

Equity Market Insights via Stock Trend Analysis

Introduction

In today's fast-paced financial markets, data-driven analysis is vital for investors aiming to make timely and informed decisions. This project addresses that task by analyzing historical stock market data to detect bullish or bearish momentum, compare stock performance across sectors, and identify early signals that may indicate broader market shifts. To enhance accessibility and insight, a dynamic Python-based dashboard featuring interactive visualizations enables intuitive exploration of trends for both individual and institutional users.

The analysis centers on a curated set of major U.S. equities, examining historical price behavior using classical technical indicators such as the Relative Strength Index (RSI) and Moving Average Convergence Divergence (MACD). Beyond individual stock signals, the project extends its scope to uncover correlations between equity trends and key macroeconomic indicators, providing deeper context into how broader economic developments may influence stock performance.

Tools & Methodologies

- *List of U.S. equities:* The following stocks from various sectors provide a broad market overview.
 - AAPL, MSFT, NVDA—Technology
 - AMZN, TSLA—Consumer Discretionary
 - PG, WMT—Consumer Staples
 - JNJ—Healthcare
 - XOM—Energy
 - JPM—Financials
 - AMT—Real Estate
- *Technical Indicators:* The following technical indicators are computed using rolling window functions to capture both short-term fluctuations and long-term trends.
 - Moving Averages (MA)—Identify prevailing trends and crossover signals to detect trend reversals
 - Relative Strength Index (RSI)—Measures momentum by comparing recent gains and losses, flagging overbought or oversold conditions
 - Moving Average Convergence Divergence (MACD)—Tracks momentum shifts via the relationship between fast and slow exponential moving averages
 - Volatility (Rolling Standard Deviation)—Quantifies the degree of price variability to signal periods of market stress or calm.
- *External indicators:* The following U.S. economic indicators are incorporated to supplement stock-level technical analysis with macroeconomic context.
 - Consumer Price Index (CPI): A monthly gauge of inflation, interpolated to daily frequency.
 - Federal Funds Rate (FFR): A benchmark (daily) interest rate set by the Federal Reserve, influencing borrowing costs and equity valuations.

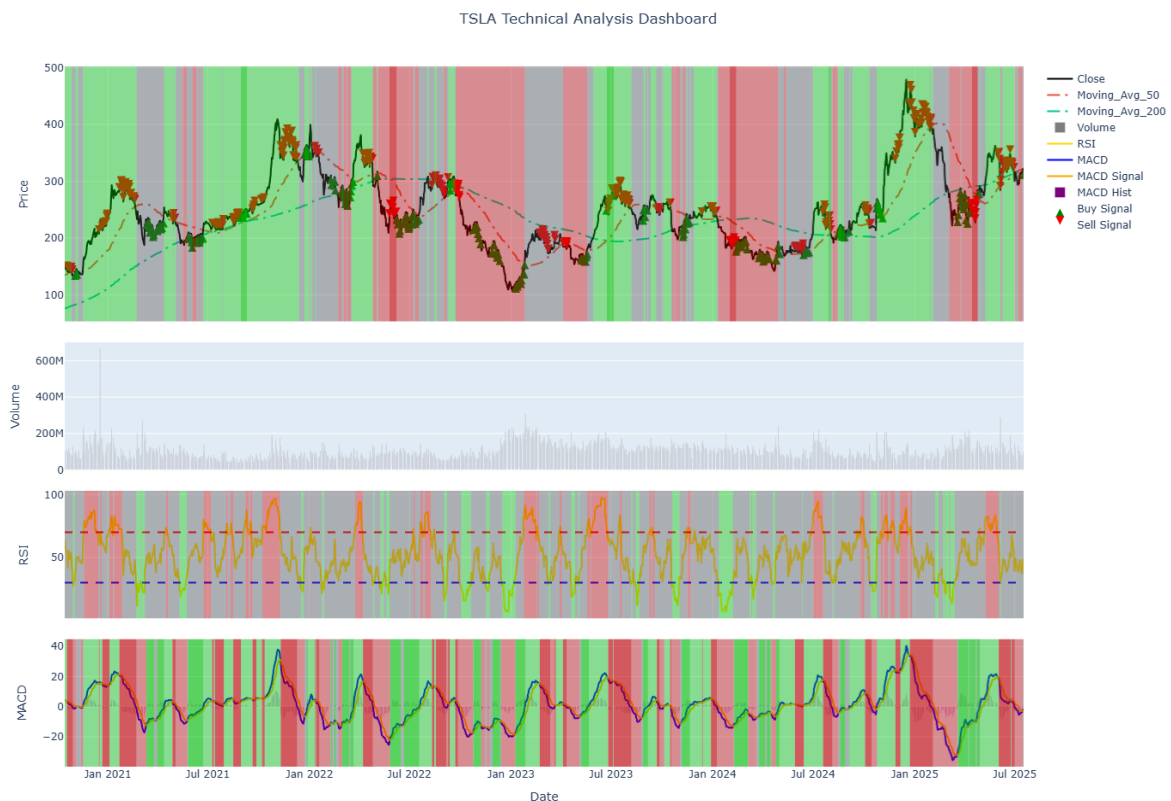
- Real Gross Domestic Product (GDP): A quarterly measure of economic growth, interpolated to daily frequency, to approximate shifts in macroeconomic momentum.

The data source for all computations, which are standardized across stocks, is the Yahoo Finance API (yfinance) for historical daily closing prices and volumes of the past five years (2020-2025), and the visual output was generated using Plotly within a Dash dashboard environment.

Analysis & Results¹

For each stock, the following simple criteria is applied to the corresponding technical indicators to gauge the market momentum of that stock²:

- If the close price > both short MA and long MA, the stock is *bullish*, especially when the short MA just crossed above the long MA. If the close price < both, the stock is *bearish*, especially when the short MA just crossed below the long MA. Otherwise, it is *neutral*.
- If RSI > 70, the stock is overbought, and the market will be *bearish*. If RSI < 30, the stock is oversold, and the market will be *bullish*. Otherwise, it will be *neutral*.
- If the MACD and its histogram are within a threshold of 0.4, the stock will be *neutral*. Otherwise, if the MACD crosses above its signal line, the stock will be *bullish*, especially when it happens below 0, and if the MACD crosses below its signal line, the stock will be *bearish*, especially when it happens above 0.



¹ For full code implementation and visual analysis, please refer to the accompanying .ipynb file. The attached is an example output.

² Dark green/red marks strong bullish/bearish, green/red marks bullish/bearish, and gray marks neutral.

The MA and MACD momentums both fit the price data well, where uptrends and downtrends are usually classified correctly. Particularly, the MACD momentums are more vigilant and sensitive as it picks up oscillations more frequently and quickly. The RSI momentums, on the other hand, are more predictive. Its bullish and bearish momentums precede the actual price uptrends and downtrends. Thus, RSI acts as a confirmation indicator for MA's and MACD's moderate bullish/bearish momentums in signalling.

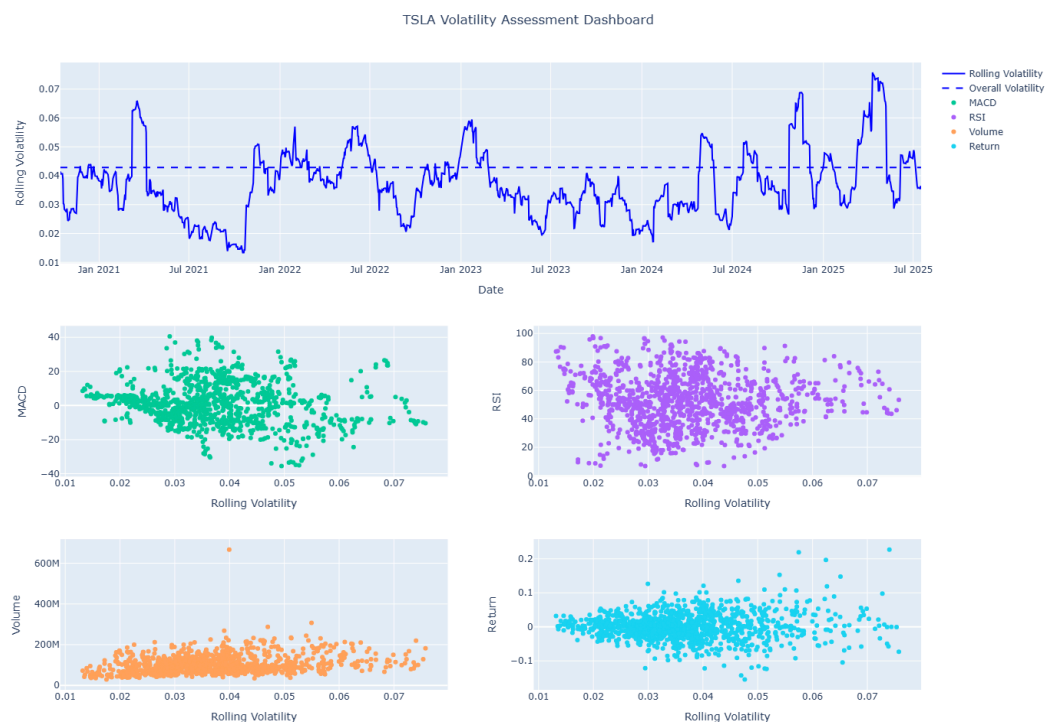
The buy/sell signals are then generated (annotated on graphs) using the MA, RSI, and MACD momentum classifications based on the following hybrid strategy:

- If either MA or MACD reads strong bullish/strong bearish on a day, that day is marked as a buy/sell signal.
- Otherwise, if either MA or MACD reads bullish/bearish on a day, and RSI reads bullish/bearish at any point in the past 8 days, that day is marked as a buy/sell signal.

Technical Indicators and Market Behavior

The buy and sell signals are generally reliable—with most groups of buy signals followed by corresponding groups of sell signals at higher price levels. The signal generation criteria appear to capture the early stages of both upward and downward price movements, effectively locking in profits. Notably, buy signals tend to occur during early bullish and late bearish MA momentum phases, while sell signals typically appear during late bullish and early bearish MA phases. This pattern supports the credibility of the strategy.

The MACD shows minimal correlation with rolling volatility and tends to cluster around zero with reduced variance at higher volatility levels. During whipsaws, MACD struggles to diverge from zero because short-term noise—such as price reversals and fake-outs—cancels out the longer-term momentum tracked by the exponential moving average. In volatile, short-term environments, price movements often outpace MACD, resulting in delayed or misleading trend signals.



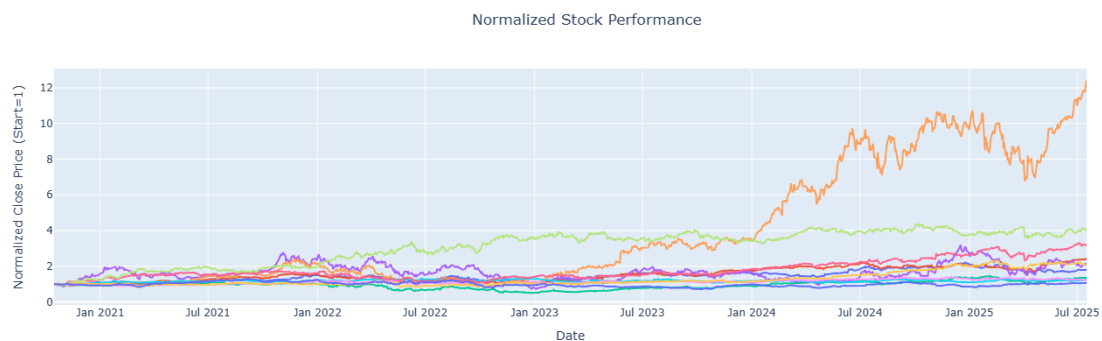
Volume demonstrates a slight positive correlation with volatility, especially when both the time range of analysis and the volatility window are shortened. On shorter time scales, spikes in trading activity often coincide with sharp price movements, reflecting more aggressive trader reactions. This suggests that short-term volatility is frequently driven by immediate responses to news, sentiment shifts, and technical triggers.

RSI, although not meaningfully correlated with volatility, tends to display a narrower amplitude as volatility increases. This aligns with the fact that RSI reaches more extreme values during strong trends—periods that usually exhibit lower volatility and fewer momentum reversals.

Returns also show little direct correlation with volatility but exhibits a wider amplitude as volatility rises. As price fluctuations increase, the potential for both gains and losses grows due to larger price differentials.

Stock Performance and Interrelationships

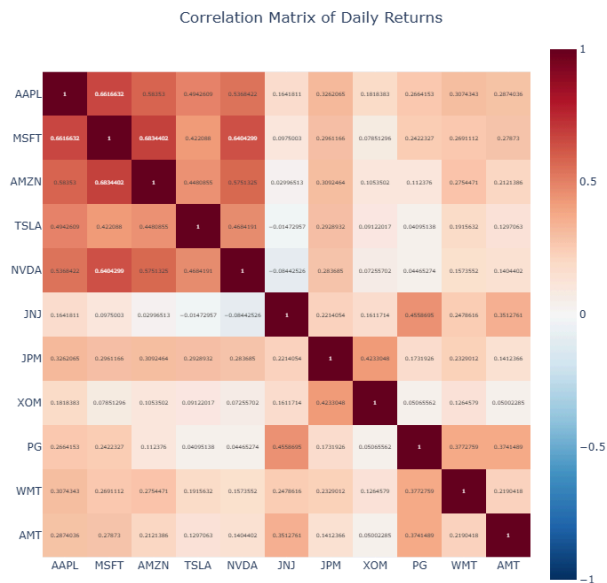
Among all the stocks analyzed, NVDA delivered the highest return, with an impressive ~12x growth over the study period. It was followed by XOM with approximately 4x growth, and JPM with around 3x growth. Most other stocks showed roughly 2x growth, while AMT had the smallest increase, growing by only about 4%. This data supports the common view that stocks in the technology and energy sectors generally offer higher growth potential.



Almost all stock pairs in this study show positive correlations, especially among companies in the technology and consumer discretionary sectors—AAPL, MSFT, NVDA, AMZN, and TSLA. This aligns with the fact that these stocks often move together due to shared market drivers such as innovation cycles, risk appetite, and investor sentiment. While they are sometimes considered cyclical—benefiting from economic expansions—their growth-oriented nature also makes them sensitive to interest rate expectations. As a result, during periods of strong GDP growth, they may lag broader market performance if rising rates weigh on their valuations. The distinction between technology and consumer discretionary is also increasingly blurred: AMZN and TSLA, while classified as consumer discretionary, rely heavily on technological innovation and can be considered quasi-tech stocks in this context.

Notably, JPM and XOM exhibit a moderate positive correlation of 0.423, reflecting their alignment with broad market trends as constituents of the S&P 500. Both the financial and energy sectors are traditionally cyclical, benefiting more directly from economic

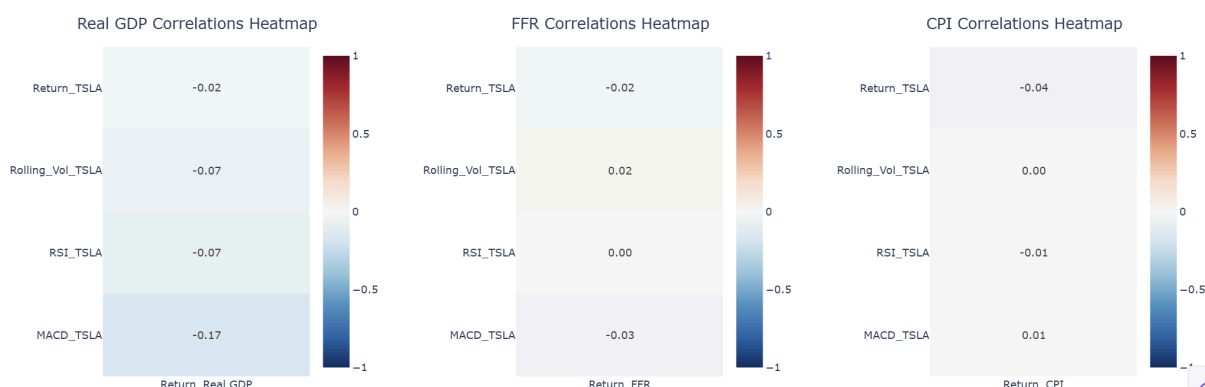
growth—financials through increased lending and investment activity, and energy through rising demand for oil and gas.



Macroeconomic Indicators and Sector Responses

Among macroeconomic variables analyzed, the FFR and CPI show negligible correlation with technical indicators. However, the percentage change in real GDP demonstrates more pronounced relationships, particularly with RSI and MACD, highlighting how different sectors respond to broader economic cycles.

For TSLA, AAPL, AMZN, and MSFT, both RSI and MACD show consistently negative correlations with real GDP changes. These large-cap growth and tech stocks are highly sensitive to shifts in interest rate expectations. When GDP growth is strong, markets often anticipate monetary tightening (e.g., rising interest rates), which can lower growth stock valuations and weaken both short-term momentum (RSI) and longer-term trend signals (MACD).



In contrast, NVDA, XOM, AMT, PG, and JNJ exhibit positive correlations with both indicators. These companies either benefit more directly from economic expansion—such as XOM in the energy sector and NVDA from industrial tech demand—or maintain stable performance in growth periods due to consistent consumer demand, as seen with PG and JNJ.

Interestingly, JPM and WMT display mixed correlations: MACD is negatively correlated while RSI is positively correlated with GDP changes. This suggests that short-term sentiment—driven by stronger consumer spending or improved financial activity—remains positive, while longer-term momentum may be constrained by structural challenges such as margin compression (in retail) or interest rate risk (in financials).

Conclusion

This analysis explored stock momentum, interrelationships, and macroeconomic influences using technical indicators (MA, RSI, MACD) alongside a rule-based trading strategy. The strategy generated buy and sell signals based on strong bullish or bearish readings from MA and MACD, confirmed by RSI signals within an 8-day window. These signals proved generally reliable, effectively capturing early trend reversals and enabling timely profit-taking.

NVDA stood out with the clearest signals and highest return (~12x), followed by XOM and JPM. Most stocks, particularly tech and consumer discretionary names like AAPL, MSFT, AMZN, and TSLA, showed strong inter-stock correlations but negative correlations between GDP and both RSI and MACD—likely due to sensitivity to interest rate expectations during periods of strong economic growth. In contrast, XOM, PG, JNJ, and AMT exhibited positive correlations, reflecting either cyclical alignment or stable demand during expansions.

While FFR and CPI had minimal impact, real GDP change emerged as the most relevant external indicator for RSI and MACD, particularly during short-term momentum. These findings support the use of technical indicators, enhanced by macroeconomic context, to inform a responsive and sector-aware trading strategy.

While the current analysis provides valuable insights, one important direction for future work is to rigorously backtest the proposed trading strategy. Backtesting would allow for a systematic evaluation of the strategy's performance across various market conditions, quantifying its profitability, risk, and robustness. This empirical validation is essential to moving beyond theoretical observations and toward practical application.

Additionally, there is substantial scope to enhance the strategy with more sophisticated techniques. For example, incorporating MACD divergence analysis, which involves comparing the highs and lows of MACD with those of the underlying stock price, can improve trend confirmation and help filter false signals. Likewise, analyzing sharp shifts in MACD values alongside RSI overbought or oversold signals can provide stronger and more reliable entry and exit points.

Finally, expanding the array of stocks under analysis would further strengthen the robustness of findings and applicability of the strategy. A broader set of equities across different sectors and market capitalizations could not only uncover additional correlation patterns but also reduce the bias of outlier stocks, improving the generalizability of results.