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IW 11
13 APRIL 2022

TECHNICAL ANALYSIS OF CRYPTOCURRENCIES

MOTIVATION AND GOAL

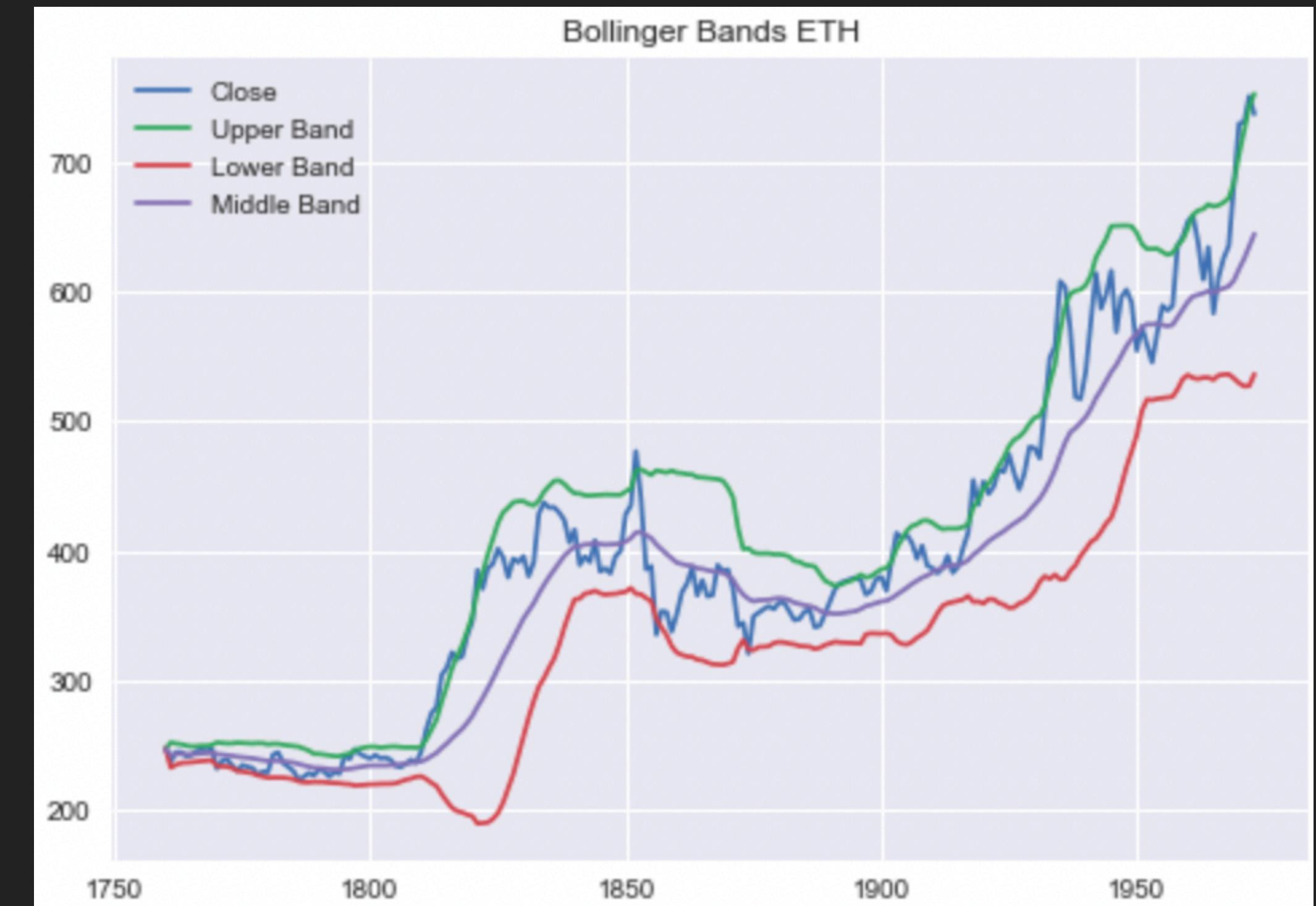
- ▶ Technical analysis methods have been developed and refined historically for the stock market. However, it is not guaranteed that traditional stock market methods will translate directly into the cryptocurrency market.
- ▶ The goal of my project is to provide substantial basis for the use of traditional technical analyses techniques, and prove whether they can be reliably applied to the cryptocurrency market.

RELATED WORK

- ▶ No idea what to put here

APPROACH

- ▶ Studied two cryptocurrencies: Ethereum and Bitcoin, due to their dominance in the cryptocurrency market
- ▶ Applied various technical analysis methods in 4 broad categories: Volume, Volatility, Trend, Momentum
- ▶ Filtered for most accurate and efficient methods, then combined them.



IMPLEMENTATION

- ▶ Datasets: CSV files for Ethereum and Bitcoin, containing the Date, Open, High, Low, Close and Volume for each
- ▶ Datasets were filtered to 2020, from June to December (roughly 214 days, some days excluded due to corrupt data)
- ▶ The stock market is open for 220 days of the year, which is where the inspiration for 214 days came from
- ▶ Especially important to include holidays such as Thanksgiving and Christmas, where news of cryptocurrencies tends to spread between people

DATASETS

```
pd.set_option("display.max_rows", 10, "display.max_columns", 10)
eth
✓ 0.3s
```

	Date	Open	High	Low	Close	Adj Close	Volume
1760	2020-06-01	230.860260	248.236282	230.488052	246.991760	246.991760	1.395173e+10
1761	2020-06-02	246.828186	252.222000	233.225296	237.219055	237.219055	1.378211e+10
1762	2020-06-03	237.395218	244.179321	235.464447	244.179321	244.179321	9.861761e+09
1763	2020-06-04	244.105286	245.928970	236.765305	244.426392	244.426392	1.017041e+10
1764	2020-06-05	244.349594	247.329498	240.682053	241.221985	241.221985	9.293964e+09
...
1969	2020-12-27	635.887146	711.393555	628.334961	682.642334	682.642334	2.609355e+10
1970	2020-12-28	683.205811	745.877747	683.205811	730.397339	730.397339	2.422257e+10
1971	2020-12-29	730.358704	737.952881	692.149414	731.520142	731.520142	1.871068e+10
1972	2020-12-30	731.472839	754.303223	720.988892	751.618958	751.618958	1.729457e+10
1973	2020-12-31	751.626648	754.299438	726.511902	737.803406	737.803406	1.392685e+10

211 rows × 7 columns

```
btc
✓ 0.2s
```

	Date	Open	High	Low	Close	Adj Close	Volume
2084	2020-06-01	9463.605469	10199.565430	9450.899414	10167.268555	10167.268555	35198901068
2085	2020-06-02	10162.973633	10182.340820	9460.571289	9529.803711	9529.803711	39137252109
2086	2020-06-03	9533.760742	9682.859375	9471.846680	9656.717773	9656.717773	25007459262
2087	2020-06-04	9655.854492	9887.610352	9525.247070	9800.636719	9800.636719	25921805072
2088	2020-06-05	9800.215820	9869.237305	9663.216797	9665.533203	9665.533203	23509628646
...
2293	2020-12-27	26439.373047	28288.839844	25922.769531	26272.294922	26272.294922	66479895605
2294	2020-12-28	26280.822266	27389.111328	26207.640625	27084.808594	27084.808594	49056742893
2295	2020-12-29	27081.810547	27370.720703	25987.298828	27362.437500	27362.437500	45265946774
2296	2020-12-30	27360.089844	28937.740234	27360.089844	28840.953125	28840.953125	51287442704
2297	2020-12-31	28841.574219	29244.876953	28201.992188	29001.720703	29001.720703	46754964848

214 rows × 7 columns

IMPLEMENTATION

- ▶ Raw datasets are then expanded to include a variety of technical analysis features through the ta library (<https://github.com/bukosabino/ta>)

featuresETH												
# featuresBTC												
✓ 0.3s												
Date	Open	High	Low	Close	...	momentum_pvo_hist	momentum_kama	others_dr	others_dlr	others_cr		
1760	2020-06-01	230.860260	248.236282	230.488052	246.991760	...	0.000000	246.991760	-37.253041	0.000000	0.000000	
1761	2020-06-02	246.828186	252.222000	233.225296	237.219055	...	-0.077657	244.727784	-3.956693	-4.037098	-3.956693	
1762	2020-06-03	237.395218	244.179321	235.464447	244.179321	...	-1.959735	244.590431	2.934109	2.891888	-1.138677	
1763	2020-06-04	244.105286	245.928970	236.765305	244.426392	...	-2.949433	244.546504	0.101184	0.101133	-1.038645	
1764	2020-06-05	244.349594	247.329498	240.682053	241.221985	...	-3.902956	243.614325	-1.310991	-1.319660	-2.336019	
...	
1969	2020-12-27	635.887146	711.393555	628.334961	682.642334	...	6.031571	607.229774	7.361416	7.103068	176.382635	
1970	2020-12-28	683.205811	745.877747	683.205811	730.397339	...	7.606752	613.684850	6.995611	6.761763	195.717290	
1971	2020-12-29	730.358704	737.952881	692.149414	731.520142	...	6.044770	619.573432	0.153725	0.153607	196.171881	
1972	2020-12-30	731.472839	754.303223	720.988892	751.618958	...	4.209363	632.666618	2.747541	2.710474	204.309325	
1973	2020-12-31	751.626648	754.299438	726.511902	737.803406	...	1.564167	646.546688	-1.838106	-1.855209	198.715798	

211 rows × 93 columns

# featuresETH												
featuresBTC												
✓ 0.2s												
Date	Open	High	Low	Close	...	momentum_pvo_hist	momentum_kama	others_dr	others_dlr	others_cr		
2084	2020-06-01	9463.605469	10199.565430	9450.899414	10167.268555	...	0.000000	10167.268555	-22.634052	0.000000	0.000000	
2085	2020-06-02	10162.973633	10182.340820	9460.571289	9529.803711	...	0.708177	10015.128618	-6.269775	-6.474947	-6.269775	
2086	2020-06-03	9533.760742	9682.859375	9471.846680	9656.717773	...	-1.456209	9926.568127	1.331759	1.322969	-5.021514	
2087	2020-06-04	9655.854492	9887.610352	9525.247070	9800.636719	...	-2.631254	9892.794624	1.490351	1.479354	-3.606001	
2088	2020-06-05	9800.215820	9869.237305	9663.216797	9665.533203	...	-3.756058	9818.290716	-1.378518	-1.388108	-4.934810	
...	
2293	2020-12-27	26439.373047	28288.839844	25922.769531	26272.294922	...	4.880568	24193.339700	-0.623149	-0.625099	158.400718	
2294	2020-12-28	26280.822266	27389.111328	26207.640625	27084.808594	...	3.550587	24614.574974	3.092663	3.045804	166.392182	
2295	2020-12-29	27081.810547	27370.720703	25987.298828	27362.437500	...	1.940141	24977.241892	1.025036	1.019818	169.122797	
2296	2020-12-30	27360.089844	28937.740234	27360.089844	28840.953125	...	1.580981	25802.015244	5.403450	5.262518	183.664713	
2297	2020-12-31	28841.574219	29244.876953	28201.992188	29001.720703	...	0.573881	26787.231451	0.557428	0.555880	185.245939	

214 rows × 93 columns

IMPLEMENTATION

Volume

- Money Flow Index (MFI)
- Accumulation/Distribution Index (ADI)
- On-Balance Volume (OBV)
- Chaikin Money Flow (CMF)
- Force Index (FI)
- Ease of Movement (EoM, EMV)
- Volume-price Trend (VPT)
- Negative Volume Index (NVI)
- Volume Weighted Average Price (VWAP)

Volatility

- Average True Range (ATR)
- Bollinger Bands (BB)
- Keltner Channel (KC)
- Donchian Channel (DC)
- Ulcer Index (UI)

Trend

- Simple Moving Average (SMA)
- Exponential Moving Average (EMA)
- Weighted Moving Average (WMA)
- Moving Average Convergence Divergence (MACD)
- Average Directional Movement Index (ADX)
- Vortex Indicator (VI)
- Trix (TRIX)
- Mass Index (MI)
- Commodity Channel Index (CCI)
- Detrended Price Oscillator (DPO)
- KST Oscillator (KST)
- Ichimoku Kinkō Hyō (Ichimoku)
- Parabolic Stop And Reverse (Parabolic SAR)
- Schaff Trend Cycle (STC)

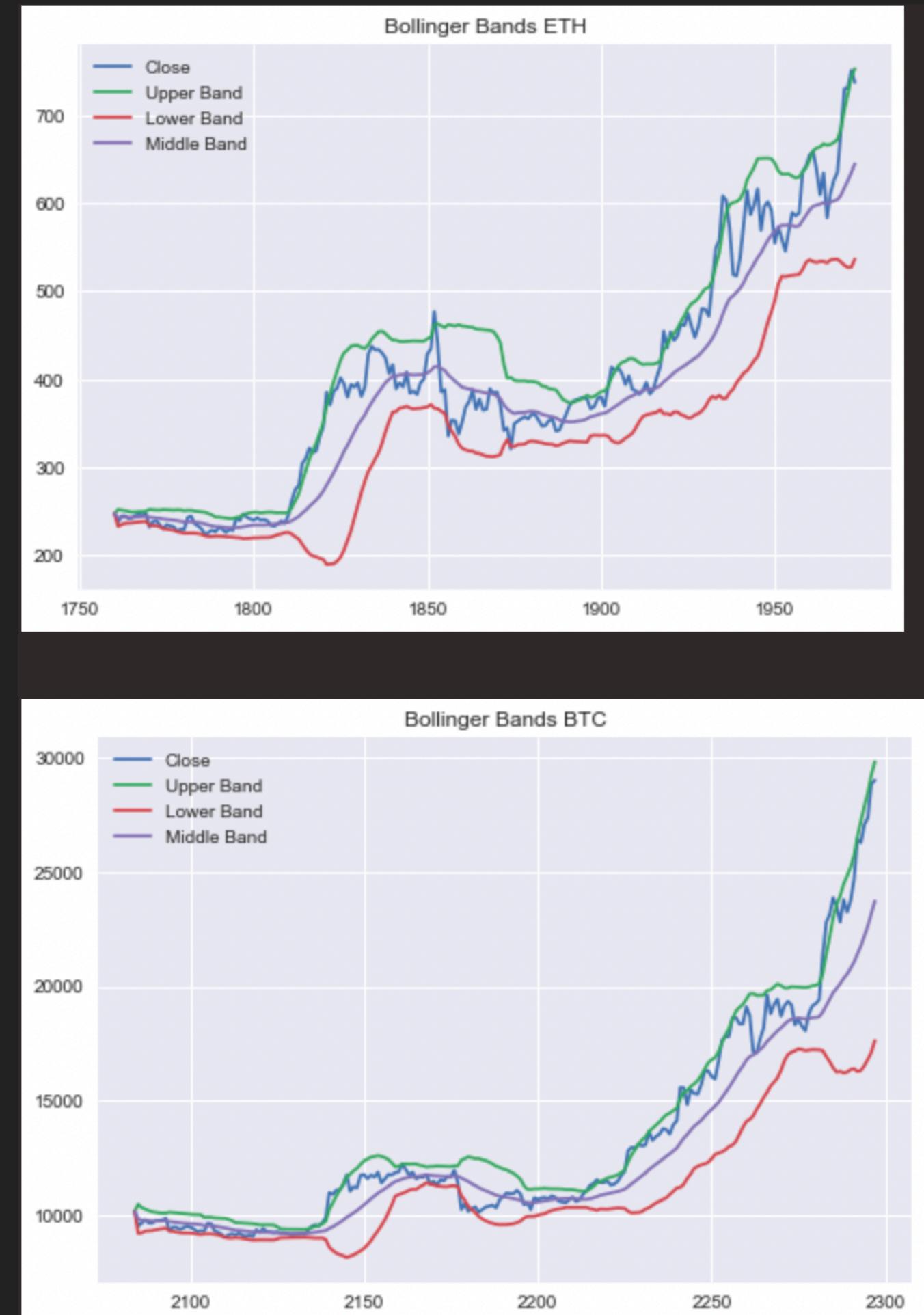
Momentum

- Relative Strength Index (RSI)
- Stochastic RSI (SRSI)
- True strength index (TSI)
- Ultimate Oscillator (UO)
- Stochastic Oscillator (SR)
- Williams %R (WR)
- Awesome Oscillator (AO)
- Kaufman's Adaptive Moving Average (KAMA)
- Rate of Change (ROC)
- Percentage Price Oscillator (PPO)
- Percentage Volume Oscillator (PVO)

ANALYSIS

- ▶ Proceeded to graph the available TA methods and evaluate their effectiveness, based off analysis of the charts and price movement
- ▶ Created list of methods that are effective on their own, and then proceeded to create combinations of these methods to examine their combined reliability

```
# bollinger bands - volatility
def bollinger_bands(df):
    # bollinger bands are a TA tool defined by using three trendlines: an upper band, a lower band, and a moving average band
    # bollinger bands fall under the volatility class of TA methods
    # the closer the prices move to the upper band, the more overbought the market, and the closer the prices move to the lower band, the more oversold the market
    # as seen across the yearly data
    # When the bands come close together, constricting the moving average, it is called a squeeze. A squeeze signals a period of low volatility and is considered by
    # traders to be a potential sign of future increased volatility and possible trading opportunities. Conversely, the wider apart the bands move, the more likely the
    # chance of a decrease in volatility and the greater the possibility of exiting a trade. However, these conditions are not trading signals. The bands give no indication
    # when the change may take place or in which direction the price could move.
    plt.plot(df.Close, label='Close')
    plt.plot(df.volatility_bbh, label='Upper Band')
    plt.plot(df.volatility_bbl, label='Lower Band')
    plt.plot(df.volatility_bbm, label='Middle Band')
    plt.title('Bollinger Bands ' + df.name)
    plt.legend()
    plt.show()
```



STANDALONE ANALYSIS

volatility:

- bollinger bands
 - not generally considered a reliable standalone method
 - if price breaks the lower band, this signals a downtrend and the price is considered cheap. this is generally treated as a buy signal
 - however, as shown by the graphs, when the price crossed the lower band, it generally tended to stay there for quite some time.
 - therefore, NOT RELIABLE
- keltner channels
 - One of the most common applications of Keltner Channels in mean reversion is to buy once the market closes under the lower band
 - however, there are a number of cases where the price crosses the lower band and remains in that territory for quite some time
 - therefore, NOT RELIABLE
- Donchian
 - When prices fall to the lower Donchian Channel boundary, traders are likely to begin entering into long positions as a way to benefit from a potential upward rebound.
 - In contrast, traders are likely to begin entering into short positions when prices move toward the upper boundary because it is unlikely that the uptrend is likely to continue much 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 a severe uptrend
 - therefore, RELIABLE
- Ulcer
 - 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.
 - both charts had a huge spike in the ulcer index, which immediately corresponded with a heavy dip and extreme volatility afterwards. when the ulcer index dropped to normal levels, there was a consistent uptrend
 - therefore, RELIABLE

COMBINATION ANALYSIS

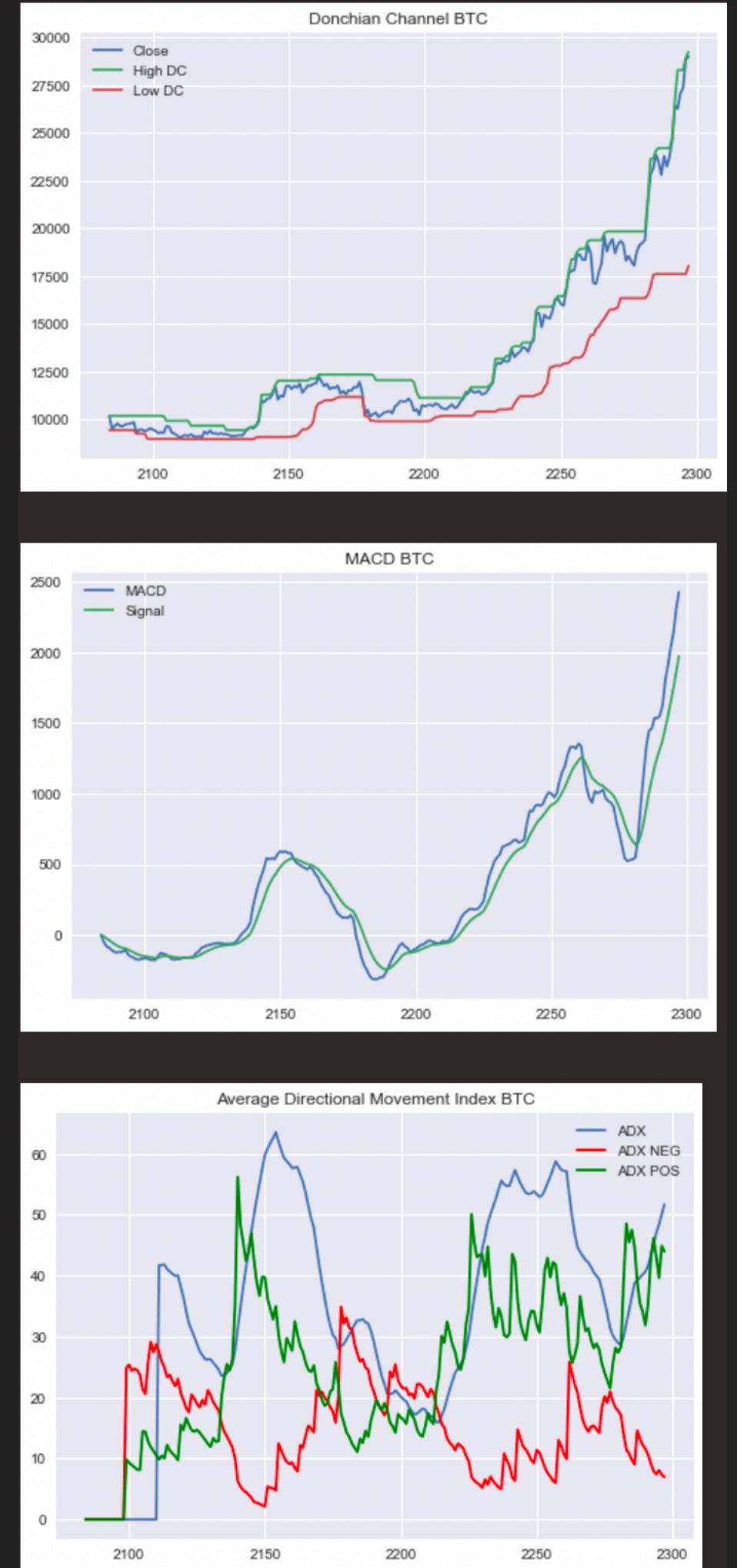
General analysis

- RSI and OBV and Bollinger
 - Take profit when the price breaks below the lower BB
 - First confirmation is when the price closes above the middle band
 - RSI reading above 50 represents positive momentum, below 50 is negative momentum
 - Wait for OBV to rise.
 - VERY RELIABLE
- SMA and Stochastic Oscillator
 - Using these two indicators together, the following signals might be indicated. When the market breaks the SMA line from below upwards and the green line of the Stochastic crosses the blue line upwards, it may be a sign of an upward trend. A signal of a downward trend is received when the market crosses the SMA line from above downwards and the Stochastic shows the green line crossing the blue line downwards.
 - VERY RELIABLE
- MACD and MFI
 - Buy when MFI is oversold, or around 20 and when MACD goes from near negative to positive
 - VERY RELIABLE
- Donchian and MACD and ADX
 - Needs to be a breakout at the upper donchian channel band
 - ADX must be higher than 30
 - Enter when MACD crosses above the signal line
 - VERY RELIABLE

RESULTS



```
def macd_donchian_adx(df):
    plt.plot(df.Close, label='Close')
    plt.plot(df.volatility_dch, label='High DC')
    plt.plot(df.volatility_dcl, label='Low DC')
    plt.title('Donchian Channel ' + df.name)
    plt.legend()
    plt.show()
    plt.plot(df.trend_macd, label='MACD')
    plt.plot(df.trend_macd_signal, label='Signal')
    plt.title("MACD " + df.name)
    plt.legend()
    plt.show()
    plt.plot(df.trend_adx, label='ADX')
    plt.plot(df.trend_adx_neg, label='ADX NEG', color='red')
    plt.plot(df.trend_adx_pos, label='ADX POS', color='green')
    plt.title("Average Directional Movement Index " + df.name)
    plt.legend()
    plt.show()
```



CONCLUSION

- ▶ Ethereum and Bitcoin behave EXTREMELY similarly in terms of price movement
- ▶ Many traditional TA methods that see success in the stock market can also see success in the cryptocurrency market.
- ▶ This is even amplified further when creating a complex charting setup that incorporates multiple effective methods together.