moving average, and negative when the shorter volume moving average is below the larger volume moving average. This indicator is best used to determine uptrends and downtrends relative to volume movement, especially when combined with other indicators. For example, a breakout can be validated using the Percentage Volume Oscillator when the oscillator line is rising or in positive territory. This proves to be generally consistent with the dataset; the oscillator line crossed negative territory on price reversals and remained in positive territory when a current uptrend continued. Therefore, this is a reliable standalone method.

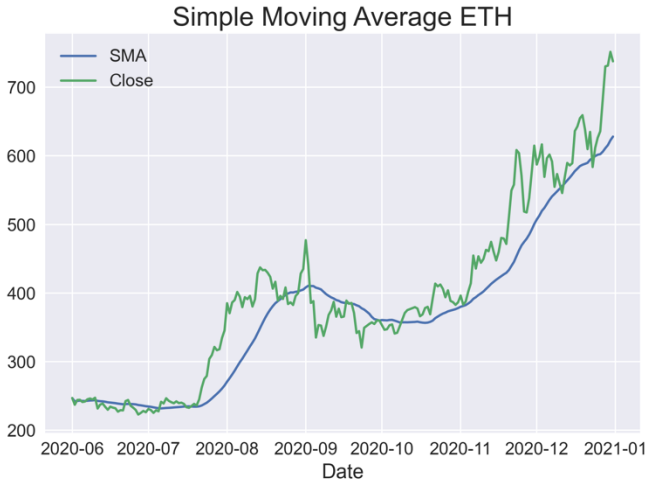


4.4 Trend Indicators

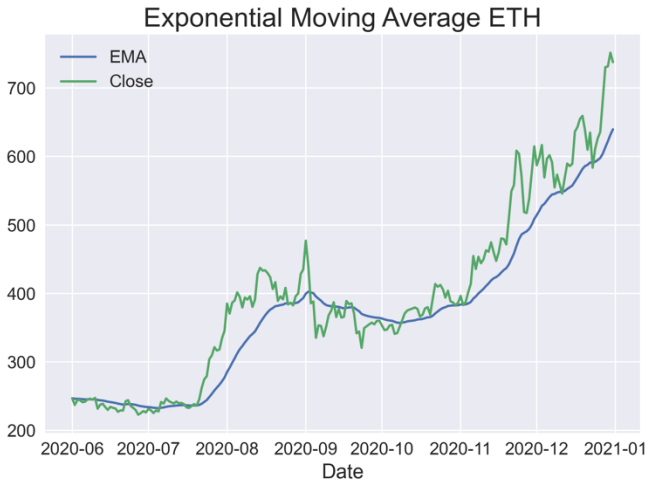
Vortex Indicator: The Vortex Indicator is an indicator composed of two lines: an uptrend, positive line and a downtrend, negative line. It is best used to detect price reversals. A buy signal occurs when the positive line crosses above the negative line from below it. A sell signal occurs when the negative line crosses above the positive line from below it. This is consistently accurate when analyzing the dataset, especially with regards to detecting price reversals that correspond to the buy and sell signals (buy signal means the current downtrend will reverse to an uptrend, and a sell signal means the current uptrend will reverse to a downtrend). Therefore, this is a very reliable standalone method.



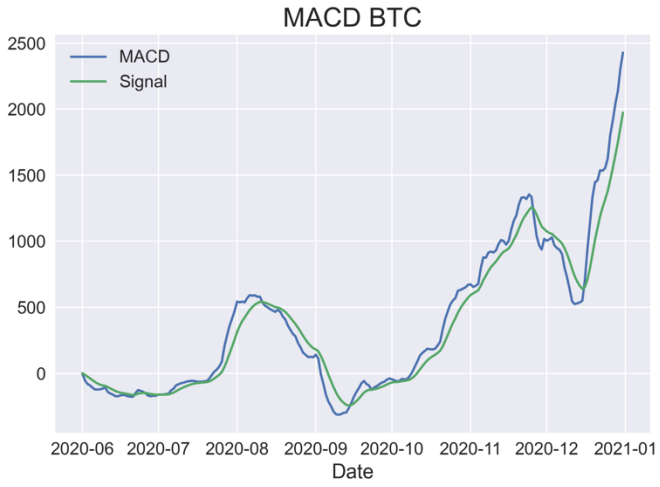
Simple Moving Average: The Simple Moving Average calculates the average of a range of prices given a certain period in a timeframe of analysis. Because of the nature of this indicator, it cannot be used as a standalone indicator. Rather, it is best used as a supplement to other indicators, as previously mentioned. A benefit of using this indicator is that it helps smooth out extreme spikes and drops, which helps normalize the dataset being analyzed. Therefore, this is an unreliable standalone method.



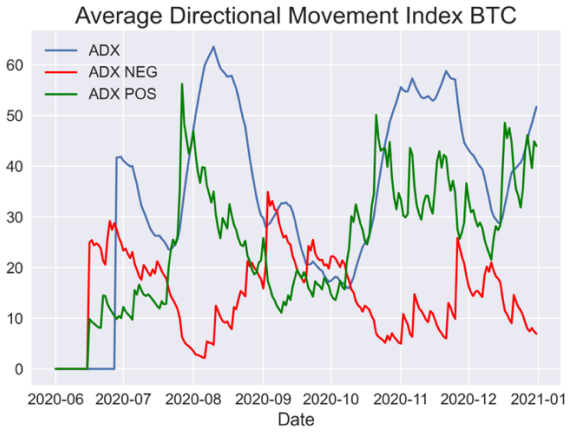
Exponential Moving Average: The Exponential Moving Average is similar to the Simple Moving Average, except that it places a greater weight and significance on the more recent data points. The Exponential Moving Average reacts much more significantly to recent price changes than the Simple Moving Average, since the latter applies an equal weight to all data points in the time period. The Exponential Moving Average also tends to hug the price movement much tighter; by extension, one could argue that this is more optimal than the Simple Moving Average for this reason in addition to the emphasis on more recent price movements. However, like the Simple Moving Average, this indicator cannot really be used alone, and it is instead mainly a supplement to other technical analysis methods. Therefore, this is an unreliable standalone method.



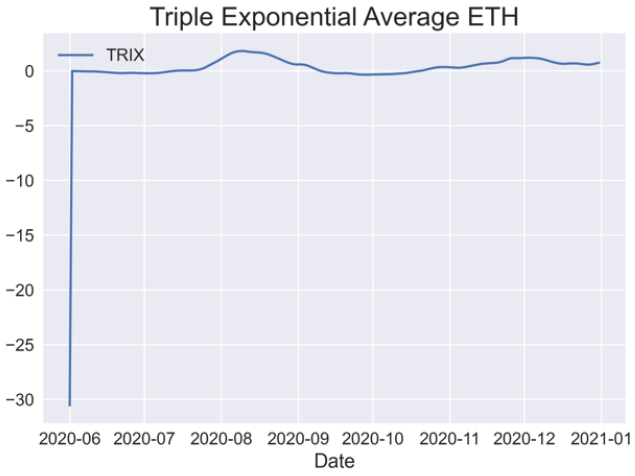
Moving Average Convergence Divergence: The Moving Average Convergence Divergence is a trend-following momentum indicator that shows the relationship between two moving averages of an asset's price. The graph is composed of the Moving Average Convergence Divergence indicator line as well as a signal line. A typical buy signal is generated when the Moving Average Convergence Divergence line crosses above its signal line. A typical sell signal is generated when the Moving Average Convergence Divergence line crosses below its signal line. In addition to using crossovers to generate trading signals, you can also utilize the Moving Average Convergence Divergence indicator to spot divergences and rapid rise and falls in an asset's price. The indicator can also add more depth to the buy and sell signals by examining the slope and speed of the crossovers that generated the trading signals; this can give more insight into whether an asset is overbought or oversold. This can then be used to help justify bullish and bearish price movement. In the dataset, all these methods are consistently very accurate in predicting their respective price movements. Therefore, this is a very reliable standalone method.



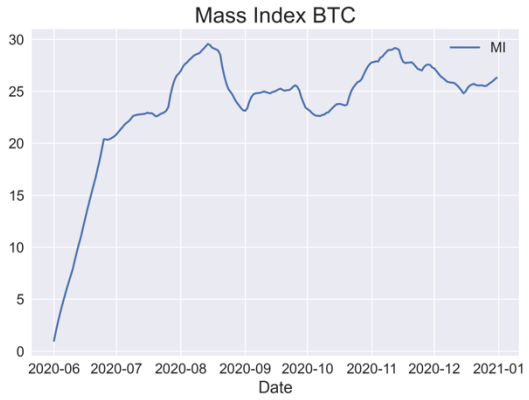
Average Directional Movement Index: The Average Directional Movement Index is an indicator that is primarily used to determine the strength of a current asset's price trend. The indicator has three main elements: the index line, as well as a positive indicator and a negative indicator. The current trend has strength when the index line is above 25. The current trend is weak when the index line is below 25. In addition, crossovers of the positive and negative lines can be used to generate trading signals. If the positive line crosses above the negative line while the Average Directional Movement Index is above 25, this is treated as a long term buy signal. Conversely, if the negative line crosses above the positive line and the Average Directional Movement Index is below 25, this is treated as a sell signal. Analysis of the dataset with the above methods is generally very consistent with what each respective strategy corresponds to. Therefore, this is a very reliable standalone method.



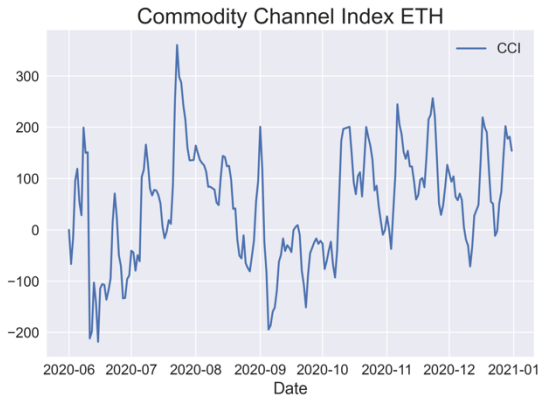
Triple Exponential Moving Average: The Triple Exponential Moving Average is a momentum indicator that shows the percentage change in a moving average that has been smoothed exponentially three times over. It is mainly used to identify oversold and overbought markets. When the Triple Exponential Moving Average crosses above 0, it is treated as a buy signal. When it crosses below 0, it is treated as a sell signal. The main complication with this indicator is that due to the time period analyzed, the price movements below and above 0 are extremely minimal. However, if we do analyze it closely, it does yield accurate results when using 0 as the reference level. Therefore, this is a reliable standalone method.



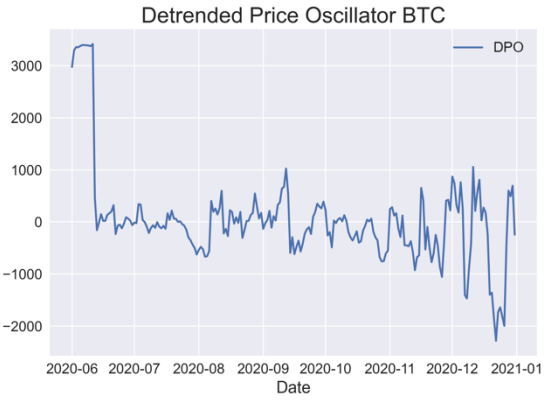
Mass Index: The Mass Index is a form of technical analysis that examines the range between high and low asset prices. When the range widens at a certain point and then promptly contracts, this is generally treated as a reversal of the price. However, its main use is for short term, intraday trading which results in the indicator not being helpful in the long-term timeframe analyzed. Therefore, this is an unreliable standalone method.



Commodity Channel Index: The Commodity Channel Index is a momentum-based oscillator that is best used to determine whether an asset is reaching overbought or oversold territory. It measures the difference between the current price and the historical average price. When the Commodity Channel Index is above 0, it indicates that the price is currently above the historic average. Conversely, when the index is below 0, it indicates that the price is currently below the historic average. This indicator does not provide much information with regards to the movement of the actual price, since it mainly deals with historic data. One could argue that it could detect threshold high and lows, but this is not helpful with the dataset. Therefore, this is an unreliable standalone method.

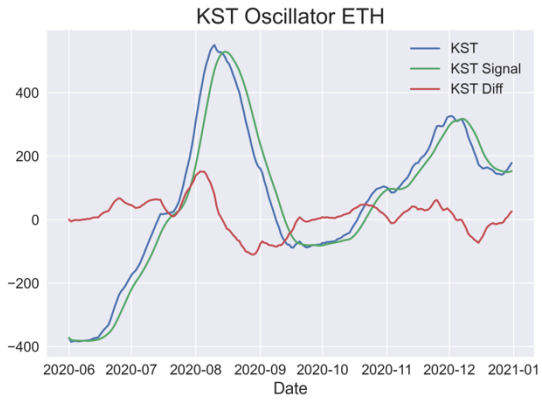


Detrended Price Oscillator: The Detrended Price Oscillator is not a momentum indicator like other oscillators. Instead, it highlights peaks and troughs in asset price movement, which are used to estimate buy and sell signals. For example, if peaks have been historically two months apart, and a current peak occurs, one could estimate that the next peak would be in another two months, and they would sell at that point. Surprisingly, both peak and trough detection is generally accurate when analyzing the dataset. Therefore, this is a reliable standalone method.



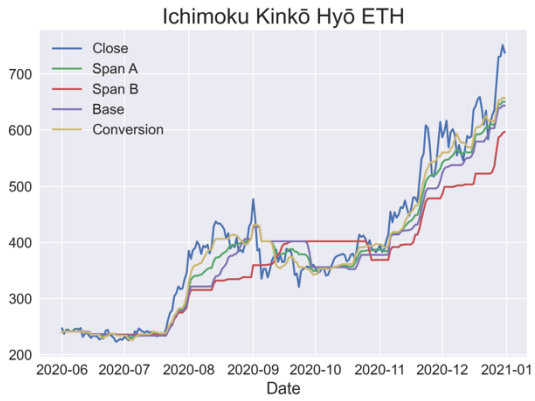
KST Oscillator: The KST Oscillator contains three lines: the KST line, the KST signal line, and the KST diff line. The main methods of analysis primarily deal with the KST line and the signal line, which keeps it relatively simple. When the KST line crosses over the signal line from below it, this is generally treated as a buy signal. When the KST line crosses below the signal line from above it, this is generally treated as a sell signal. In addition, it is best combined with other

indicators that can detect overbought and oversold territory. This is generally very consistent when analyzing the dataset. Therefore, this is a very reliable standalone method.



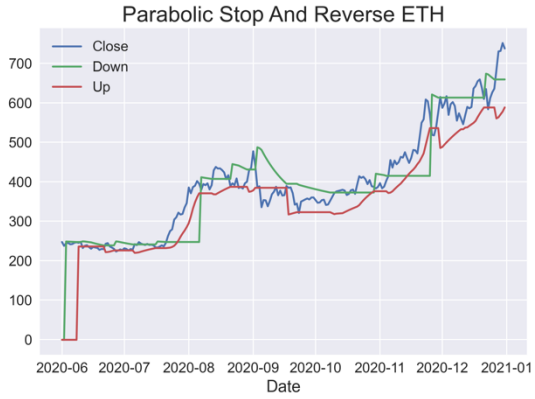
Ichimoku Kinkō Hyō: The Ichimoku Kinkō Hyō is an all-in-one technical indicator. It is composed of 5 lines: the tankan-sen, kijun-sen, senkou span A, senkou span B, and chikou span. Despite being dubbed as an all-in-one indicator, the Ichimoku indicator is supposedly best used in conjunction with other technical analysis methods, which is not the case when analyzing the dataset. The tenkan-sen, or the conversion line, is calculated by adding the highest high and the lowest low over the past 9 periods (split from the analyzed timeframe) and dividing the result by two. The line represents a key support and resistance level, as well as represents a signal line to predict reversals. The kijun-sen, or base line, is calculated by adding the highest high and the lowest low over the past 26 periods (split from the analyzed timeframe) and dividing the result by two. The resulting line represents a key support and resistance level, a confirmation of a trend change, or it can be used as a trailing stop loss point to prevent any further losses in the event the asset's price is heading downwards. The senkou span A, or leading span A, is calculated by adding the tenkan-sen and the kijun-sen, dividing the result by two, and then plotting the result 26 periods (split from the analyzed timeframe) ahead. The resulting line forms one edge of the kumo (the cloud) which is used to identify future areas of support and resistance. The senkou

span B, or leading span B, is calculated by adding the highest high and the lowest low over the past 52 periods (split from the analyzed timeframe), dividing it by two, and then plotting the result 26 periods ahead. The resulting line forms the other edge of the cloud that is used to identify future areas of support and resistance. Lastly, the chikou span, or lagging span, is the current period's closing price plotted 26 days back on the chart. This line is used to show possible areas of support and resistance. There are numerous other ways that these lines can be interpreted together in order to produce buy and sell signals. When the asset price is above the base line, momentum is on the upside which means the asset is primed to go in an uptrend. In addition, if the price is above the senkou span A, this may be interpreted as a buy signal. When the tenkan-sen line crosses above the kijun line, this means that momentum has shifted to the downside and may be interpreted as a sell signal. These methods are generally very accurate on their own, given the complexity of the indicators and how they work together. Therefore, this is a very reliable standalone method.

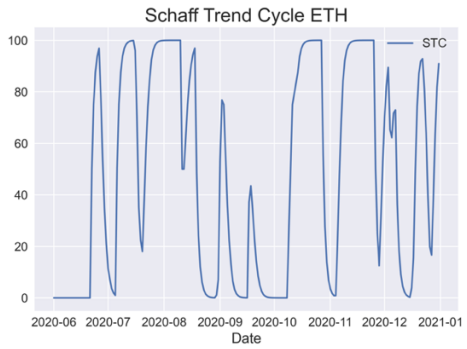


Parabolic SAR: The Parabolic SAR (stop and reverse) indicator is used to spot trends and reversals. The indicator contains 2 lines: the up line, and the down line. If the up line is above the down line, this signals that the price can increase and is treated as a buy signal. If the up line is below the down line, this signals a price decrease and is treated as a sell signal. Using the

indicator to spot price reversals along with the trading signals is generally accurate across the dataset. Therefore, this is a reliable standalone method.



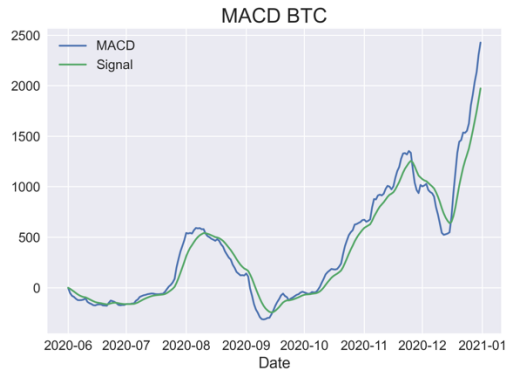
Schaff Trend Cycle: The Schaff Trend Cycle is a technical indicator used to spot buy and sell points in the market. This indicator reacts faster to changing market conditions, especially relative to the Moving Average Convergence Divergence indicator. One major drawback of the Schaff Trend Cycle indicator is that it can stay in overbought or oversold territory for long stretches of time without properly adjusting; this is when the indicator line has a slope of 0. A buy signal is generated when the signal line turns up from 25 (to indicate a bullish reversal is happening). A sell signal is generated when the signal line turns down from 75 (to indicate a bearish reversal). The trading signals along with the volume aspect of this indicator overall are not very accurate when analyzing the dataset. Therefore, this is an unreliable standalone method.

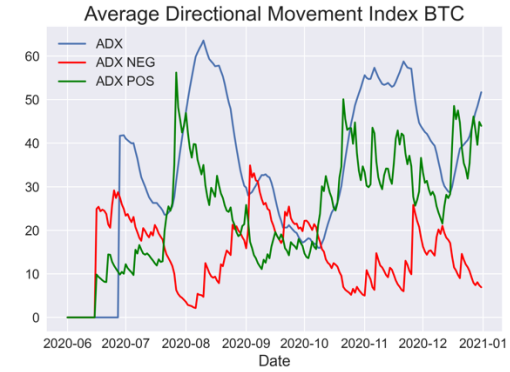


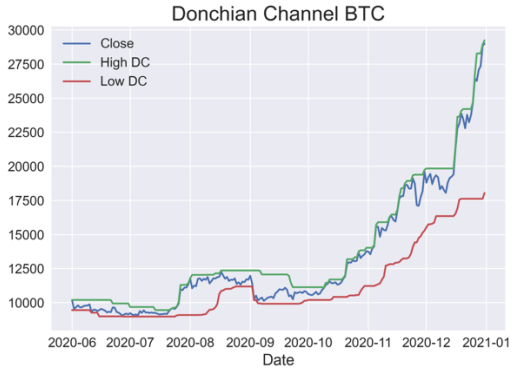
4.5 Combination Indicators

Ideally, a reliable combination of technical analysis methods contains one method from each major category: that is, a momentum, trend, volume, and volatility indicator that complement each other. However, volatility indicators are not explicitly required, since most volatility indicators themselves make use of some other categories in their calculations. Below are the most common and historically accurate combinations of technical analysis methods, as well as some unique combinations that arose from the analysis of the dataset. Since they are combinations of technical analysis indicators, they require much more complex and thorough readings before deciding on a trade. It is also important to note that unreliable methods can potentially be made reliable or even very reliable when used in conjunction with other methods that complement it properly.

Donchian Channels + Moving Average Convergence Divergence + Average Directional Movement Index: The first step in reading this combination of technical indicators is to check if the asset price is currently breaking out at the upper Donchian Channel Band. Once this is confirmed, the Average Directional Movement Index must then be higher than 30. Lastly, when Moving Average Convergence Divergence crosses above the signal line, this is the final confirmation for a buy signal. Similarly, the conditions for a sell signal are when the price is breaking the lower Donchian Channel Band, the Average Directional Movement Index is less than 25, and the Moving Average Convergence Divergence line crosses below the signal line. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.

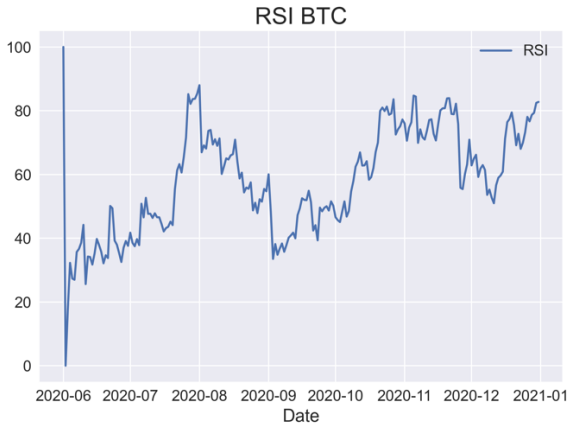


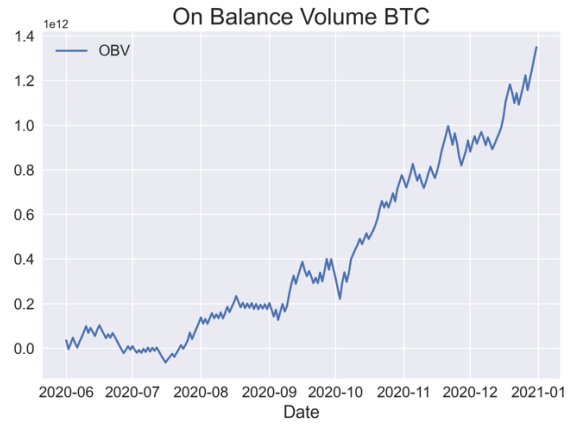


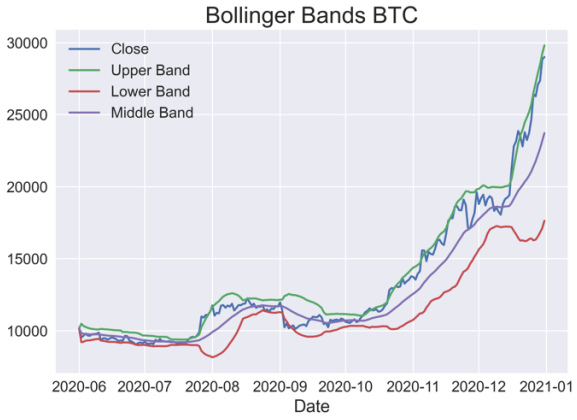


RSI + On Balance Volume + Bollinger Bands: The first reading of this combination deals with the Bollinger Bands. The first confirmation is when the price closes above the middle Bollinger Band. When that is achieved, the trader should look at the RSI levels simultaneously; an RSI reading above 50 represents positive momentum, while an RSI reading below 50 represents negative momentum. Next, it is best to wait for the On Balance Volume to rise; once the volume confirms the rise in price, this is generally treated as a buy signal. Once the price breaks below

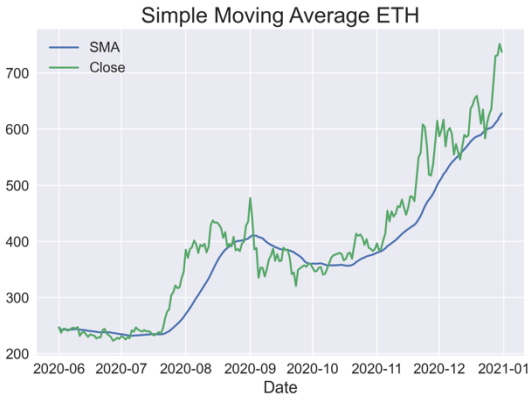
the lower Bollinger Band, this is generally treated as a sell signal. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.

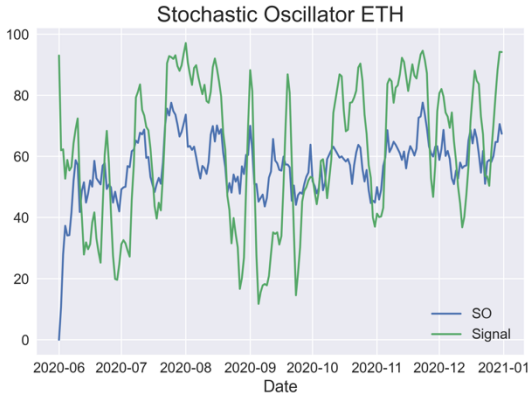






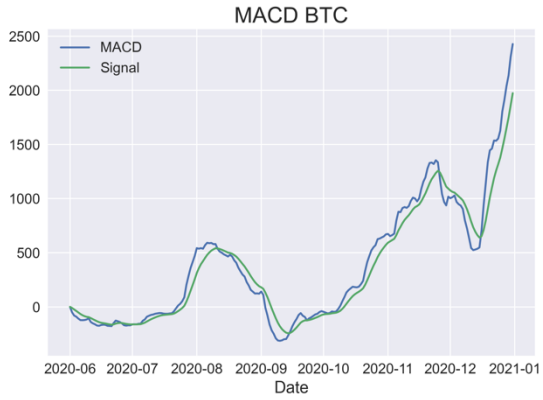
Simple Moving Average + Stochastic Oscillator: Using these two indicators together results in the following trading signals: when the asset price breaks the simple moving average line from below upwards, and the Stochastic Oscillator signal line crosses the signal line upwards, it may be a sign of an upward trend. A sign of a downward trend occurs when the asset price crosses the simple moving average line from above downwards, and the Stochastic Oscillator signal line crosses the oscillator line downwards. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.

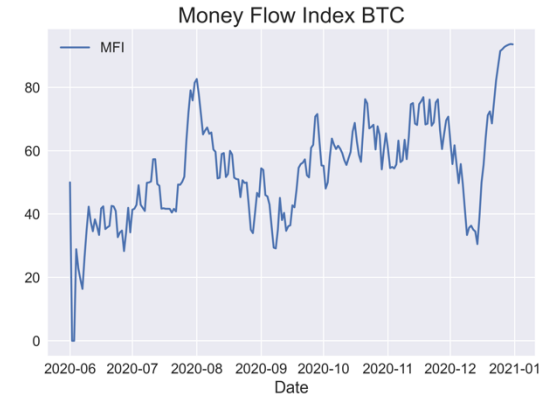




Moving Average Convergence Divergence + Money Flow Index: This setup of indicators is relatively simple to read, which is what makes it so efficient and practical. The first step in determining a buy signal is to check if the Money Flow Index is oversold, or if the value is around 20. The next step is to check if the Moving Average Convergence Divergence line goes

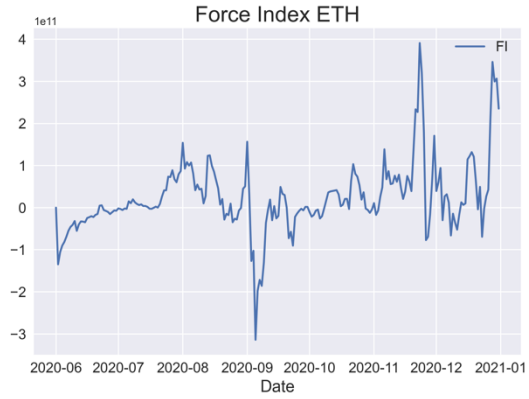
from near negative to positive. There is added support behind the trade if the Moving Average Convergence Divergence line crosses above the signal line. Conversely, determining a sell signal occurs when the Money Flow Index is overbought, or if the value is around 80. In addition, this is supported by the Moving Average Convergence Divergence line crossing below the signal line. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.

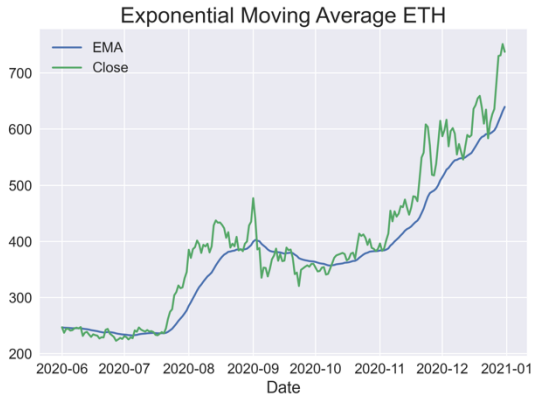




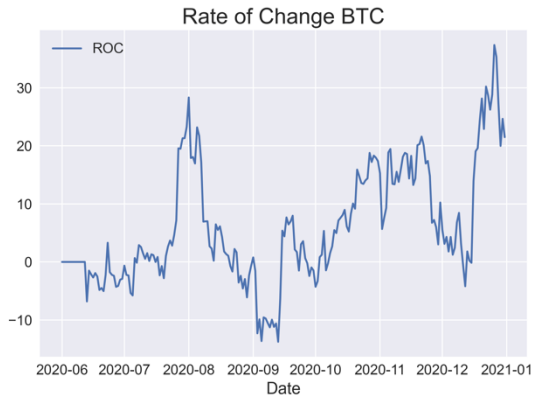
Force Index and Exponential Moving Average: The first step in reading this combination of technical indicators is to check if the Force Index is increasing. Once this is confirmed, if the Exponential Moving Average is increasing or positively sloped, this results in a buy signal. If the Exponential Moving Average then changes to be neutrally sloped or the Force Index drops below

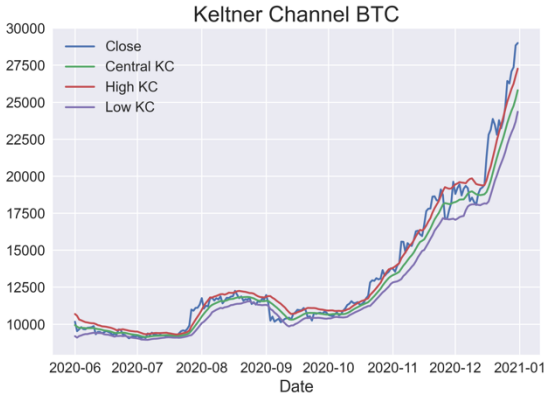
0, this is an immediate sell signal. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.



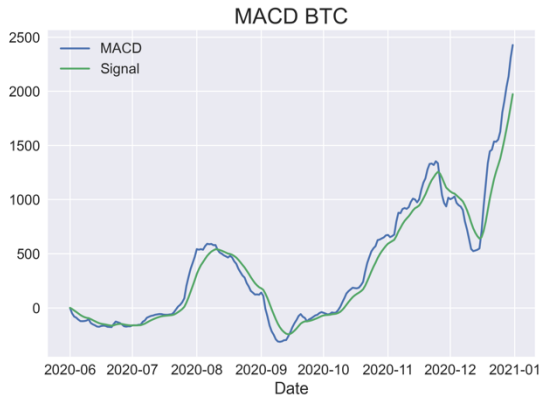


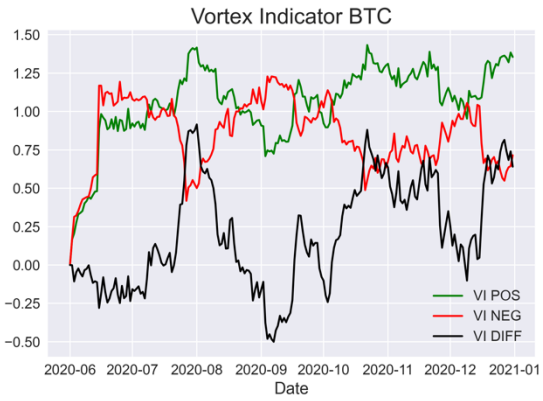
Rate of Change and Keltner Channels: The first step in reading this combination of technical indicators is to check the Rate of Change value and the asset price relative to the central Keltner Channel. If the Rate of Change is below 0 and the price closes below the central Keltner Channel, this is treated as a buy signal. If the Rate of Change is above 0 and the price closes above the Keltner Channel, this is treated as a sell signal. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.



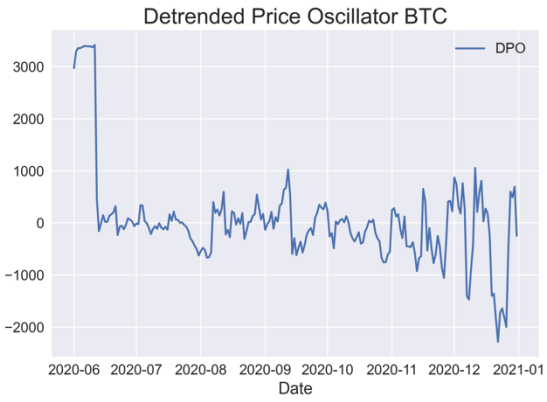


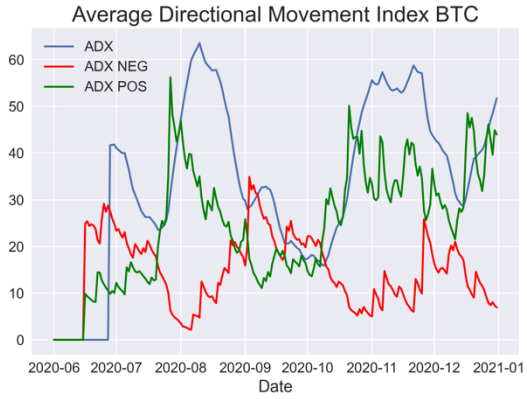
Moving Average Convergence Divergence + Vortex Indicator: Like other uses of the Moving Average Convergence Divergence indicator, the first step in reading this combination of technical indicators is to check the Moving Average Convergence Divergence relative to its signal line. Next, the trader should check the Vortex Indicator positive and negative lines, and how they interact with each other. If the Moving Average Convergence Divergence crosses above the signal line from below it, and the Vortex Indicator positive crosses over the negative, this is generally treated as a buy signal. If the Moving Average Convergence Divergence crosses below the signal line from above it, and the Vortex Indicator negative crosses over the positive, this is generally treated as a sell signal. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.





Detrended Price Oscillator + Average Directional Movement Index: The first step in reading this combination of technical indicators is to check the distance between peaks and lows on the Detrended Price Oscillator, in order to estimate when they may occur again in the future and use lows for buy signals and peaks for sell signals. Next, the trader should check if the Average Directional Movement Index positive line is above the negative line for buy signals, and if the negative line is above the positive line for sell signals. Overall, this combination of indicators proved to be very consistent and accurate when analyzing the dataset. Therefore, this is a very reliable method.





5. Evaluation

Of the 37 indicators analyzed, 19 of them were deemed to be unreliable, 11 were deemed to be reliable, and 7 were deemed very reliable in predicting asset prices. Combinations of technical indicators that are historically proven to be the most accurate were also tested, and all 8 of these combinations were shown to be very reliable. Therefore, technical analysis methods are indeed able to be applied to the cryptocurrency market, but they should be tested before doing so as this is not always the case.

Indicator	Description	Rating
Bollinger Bands	If price breaks the lower band, this is a buy signal	Not Reliable
Keltner Channels	If price crosses under the lower band, this is a buy signal	Not Reliable
Donchian Channels	If price falls to the lower bound, this is a buy signal	Reliable
Ulcer Index	If there is a spike in the ulcer index, this is a sell signal	Reliable
Money Flow Index	If indicator is rising while price is falling, this is a buy signal	Not Reliable
Accumulation Distribution Index	If the line is rising, this confirms a price uptrend, and if the line is falling this confirms a downtrend	Not Reliable
On Balance Volume	If the volume line increases sharply without a significant change in price, this might lead to an extreme drop or rise in price	Reliable
Chaikin Money Flow	If the rating is above 0, this is a sign of strength in the market. If it is below 0, this is a sign of weakness	Not Reliable
Force Index	If the force index is making higher swing lows while the price is making lower swing lows, this indicates the price is in an uptrend. Also, if the force index is positive, this indicates a rising price, while negative indicates a falling price	Very Reliable
Ease of Movement	If the rating is greater than 0, this indicates that the commodity is being bought a lot, while if it is below 0, this indicates that the commodity is being sold a lot	Not Reliable
Volume Price Trend	If the volume price trend crosses above the signal line, this is a buy signal. If the volume price trend crosses below the signal line, this is a sell signal	Not Reliable

Sample Standalone Results (not all shown)

Combination	Description	Rating
RSI + OBV + Bollinger Bands	If price rises above the middle BB, and the RSI is above 50, and OBV is on a rise, this is a buy signal	Very Reliable
SMA + Stochastic Oscillator	If the price breaks the SMA line from under to above, and the green line of the SO crosses the blue line	Very Reliable
MACD + MFI	If the MFI is around 20 and MACD goes from near negative to positive, this is a buy signal	Very Reliable
Donchian Channels + MACD + ADX	If the ADX is above 30, and MACD crosses above the signal line, and there is a breakout at the upper Donchian Channel band, this is a buy signal.	Very Reliable

Sample Combined Results (not all shown)

6. Conclusions and Future Work

6.1 Conclusions

One of the main conclusions that can be drawn from this project is that Bitcoin and Ethereum behave extremely similarly in terms of price movement. To an extent, they act almost identical. Any technical analysis indicator that is applied to one can be equally applied to the other, irrespective of the price or volume differences between the two. This becomes especially interesting when you note that Bitcoin and Ethereum are completely different cryptocurrency coins.

The biggest conclusion that can be drawn from this project is that many traditional technical analysis methods that see success in the stock market can also see success in the cryptocurrency market. Out of the 37 indicators tested, 19 of them were unreliable, while 11 were reliable and 7 were very reliable. This makes the ratio of unreliable to reliable 19 to 18, which is relatively impressive. Similarly, this success is amplified even further when creating a combined indicator that incorporates multiple effective methods together, where all 8 of the combined indicators were found to be very reliable.

Lastly, with most of the indicators, false positives were extremely common. There was almost a guaranteed degree of randomness in a lot of the charts, which affirms the extreme volatility of the cryptocurrency market and shows just how unpredictable it can be. This is supported by most indicators being unreliable; however, as shown by the reliable indicators, this does not rule out technical analysis entirely and shows that when done properly, it can be effective.

6.2 Future Work

The future work in this field of study should primarily deal with the creation of new indicators as metrics, like the previously mentioned Bitcoin Dominance Index. The cryptocurrency market possesses much more volatility and arguably can reach a higher volume than the stock market, and as a result it should be treated as something entirely new. It would also be helpful to test whether strictly unreliable indicators can be altered to somehow be made reliable.

7. Bibliography

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