Algotrading Strategy Backtesting: Bollinger-Keltner Squeeze

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Bollinger Bands ("BB"s) are volatility trend lines for a financial security. The technical indicators conventionally lie two standard deviations away from the simple moving average of the security's price over twenty periods, though the number of standard deviations and periods to consider can be altered accordingly. The bands widen and contract towards the moving average when the market is trending and ranging respectively.

Keltner Channels ("KC"s) are also volatility indicators that widen during periods of higher volatility and contract during periods of lower volatility. The channels are normally based on a deviation from an exponential moving average of two times the security's average true range (ATR); the ATR is defined as the maximum of the security's current high minus the current low, the absolute value of the current high minus the previous close, and the absolute value of the current low minus the previous close.

Both Bollinger Bands and Keltner Channels widen and contract as market volatility oscillates, but Keltner Channels tend to do so more steadily. During low volatility periods, Bollinger Bands occasionally narrow to the point where they lie between Keltner Channels, indicating that a price breakout might occur. This is a key result that forms the basis of the algotrading strategy, which is as follows:

Generate a ***buy*** signal for a security under the following conditions:

- *Closing price* **above** *upper BB*
- *Upper BB* **below** *upper KC* for n consecutive number of periods prior (n = squeeze period)
- *Lower BB* **above** *lower KC* for n consecutive periods prior

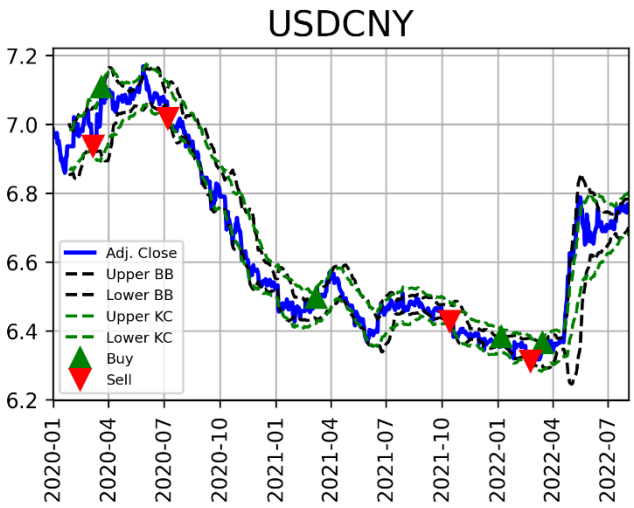
Generate a ***sell*** signal for a security under the following conditions:

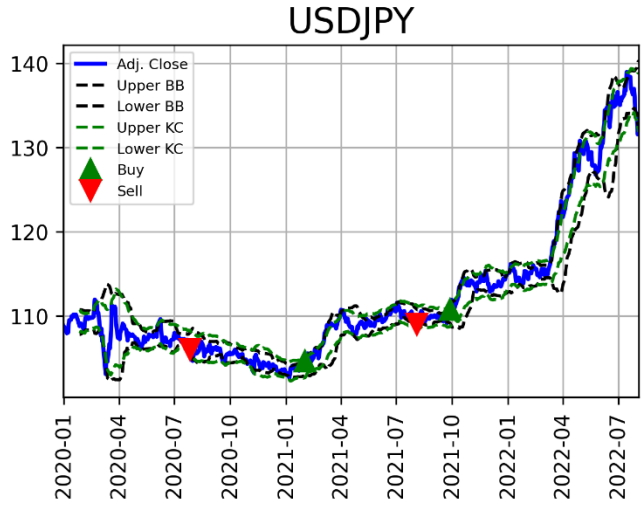
- *Closing price* **below** *lower BB*
- *Upper BB* **below** *upper KC* for n consecutive periods prior
- *Lower BB* **above** *lower KC* for n consecutive periods prior

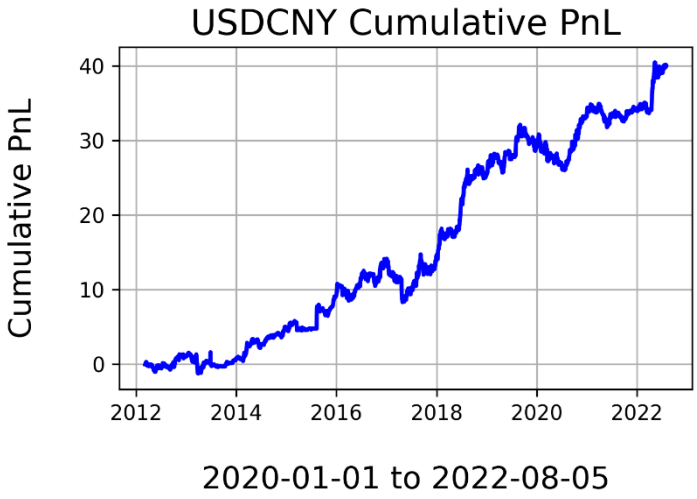
Backtesting was performed using Python and the libraries yfinance, NumPy, Pandas, and Matplotlib Pyplot. Testing in FX currency pairs has yielded good results for USDJPY and USDCNY over a ten-year period:

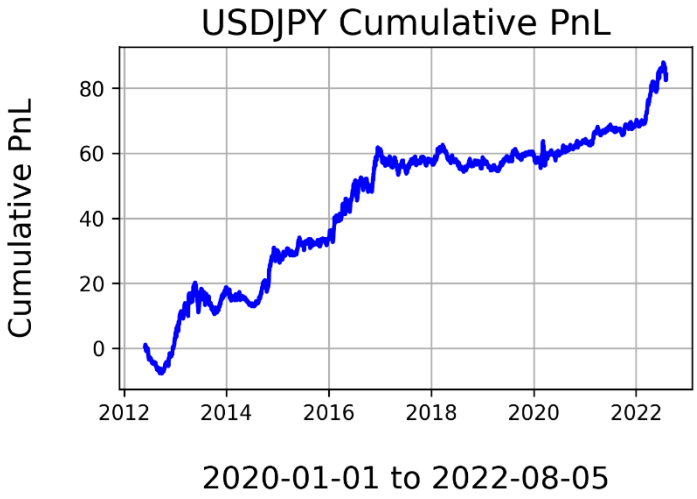
Parameter	USDCNY	USDJPY
BB SMA Period	25	23
BB StDev Period	25	23
BB StDev Multiple	2	2
KC EMA Period	30	25
KC ATR Period	42	28
KC ATR Multiple	2	2
Squeeze Period	5	4

Statistics	USDCNY	USDJPY
AUM ($)	100	100
Cum PnL ($)	39.96	87.26
Annualised Return (%)	3.22	6.1
Return StDev. (%)	3.69	8.66
Sharpe Ratio	0.87	0.7
# +ve Signals	15	11
# -ve Signals	12	9
Mean PnL +ve Signal	3.33	7.93
Mean PnL -ve Signal	-1.06	-1.12


USDCNY
Adj. Close
Upper BB
Lower BB
Upper KC
Lower KC
Buy
Sell
7.2
7.0
6.8
6.6
6.4
6.2
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10
2022-01
2022-04
2022-07


USDJPY
Adj. Close
Upper BB
Lower BB
Upper KC
Lower KC
Buy
Sell
140
130
120
110
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10
2022-01
2022-04
2022-07


USDCNY Cumulative PnL
Cumulative PnL
40
30
20
10
0
2012
2014
2016
2018
2020
2022
2020-01-01 to 2022-08-05


USDJPY Cumulative PnL
Cumulative PnL
80
60
40
20
0
2012
2014
2016
2018
2020
2022
2020-01-01 to 2022-08-05