Manual Strategy

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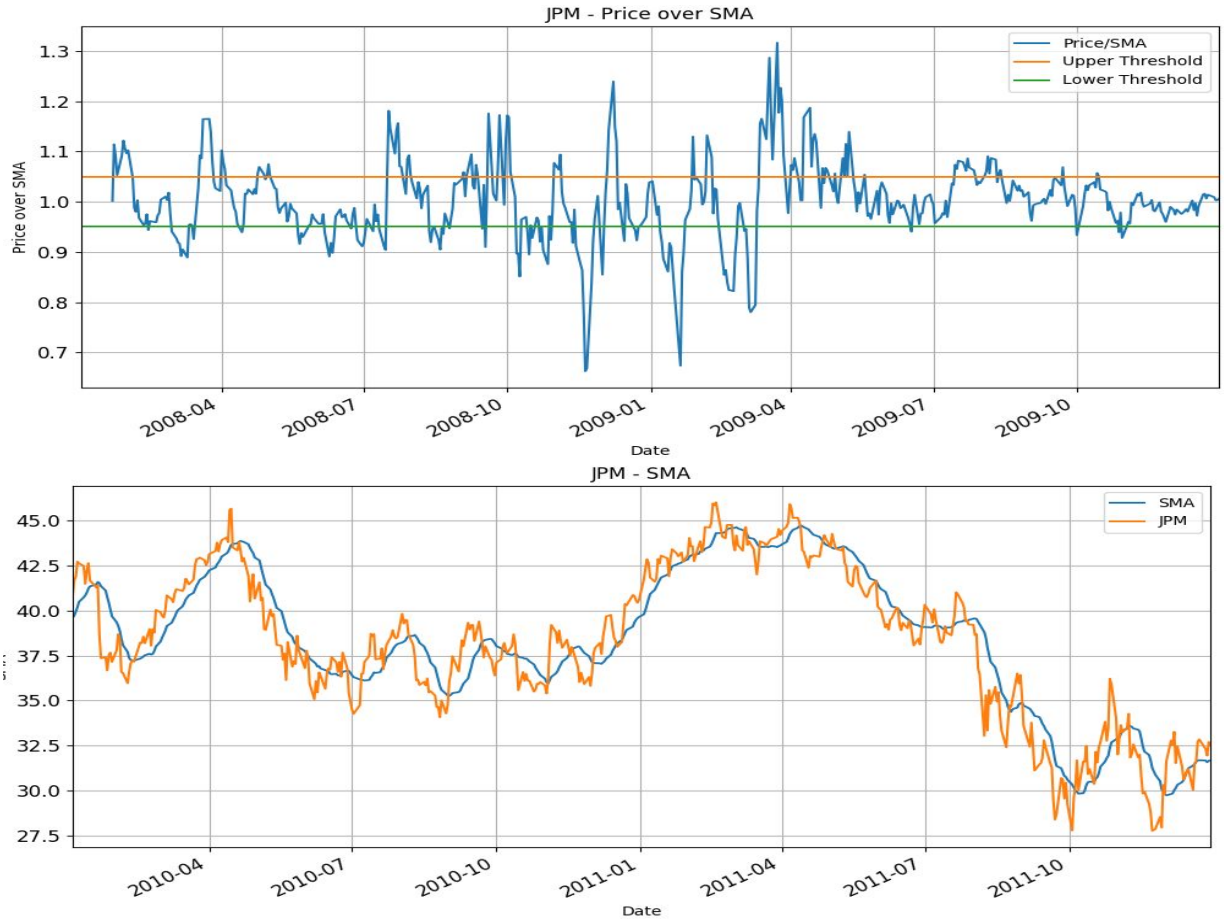
Indicators

SMA and Price/SMA

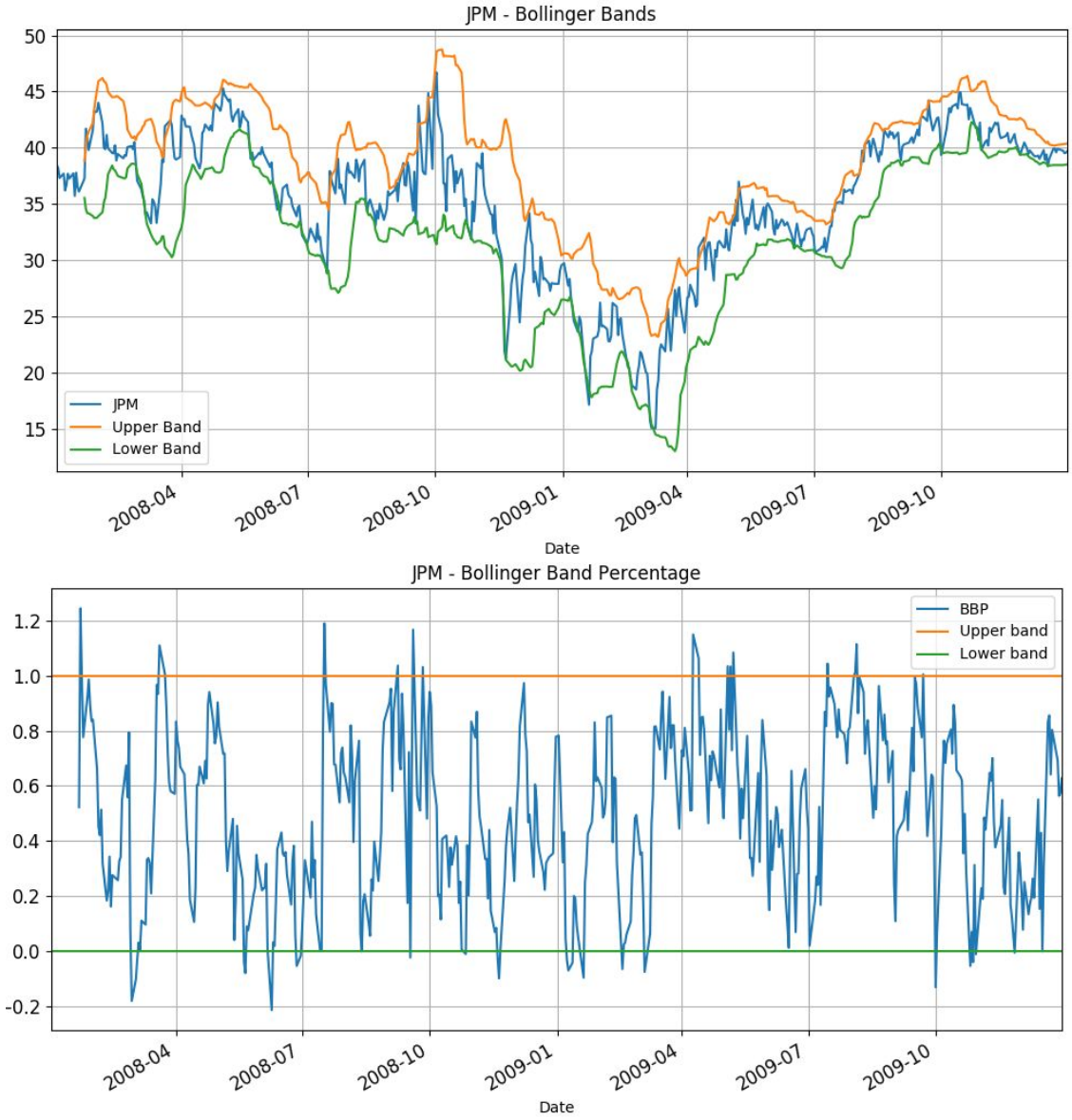


SMA (Simple Moving average) is an arithmetic moving average calculated by adding the closing price of the security for a number of time periods and then dividing this total by the number of time periods.

SMA is an indicator of upward or downward trend of the price of the stock over the time period. The above charts show how the SMA behaves over the in-sample period for the JPM stock, and the price/SMA with the upper threshold=1.1 and lower threshold=0.9

We can use price/SMA as a more normalized indicator of SMA. If it is >1, it means, price is increasing. If it is < 1, it means, the price is decreasing.

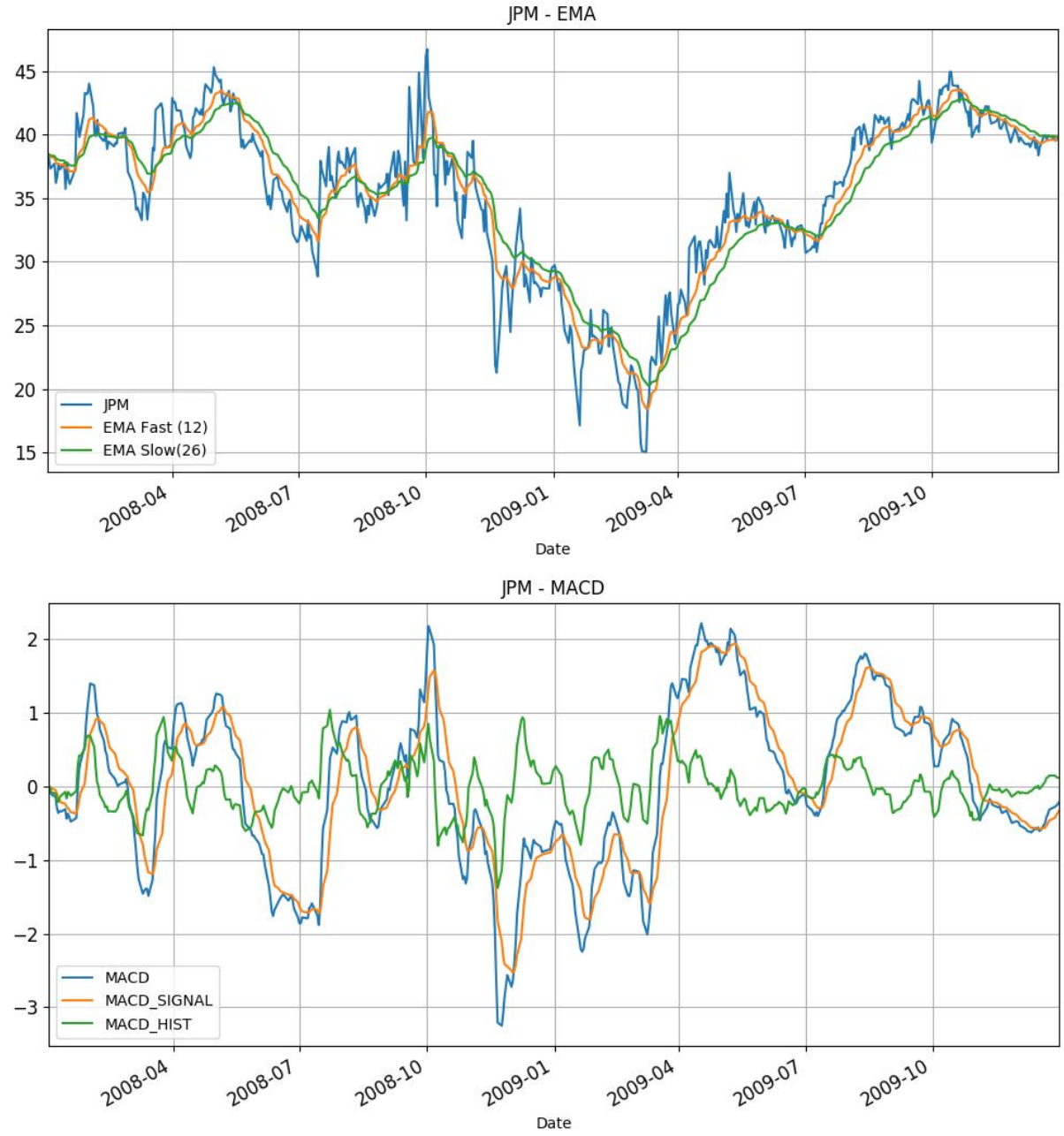
Bollinger Bands Percentage



The chart above shows the bollinger bands and the bollinger band percentage for the JPM stock for the in-sample period. BBP is the normalized version of BB with upper and lower bands represented by 1 and 0.
Bollinger Bands are an indicator of volatility of the stock. The upper BB is 2 * STD from the price of the stock, while the lower BB is -2 * STD from the price of the stock. When a stock goes

beyond the upper BB or below the lower BB, BB can be combined with SMA or price/SMA as to what trend a stock might take. On its own, BBP is not a sufficiently good trading indicator.

MACD



This chart shows the Exponential Moving Average(EMA) for fast window=12, slow_window=26 for the JPM stock in the in-sample period. It also shows the MACD series average, the SIGNAL and the HIST series for the JPM stock in the in-sample period.

MACD, short for moving average convergence/divergence, is a trading indicator used in technical analysis of stock prices. It is supposed to reveal changes in trend, momentum, and duration of a trend in a stock's price.

The MACD indicator is a collection of three time series calculated from historical price data, most often the closing price. These three series are: the MACD series proper, the "signal" or "average" series, and the "divergence" series which is the difference between the two called the MACD_HIST. The MACD series itself is the difference between a "fast" (short period = 12) exponential moving average (EMA), and a "slow" (longer period = 12) EMA of the price series. The average series is an EMA of the MACD series itself.

MACD has 3 types of crossovers that can be trading indicators - A "signal-line crossover" , zero crossover or divergence. Signal crossover recommends buying when the MACD line crosses up the average line and selling when the MACD line crosses down the average line

Best Possible Strategy

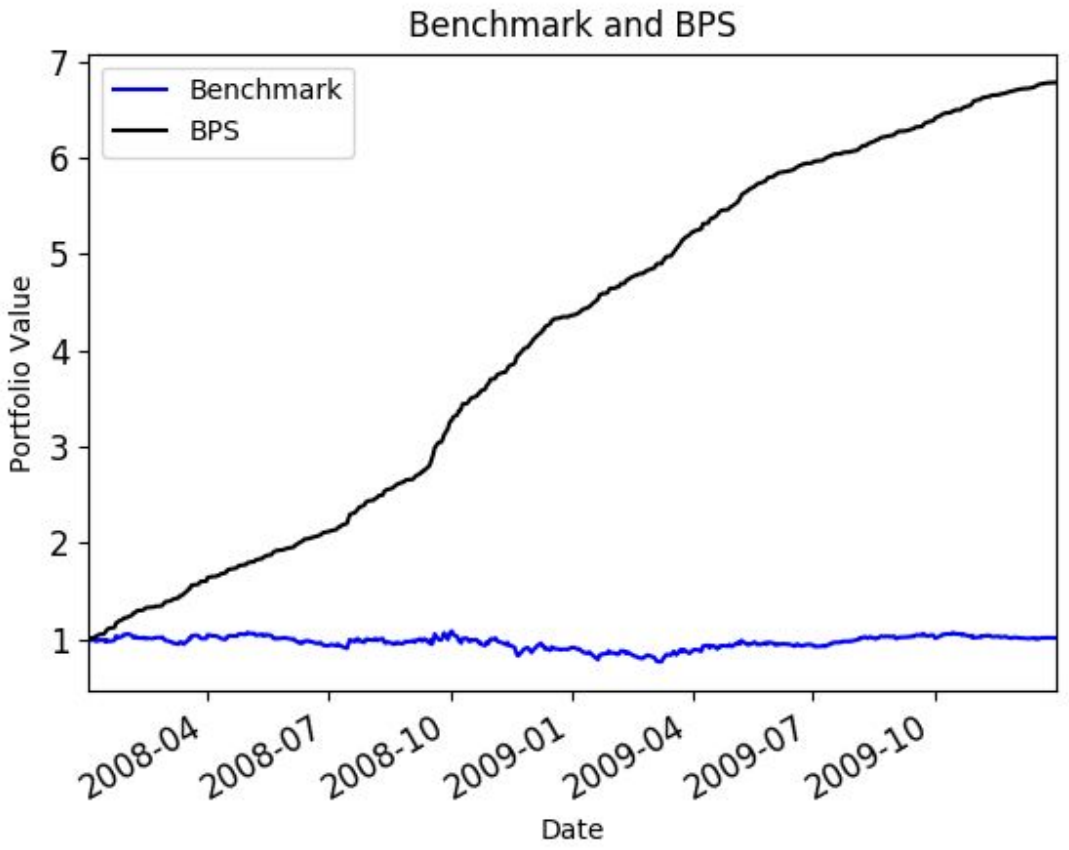


Fig shows the normalized portfolio values of Benchmark and BPS for the in-sample period

This table shows the CR, STD and Average daily returns for both benchmark and Best Possible strategy on the in-sample data for JPM.

	Benchmark	BPS
Cumulative Return	0.0123	5.7861
Std Deviation	0.0170043662712	0.00454782319791
Average Daily Return	0.000168086978191	0.00381678615086

The best possible strategy to generate trades is one that buys low and sells high. It is implemented as follows:

1) Get the prices for all trading days for JPM in the in-sample period
2) Start with net position of 0
3) Peek into the future to see how the price behaves
    a) For each date in the in-sample period, read the price of JPM for the next day
    b) Compare the day's price with the next day's price
    c) If the next day's price > current day's price
        i) If net positions is 0, then buy 1000 shares of JPM
        ii) If net positions is -1000, then buy 2000 shares of JPM
        iii) If already at net positions of 1000, do nothing
    d) If the next day's price < current day's price
        i) If net positions is 0, then sell 1000 shares of JPM
        ii) If net positions is 1000, then sell 2000 shares of JPM
        iii) If already at net positions of -1000, do nothing
4) Build the trades dataframe using the logic above iteratively for the in-sample period

Manual Strategy

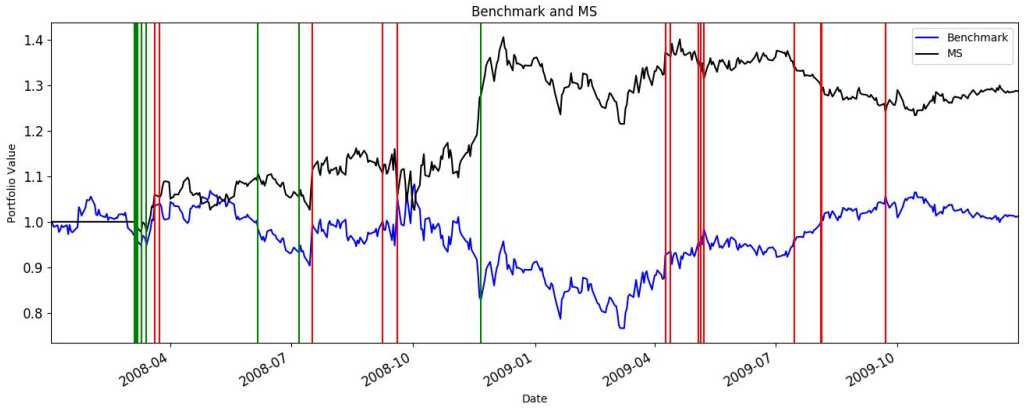


Fig shows the normalized portfolio values of Benchmark and BPS for the in-sample period

The below table shows the CR, STD and Average daily return for both benchmark and Manual strategy

	Benchmark	MS
Cumulative Return	0.0123249333401	0.286921
Std Deviation	0.0170412470682	0.0131716748223
Average Daily Return	0.000168759162146	0.000586932550987

The manual rule based strategy to generate trades that was implemented is as follows:

5) Get the prices for all trading days for JPM in the in-sample period
6) Start with net position of 0
7) Peek into the future to see how the price behaves
    a) For each date in the in-sample period, find the price/SMA, bollinger band percent(bbp), and the rsi value for JPM
    b) If the price/SMA>1.05 and bbp>1 and rsi>60
        i) If net positions is 0, then sell 1000 shares of JPM
        ii) If net positions is 1000, then sell 2000 shares of JPM
        iii) If already at net positions of -1000, do nothing
    c) If the price/SMA<0.95 and bbp<0 and rsi<25
        i) If net positions is 0, then buy 1000 shares of JPM
        ii) If net positions is -1000, then buy 2000 shares of JPM
        iii) If already at net positions of 1000, do nothing

8) Build the trades dataframe using the logic above iteratively for the in-sample period

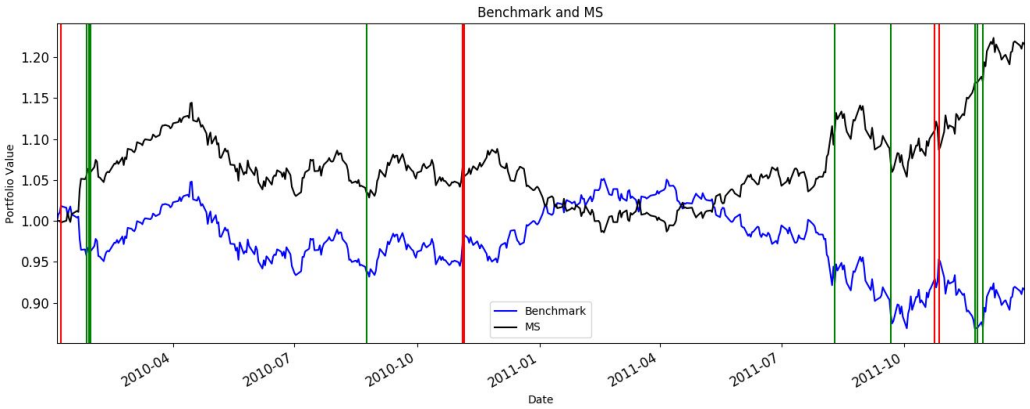
The manual rule based strategy employed here is basically this:

- Go long when symbol is oversold
- Go short when symbol is overbought

Symbol is oversold if the price/SMA goes beyond 1.05 and bbp>1 and rsi>60. price/SMA > 1.05 means price has increased beyond the SMA and it will regress to the SMA soon. BBP>1 means that the symbol is currently volatile, it has gone beyond the upper bollinger band. Rsi indicates the return. All these factors combined, then we can assume that symbol is performing at its highest, if it is overpriced, is highly volatile and will regress to the mean.

Symbol is overbought if the price/SMA goes below 0.95 and bbp<0 and rsi<25. price/SMA<0.95 means price has decreased beyond the SMA and it will regress to the SMA soon. BBP<0 means that the symbol is currently volatile, it has gone beyond the bottom bollinger band. Rsi indicates the return. All these factors combined, then we can assume that symbol is performing at its lowest, if it is underpriced, is highly volatile and will regress to the mean and is underperforming on rsi.

Comparative Analysis



	Benchmark in-sample	Benchmark out-sample	MS in-sample	MS out-sample
Cumulative Return	0.0123249333401	-0.0835791100328	0.286921	0.216198
Std	0.0170412	0.00850015832233	0.0131716748223	0.00744050576508

Deviation	470682			
Average Daily Return	0.000168759162146	-0.000137429230389	0.000586932550987	0.000416779508285

Comparing the in-sample and the out-sample benchmarks, we can see that out-sample benchmark actually performed better than the in-sample. This indicates that just holding JPM is not a viable strategy and that market factors are not being taken into account.

Comparing the Manual strategy in-sample and out-sample however, we see that there were fewer orders in the out-sample compared to the in-sample. Rhe in-sample performed better with a higher CR. But the in-sample strategy was more volatile than the out-sample strategy as observable from the std. This means that our strategy actually impacted the market in-sample and caused the stock to go more volatile. It however, did not create so much market impact in the out-sample. The average daily return was again higher on the in-sample and lesser on the out-sample.

From this, we can gather that while our strategy of finding the spots where the stock would return to the mean to buy or sell worked well in the in-sample period, the same strategy was not effective for the out-sample period because the stock itself was not so volatile then.