PROJECT 6: INDICATOR EVALUATION

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INTRODUCTION

The objective of this project is to develop different technical indicators and trading strategy in order to help determine what would be a wise trading action taken in the stock market for maximizing profits.

PART I: INDICATORS

Technical analysis is a tool that provides quantitative insights for investors to explain particular behaviors in the stock market. PART I describes five technical indicators listed as following:

1. Momentum
2. Simple Moving Average
3. Volatility
4. Commodity channel index
5. Bollinger Band

Momentum

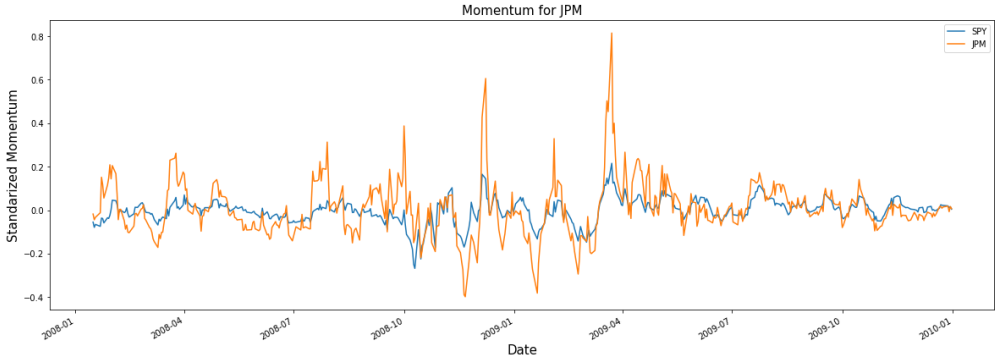
Momentum is the rate of acceleration of a security's price or volume – that is, the speed at which the price is changing [1]. In finance, when the momentum of a stock is larger than the threshold, it implies potentially the price of the stock will be moving quickly in a certain period of time. It can be a BUY signal for the investors when the momentum is positive, meaning the price is moving upward in the future. Similarly, it can be SELL signal when the momentum is negative because the price is expected to drop quickly in the future. The formula of the momentum is displayed in the following:

$$\text{Momentum}[t] = \frac{\text{price}[t]}{\text{price}[t - N]} - 1$$

Although Momentum would be a strong indicator for technical analysis, there are risks come with it as well because the trading occurs on the backs of other

people in the market and price trends can be disrupted by unexpected events/news. Therefore, it is recommended to use momentum in conjunction with other indicators.

The following figure shows the normalized price momentum for stock JPM for period of January 1st, 2008 to December 31st, 2009 (in-sample period). At around 2009 April, it shows there was a large positive momentum and rapidly it declined for JPM in comparison to the SPY (S&Y 500). It would be a signal to suggest the investor to buy for this stock and sell it immediately to gain profit.



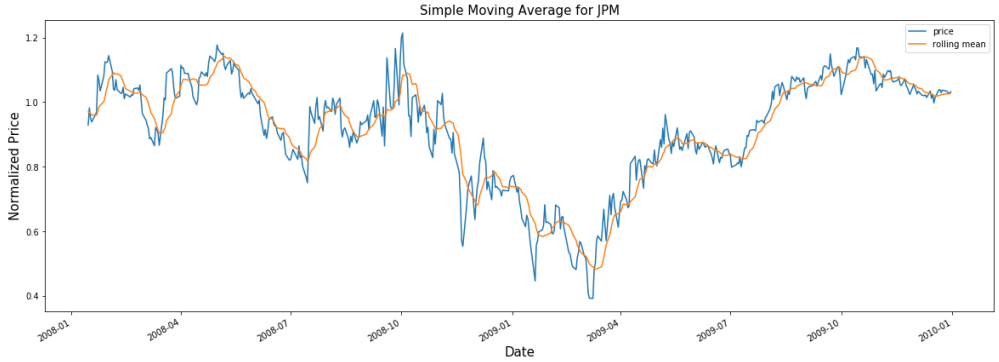
Simple Moving Average

A simple moving average (SMA) calculates the moving average for the adjusted closing prices by the number of time periods. The formula of SMA is shown as following, where An is the price of the stock at period n.

$$\text{SMA} = \frac{A_1 + A_2 + \ldots + A_n}{n}$$

SMA is an indicator used for determining the trend direction and it is recommended to use in conjunction with momentum. If the SMA is moving upward, it is a BUY signal because the trend is up. If the SMA is moving down, the trend is down and suggests to SELL. Price crossing SMA also indicates trading signals. For example, if the prices cross above the SMA, it is a signal to long for the stock. If the prices cross below the SMA, it is a signal to short for the stock. Lastly, SMA smoothens the price curve volatility. With the longer period of SMA, the smoother the result it is.

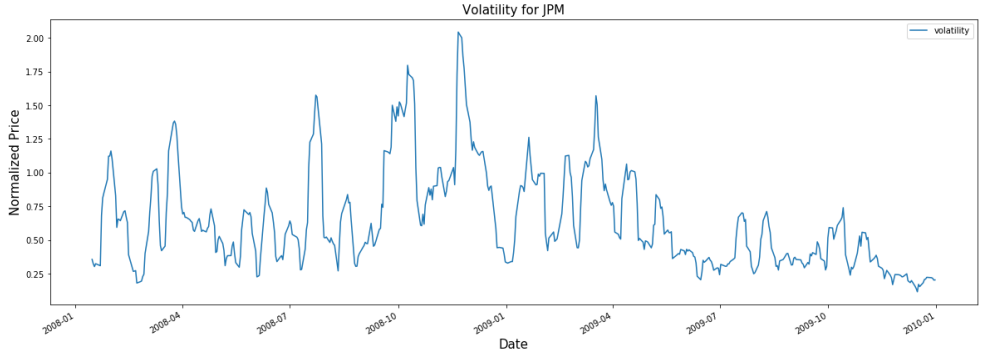
The following figure shows the normalized price SMA for stock JPM for period of January 1st, 2008 to December 31st, 2009 (in-sample period).



Volatility

By definition, volatility is a statistical measure of the dispersion of returns for a given security or market index [2]. Volatility is usually measured as the standard deviation for the security. In general, higher volatility indicates higher risks because the stock's value is spread out over a large range. It expects the prices will fluctuate greatly over a short time period in either direction. A lower volatility indicates the stock's value does not fluctuate dramatically, therefore the price changes will be moving in a steadier pace. Investors usually will want a higher return when he or she is investing a stock with high volatility to compensate the riskiness. In this project, the volatility is calculated as the standard deviation of the prices for stock JPM. The formula is shown in the following. The second figure demonstrates how volatility is used as a technical indicator in the analysis.

$$Volatility = \sigma = \sqrt{prices}$$

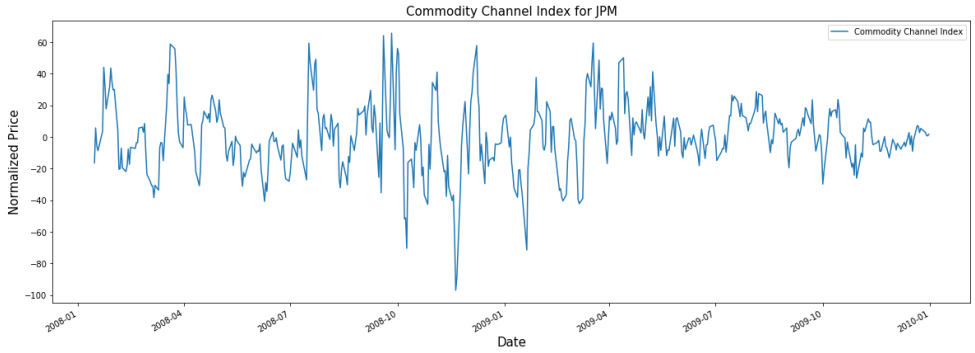


As indicated in the graph above, late 2008 to beginning of 2009 is a period of time with high volatility for stock JPM. For a risk averse investor, it is a strong signal not to enter the market in order to minimize the uncertainty. For a risk taker, it would be the trading opportunity for this stock.

Commodity channel index

Commodity channel index (CCI) is a technical indicator that measures the differences between the current price of a stock versus its historical average prices. It is a momentum-based oscillator which provides insights to the investors when the stock is reaching to a condition of being overbought or oversold. For example, if the CCI is above zero, it indicates the price of the stock is above the historical average. The price is expected to go down in the future which would be a SELL signal for the investors. On the other hand, CCI going from negative to near-zero to extremely positive (like over +100) can implies as an emerging uptrend, suggesting investors to BUY or hold this type of assets. With the same reasoning, CCI going from going from positive to near-zero to extreme negative (like over +100) can implies as an emerging downtrend, suggesting investors should no longer holds and sell the stock immediately. The following is the formula used for calculating the CCI in this project, where rm is the rolling mean and sigma is the standard deviation of the prices for stock JPM.

$$CCI = \frac{(prices - rm)}{\sigma(prices)}$$

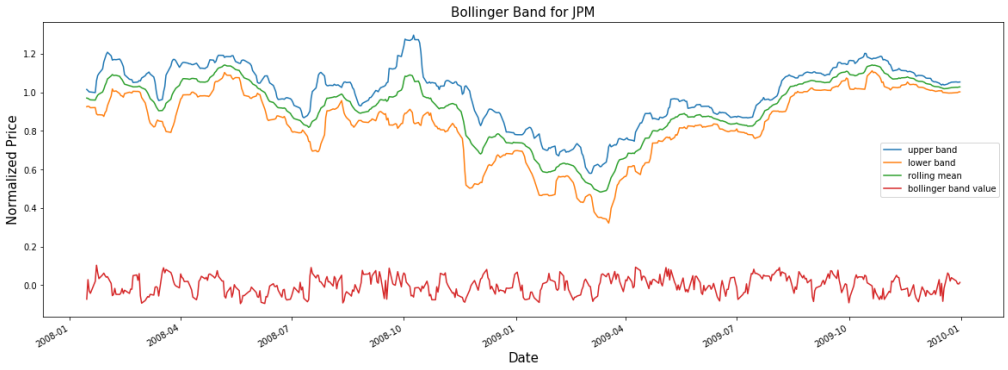


Bollinger Band

Bollinger Bands® is a strong technical analysis technique. By plotting the bands (known as the upper band and the lower band) two standard deviations away from a simple moving average, it serves as an indication to imply whether the stock appears to be oversold or overbought. For example, if the difference between the price and the SMA is negatively larger than two standard deviations, the current value of the stock is underestimated. Therefore, the price is expected to move up closer to the mean and it is a BUY opportunity for the investors. Note Bollinger Bands® are not a standalone trading system. It should be used with two or three other non-correlated indicators that provide more direct market signals. The following is the formular used for calculating the Bollinger Bands® in this project.

$$Upper - band = rolling - mean + (2 * \sigma(prices))$$
$$Lower - band = rolling - mean - (2 * \sigma(prices))$$
$$BBvalue = \frac{prices - rollingmean}{2 * \sigma(prices)}$$

The following is the Bollinger Bands® with SMA (rolling mean) and the BB value for stock JPM for period of January 1st, 2008 to December 31st, 2009 (in-sample period).



PART II: THEORETICALLY OPTIMAL STRATEGY (TOS)

Trading in stock market can be rule-based trading strategy which allows investors to estimate the potential outcome. In part II , a "Theoretically Optimal Strategy" (denoted as "TOS" in the remaining paper) is created and is analyzed

with a predefined benchmark for a period of time for examining its effectiveness in the stock market.

Assumptions made

Note in this simulation, there are several assumptions being made:
1. The strategy assumes that tomorrow's prices are known to the trader.
2. The portfolio size and order limits are constrained by three states: -1000 shares, +1000 shares and 0 shares.
3. There is $0.00 for commissions and $0.0 for impact in case for Theoretically Optimal Strategy.
4. The net holdings of the stock are constrained to -1000 shares, +1000 shares and 0 shares.

Methodology

The TOS strategy is implemented by looking one day ahead on the stock price in order to determine the trading position.
If today's price is lesser than what it would be tomorrow, it indicates a BUY opportunity for today. If today's price is greater than tomorrow's price, it indicates a SELL opportunity for today. Lastly, if today's price is the same as tomorrow's price, no action will be taken. Therefore, depending on the current net holding, the course of action will be made as the following:

If today's price < tomorrow's Price, BUY opportunity

If the current net holding is…	**Action to take…**	**Maximum net holding allows**
1000 Shares	N/A	LONG 1000 Shares
-1000 Shares	BUY +2000 Shares	LONG 1000 Shares
0 Shares	BUY +1000 Shares	LONG 1000 Shares

If today's price > tomorrow's Price,SELL opportunity

If the current net holding is…	**Action to take…**	**Maximum net holding allows**
1000 Shares	SELL -2000 Shares	SHORT 1000 Shares
-1000 Shares	N/A	SHORT 1000 Shares
0 Shares	SELL -1000 Shares	SHORT 1000 Shares

If today's price < tomorrow's Price, HOLD

The Benchmark

The purpose of the benchmark is set as a checkpoint for see what minimum value should be attained by the trading strategy. In this project, it is predefined as buying 1000 shares of JPM at the beginning of the time period and holding it forever. The initial funding for this investment is $100,000 cash.

Outcome of TOS performance versus the benchmark

The overall effectiveness of TOS is measured against the benchmark within the same in-the-sample time period from January 1st, 2008 to December 31st, 2009. The following shows the key portfolio statistics and a graph with the performance on both strategies. The TOS outperformed the benchmark significantly.

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Date Range: 2008-1-1 to 2009-12-31

Sharpe Ratio of Fund: 13.365084838916928
Sharpe Ratio of Benchmark : 0.15691840642403027

Cumulative Return of Fund: 5.7844
Cumulative Return of Benchmark : 0.012299999999999978

Standard Deviation of Fund: 0.004550893009106839
Standard Deviation of Benchmark : 0.017004366271213767

Average Daily Return of Fund: 0.003831493339603475
Average Daily Return of Benchmark : 0.00016808697819094035
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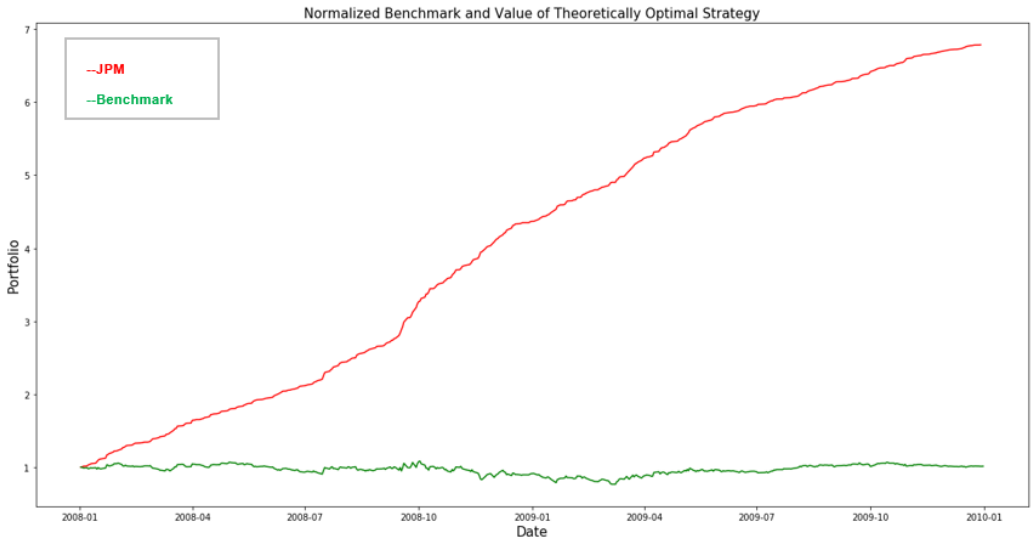

REFERENCE

[1] Investopedia. 2020. *What Momentum Means In Securities*. [online] Available at: <https://www.investopedia.com/terms/m/momentum.asp> [Accessed 19 October 2020].

[2] Investopedia. 2020. *Volatility*. [online] Available at:

<https://www.investopedia.com/terms/v/volatility.asp> [Accessed 19 October 2020].