

Project 6 – Indicator Evaluation (Report)

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Abstract—This project focuses on developing and evaluating a Theoretically Optimal Strategy (TOS) for trading the stock of JPMorgan Chase (JPM) during the period of January 1, 2008, to December 31, 2009. The TOS utilizes perfect foresight in trading, resulting in a cumulative return of 579.84% with lower volatility compared to a benchmark strategy that holds 1,000 shares of JPM throughout the same period, which only achieved a 1.23% return. Five technical indicators were also tested, effectively identifying optimal buy/sell periods during the same time. The study highlights the potential of combining theoretical and technical strategies to maximize trading performance.

1 INTRODUCTION

This project examines the performance of a Theoretically Optimal Strategy (TOS) for trading JPMorgan Chase (JPM) stock during the 2008 financial crisis. The TOS assumes perfect foresight of future price movements, contrasting traditional strategies reliant on historical trends.

Additionally, this project utilizes technical indicators – including Price to SMA Ratio, Bollinger Bands, Momentum Indicator, Percentage Price Oscillator, and Commodity Channel Index (CCI) – to derive actionable trading signals.

The goal of this analysis is to demonstrate the benefits of integrating theoretical strategies with empirical indicators.

2 EXPERIMENTS

2.1 PART 1: THEORETICALLY OPTIMAL STRATEGY (TOS)

This part focuses on the evaluation of a Theoretically Optimal Strategy (TOS) for trading JPMorgan Chase (JPM) stock during the period from January 1, 2008, to

December 31, 2009. The TOS employs a trading approach that assumes perfect foresight of future price movements, allowing for maximized returns.

The performance of the TOS was compared against a benchmark strategy, which involved holding 1,000 shares of JPM throughout the same period. Both strategies were normalized to a starting portfolio value of 1.0. The results showed a stark contrast between the two approaches:

- **Cumulative Return:** The TOS achieved a high cumulative return of **579.84%**, while the benchmark yielded **1.23%**.
- **Daily Returns:** The mean of the portfolio's daily returns stood at **0.3843%**, significantly higher than the benchmark's **0.0168%**.
- **Volatility:** The standard deviation of daily returns for the TOS was **0.008262**, indicating lower volatility compared to the benchmark's **0.017004**.

These results demonstrate that the TOS not only outperformed the benchmark in terms of total return but also showed lower risk, as indicated by its low standard deviation. Figure -1 provides a good overview of this behavior.

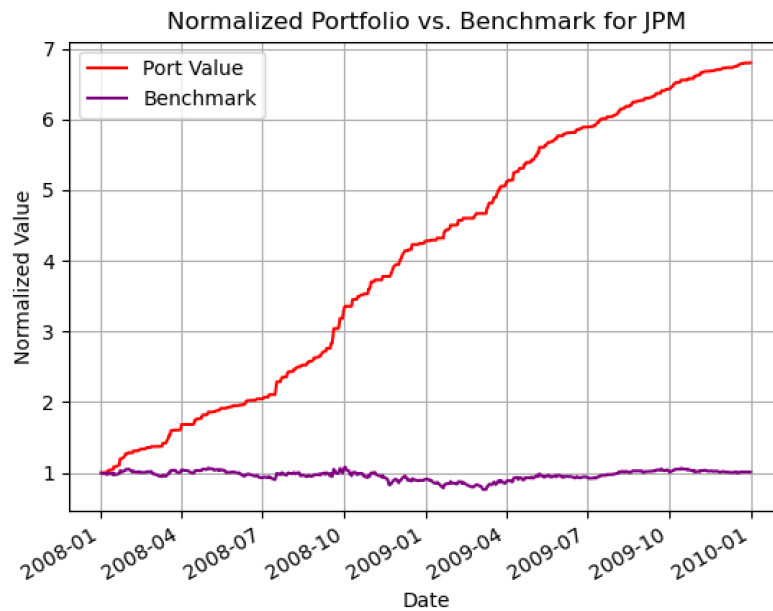


Figure 1— Captures the performance of TOS against Benchmark

In conclusion, this implementation emphasizes the advantages of utilizing an idealized trading strategy with perfect foresight, contrasting sharply with the conservative nature of passive investment strategies during the 2008 financial crisis.

2.2 PART 2: TECHNICAL INDICATORS

2.2.1 Price to Simple Moving Average (SMA):

Compares the stock price to its SMA over a window (12-days in this implementation), offering insights into whether the stock is overbought or undervalued at any given time.

This ratio helps traders identify buy and sell signals by assessing the stock's performance relative to its moving average.

Buy and Sell Signals:

- **Buy Signal:** When the Price/SMA ratio drops significantly below 1, it suggests the price is undervalued relative to its moving average. In such cases, a recovery in the ratio may indicate a potential buying opportunity. This scenario was observed around mid-2008 when the ratio dropped below 1, signaling that JPM was undervalued.
- **Sell Signal:** When the Price/SMA ratio rises significantly above 1, it suggests that the stock is overbought. This was seen towards late 2009 when the ratio crossed above 1, indicating that JPM stock might be overvalued, thus signaling a potential sell opportunity.

Figure -2 provides a graphical representation of the insights observed.

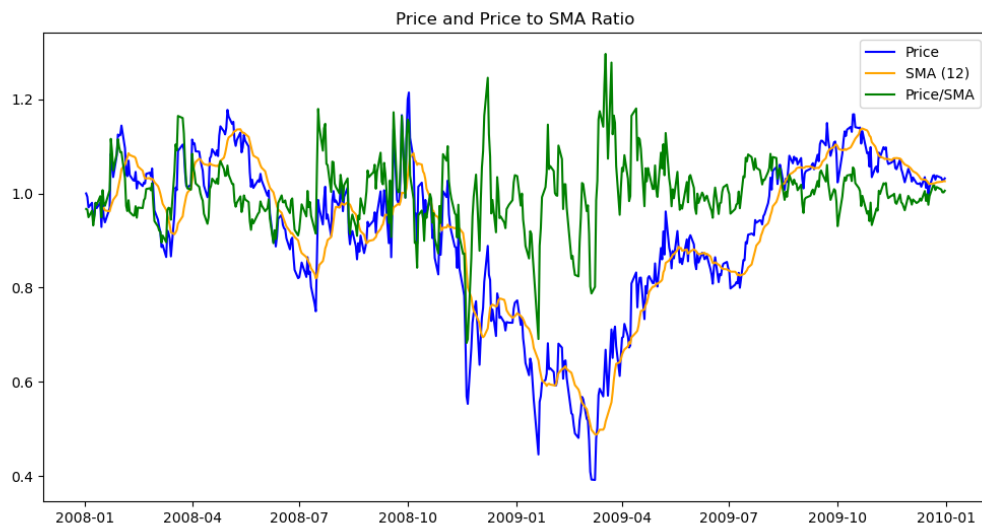


Figure 2— Price/SMA shows the periods of over and under valuations

In conclusion, the **Price to SMA Ratio** provides a clear, systematic way to detect periods of overvaluation and undervaluation, helping traders make informed buy and sell decisions. This indicator is particularly useful in identifying trend reversals, allowing for better-timed entries and exits in the market.

2.2.2 Bollinger Bands

It helps traders identify overbought and oversold conditions by measuring price movements relative to the upper and lower Bollinger Bands. These bands are constructed around a Simple Moving Average (SMA) with the width of the bands determined by the stock's volatility (standard deviation).

It indicates whether the stock is trading above or below the Bollinger Bands, helping to identify potential buying and selling opportunities.

Buy and Sell Signals:

- **Buy Signal:** When the %B value falls below 0, the stock price is below the lower Bollinger Band, indicating that the stock is oversold. This can be interpreted as a potential buying opportunity. For example, in late 2008, the %B value frequently dips below 0, signaling that the stock is oversold during the financial crisis.
- **Sell Signal:** When the %B value exceeds 1, the stock price is above the upper Bollinger Band, indicating that the stock is overbought. This signals a potential sell opportunity. In early 2009, the %B value rises above 1, suggesting overbought conditions as the market begins to recover.

Figure -3 confirms this behavior.

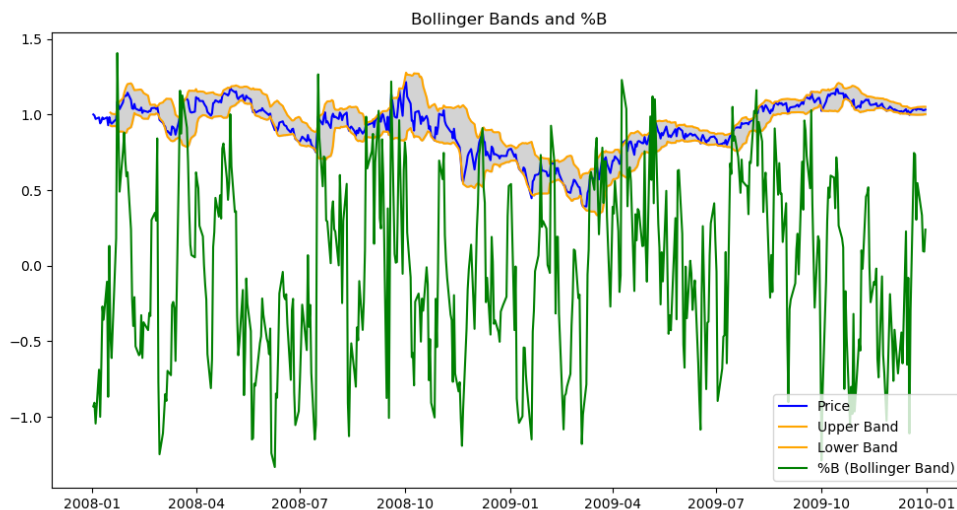


Figure 3— %B indicates oversold and overbought periods of a stock

Observations:

- **Late 2008:** The %B value frequently dips below 0, indicating oversold conditions and potential buy signals.
- **Early 2009:** The %B value rises above 1, indicating overbought conditions and potential sell signals.

In summary, the **Bollinger Bands %B** is a valuable tool for identifying price extremes. It helps in capturing buy opportunities in oversold markets and sell opportunities in overbought conditions.

2.2.3 Momentum

The **Momentum Indicator** is a technical analysis tool that is used to identify shifts in market trends by evaluating the strength of a stock's upward or downward movement. This indicator helps in recognizing buy and sell signals based on the direction and intensity of the momentum.

The Momentum Indicator is calculated using the formula:

$$M = \frac{P_t}{P_{t-w}} - 1$$

- P_t : Current Price
- P_{t-w} : Previous Price over a specified window period – 12 days.

This calculates the relative price change over a given window (e.g., 12 periods), with positive values indicating upward momentum and negative values indicating downward momentum.

Buy and Sell Signals:

- **Buy Signal:** Positive momentum indicates that the stock is gaining upward strength, signaling a potential buy opportunity. For example, in early 2009, the momentum indicator shows a sharp rise, suggesting an increase in buying pressure as the market rebounds.

- **Sell Signal:** When momentum crosses below the zero line, it signals weakening strength or downward pressure, indicating a potential sell signal. This can be observed in late 2008, where momentum turned sharply negative during the market crash, signaling potential exits.

This behavior is reflected in the *figure-4* which shows momentum of “JPM” stock during the 2008 – 2009 years.

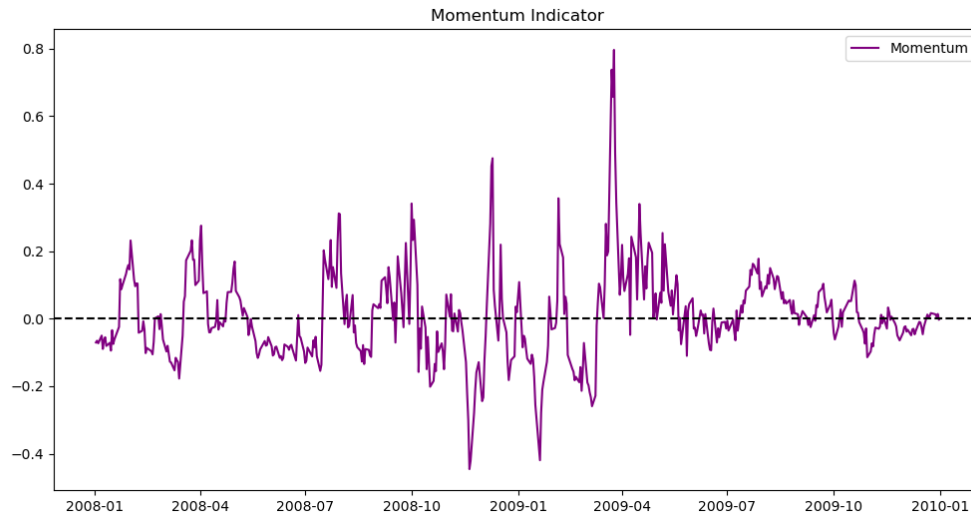


Figure 4— Momentum of JPM stock during 2008 to 2009 years.

In summary, the Momentum Indicator reflects market volatility during the 2008-2009 period. It captures both the significant downturn during the 2008 financial crisis (negative momentum) and the subsequent recovery in early 2009 (positive momentum).

2.2.4 Percentage Price Oscillator

The **Percentage Price Oscillator (PPO)** is a momentum indicator that measures the percentage difference between two Exponential Moving Averages (EMAs) of varying periods. It is used to identify trends by examining the crossover between the shorter-term and longer-term EMAs.

It is calculated using the formula:

$$\text{PPO} = \left(\frac{\text{EMA}_{\text{Short}} - \text{EMA}_{\text{Long}}}{\text{EMA}_{\text{Long}}} \right) \times 100$$

Buy and Sell Signals:

- **Buy Signal:** When the PPO value crosses from negative to positive, it indicates a shift in momentum, signaling a potential buy opportunity. This can be observed in late 2008 and early 2009. This behavior can be seen in *Figure – 5*.

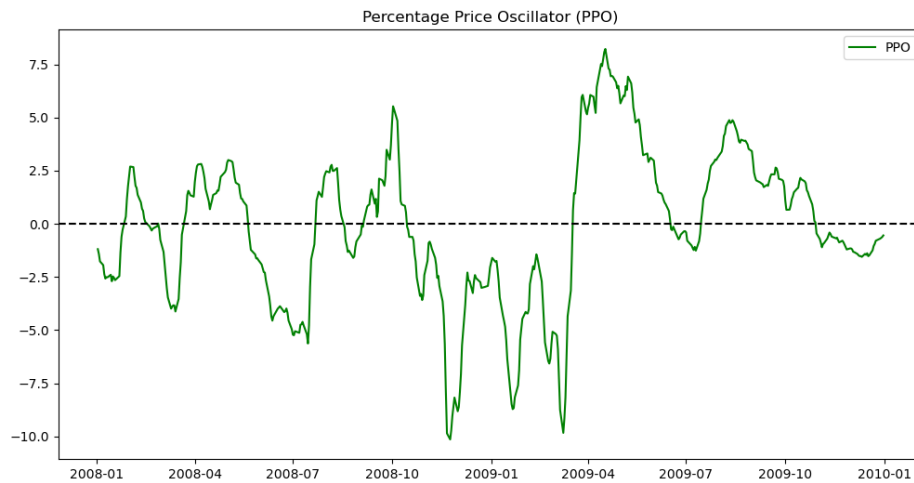


Figure 5— PPO of JPM stock shows Bearish and Bullish trends

- **Sell Signal:** A crossover from positive to negative suggests that the stock's momentum is shifting from bullish to bearish, signaling a potential sell opportunity. This can be seen in mid-2009, where the PPO value falls below zero.

In summary, PPO is a useful trend-following indicator that helps identify bullish and bearish momentum.

2.2.5 Commodity Channel Index (CCI)

CCI measures the deviation of the stock price from its moving average over a set period. The indicator is used to detect overbought or oversold conditions. The CCI values fluctuate above or below zero, where readings above +100 suggest overbought conditions, and readings below -100 suggest oversold conditions.

Buy and Sell Signals:

- **Buy Signal:** When the CCI crosses below -100 (green line) and then starts to move upward, it indicates that the stock may be oversold, potentially signaling a buying opportunity.
- **Sell Signal:** A sell signal is generated when the CCI crosses above +100 (red line) and then starts to fall, indicating overbought conditions.

This behavior becomes apparent in *figure -6*.

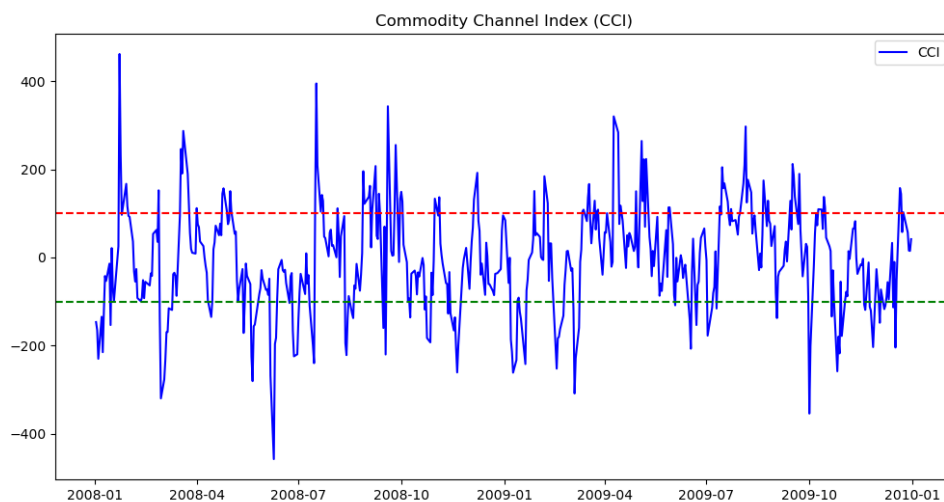


Figure 6— CCI shows the period when the stock is overbought and over sold

In summary, the **Commodity Channel Index (CCI)** is a momentum-based indicator that helps traders identify overbought or oversold conditions. During the 2008-2009 period, the CCI effectively captures price deviations and provides signals aligned with market volatility.

3 CONCLUSION

The results of this project highlight the stark differences between theoretical trading strategies and conventional market practices. The Theoretically Optimal Strategy (TOS) for JPM demonstrated an extraordinary cumulative return of 579.84%, significantly outperforming the benchmark of holding 1,000 shares, which yielded a 1.23% return. This stark contrast illustrates the potential benefits of utilizing perfect foresight in trading decisions.

In the second implementation, the application of various technical indicators provided a robust framework for identifying optimal buying and selling periods, particularly during the market's recovery phase in early 2009 and the overbought conditions in mid-2009.