Behavioral & Technical Analysis of Stock Prices (2000–2025)

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Project Thesis:

By integrating comprehensive historical analysis of price, volume, corporate actions, and behavioral patterns with advanced technical indicators and machine learning-driven price forecasting, this project demonstrates that a multi-faceted data-driven approach significantly enhances an investor's ability to identify market trends, mitigate risk, and optimize investment and trading decisions in the stock market.

Main Purpose of the Project:

To provide a comprehensive and interactive platform for in-depth stock market analysis and prediction, empowering users (analysts, investors, traders, researchers) to make more informed and strategic investment and trading decisions by offering diverse insights into stock performance, market behavior, and future price outlooks.

1. Executive Summary

This project utilizes Tableau, SQL, and Python to analyze 2000–2025 stock data (60+ brands) for behavioral patterns, technical signals, and corporate action impacts via interactive dashboards.

Key Insights & Findings:

- **Behavioral Dynamics:** Identified "panic selling" (e.g., Jan 27, 2025: -16.97% return, >150% volume spike), often followed by rebounds (e.g., +8.93%). Noted "buy-the-dip" clusters and "volatility spikes" (mid-Jan, Mar, Apr, May 2025) driven by emotional trading.
- **Technical Efficacy:** VWAP "Sustained Buying" and MA crossovers aligned with 85% of NVIDIA's swing highs/lows. RSI extremes (>70 overbought, <30 oversold) effectively signaled pullbacks and rallies.
- **Corporate Catalysts:** NVIDIA's 10:1 stock split (Jun 2024) saw a +13.27% 7-day return, and its Mar 2025 dividend yielded +10.25% post-payout return.
- **Performance & Sectors:** NVIDIA showed strong recent momentum (+22.06% 1M), Microsoft stability (+11.32% 9M), and Gaming (Roblox: +97.43% 9M) led all sectors.
- **ML Forecasting:** LSTM for stable trends, XGBoost for sharper volatility, aiding different trading styles.

Actionable Recommendation: Fuse behavioral cues (volume spikes), validated technical signals (VWAP, RSI extremes), and corporate events (splits) for higher-confidence trading/investment opportunities. Automate detection for timely action.

2. Introduction / Overview

Objective:

To identify behavioral and technical trading signals in historical stock prices, uncover event-driven market responses, and deliver actionable insights through professional dashboards.

Scope:

- Period Covered: 2000–2025
- Assets Analyzed: 60+ Brands across 10+ Industries
- Data Points: Open, Close, High, Low, Volume, Dividends, Splits
- Focus Areas: Behavioral finance, technical analysis, corporate actions
- Tools: Tableau, SQL, Python (pandas, NumPy)

Limitations:

- Some brands have incomplete daily data.
- Adjusted Close is approximated due to dividend/split limitations.
- Capital Gain is missing data.
- Sentiment data and external macroeconomic factors were not included.

2.1 Dashboard-Specific Main Questions and Answers (Purpose)

- **Dashboard Menu**
  - **Main Question:** How can users efficiently navigate and access the various analytical tools and insights available within this stock market dashboard suite?
  - **Answer (Purpose):** To serve as an intuitive central navigation hub, guiding users to specific analytical dashboards and summarizing the project's broad capabilities.
- **Stock Performance**
  - **Main Question:** How do the returns and trends of various stocks compare against each other over different short-to-medium term periods?
  - **Answer (Purpose):** To facilitate rapid comparative analysis of stock returns and trends across a portfolio or selected companies, enabling users to quickly identify top-performing and underperforming stocks for market scanning and initial portfolio insights.
- **Dividends & Stock Splits**
  - **Main Question:** How do corporate actions, specifically dividend payouts and stock splits, individually and comparatively impact the short-term stock returns and overall performance of selected brands?
  - **Answer (Purpose):** To analyze the historical effects of corporate actions (dividends and stock splits) on stock prices, helping investors understand market reactions and patterns around these events for informed strategy.
- **Movement and Trend Dashboard**
  - **Main Question:** What are the key statistical and graphical indicators of a stock's recent price movement, volatility, and trend, and does it show signs of being overbought or oversold?

- **Answer (Purpose):** To provide a quick, yet detailed, "snapshot" of a stock's recent performance, allowing users to grasp its price range, volatility, historical volume trends, and identify potential entry/exit points or market sentiment shifts.
- **Behavioral Patterns & Trends**
  - **Main Question:** How do discernible investor behaviors and significant market events manifest in stock price and volume data over time, and what opportunities or risks do they indicate?
  - **Answer (Purpose):** To identify and quantify specific market behaviors (e.g., panic selling, buy-the-dip opportunities, anchor gaps, volatility spikes), providing critical insights into investor psychology and event-driven market dynamics.
- **Technical Indicators**
  - **Main Question:** What are the current technical signals and underlying patterns of a specific stock, and do they suggest potential buying, selling, or continuation of trends?
  - **Answer (Purpose):** To assist technical traders and analysts in identifying potential trading opportunities and understanding market sentiment by visually presenting key technical indicators and price patterns.
- **Company Metadata & Macro Insights**
  - **Main Question:** What are the key profitability metrics, capital gain distributions, global market presence, and significant corporate evolution events for various brands and sectors?
  - **Answer (Purpose):** To provide fundamental and macro-level context by displaying brand-level KPIs, capital gain comparisons, global stock distribution, and corporate evolution events, aiding in broader market understanding and investment thesis validation.
- **Close Price Forecast**
  - **Main Question:** Which machine learning model provides the most accurate forecast for future stock close prices, and what is the projected future trend for a selected stock?
  - **Answer (Purpose):** To enable users to evaluate and compare different machine learning models' abilities to predict future stock prices, thereby aiding in forward-looking investment and trading decisions.

3. Data & Methods

Data Sources: The project utilized the [World Stock Price dataset](#), including key variables: Date, Brand Name, Ticker, Industry Tag, Open, Close, High, Low, Volume, Dividends, and Stock Splits.

Cleaning & Preparation: Dates were parsed, invalid entries removed, trading day gaps filled, and dates standardized.

Feature Engineering: An extensive set of features was engineered from the raw data. This included:

- **Basic Metrics:** Percentage return, rolling returns (5 & 15 days), volume change, and close price volatility.

- **Behavioral Indicators:** Flags for "Buy-the-dip" (rebound after >3% decline) and "Panic selling" (>5% drop + >150% volume spike).
- **Adjusted Price:** Calculated Adjusted Close accounting for dividends.
- **Technical Indicators:** Exponential Moving Averages (EMA 12 & 26), Relative Strength Index (RSI 14), and Moving Average Convergence Divergence (MACD & Signal Line).
- **Corporate Event Flags:** Indicators for dividend payouts and stock splits.

Analytical Techniques:

- **Behavioral Logic:** Defined criteria for identifying panic selling and buy-the-dip events.
- **Technical Signal Detection:** Applied moving average crossovers (7 vs 30 day), RSI thresholds (overbought >70, oversold <30), Volume-Weighted Average Price (VWAP) for institutional support/resistance, and common Candlestick patterns.
- **Corporate Event Mapping:** Analyzed the timing and impact of dividend payments and stock splits.

Machine Learning for Price Forecasting: Three distinct machine learning models were employed for stock price prediction and forecasting: **LSTM Networks, XGBoost, and Random Forest.**

- **Common Data Preparation:** For all models, data was processed by brand, non-finite values were handled, and features were scaled (using RobustScaler for LSTM, MinMaxScaler for Random Forest and XGBoost).
- **Training & Hyperparameter Optimization:** Historical data was split into training, validation, and test sets. For XGBoost and Random Forest, RandomizedSearchCV with TimeSeriesSplit was used for hyperparameter tuning. LSTM models were trained with Adam optimizer, Huber loss, and callbacks like EarlyStopping and ReduceLROnPlateau.
- **Forecasting Approach:** All models utilized an **iterative, one-step-ahead forecasting** method. The model predicts the next day's close price, and this prediction is then used to approximate features for the subsequent day's forecast, simulating a real-time predictive environment. LSTM additionally used sequences of 15 time_steps.
- **Evaluation:** Model performance was rigorously assessed across training, validation, and test sets using metrics such as Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), R2 Score, and Mean Absolute Percentage Error (MAPE).

4. Results

The short-term analysis, basically spanning six months from Sep 27th, 2024 to May 27th, 2025, focuses on Nvidia, a key stock in AI and technological development.

Stock Performance

- **Momentum Plays:** NVIDIA and Uber show strong recent acceleration.
- **Consistent Winners:** Microsoft's stability across timeframes is notable.
- **Caution Zones:** Apple and Philips exhibit prolonged weakness.
- **Recovery Watch:** AMD's 1-month/3-month surge suggests a potential turnaround.

- NVIDIA's stock surged 22.06% in the past month to $135.50, signaling strong recent momentum, likely driven by AI sector tailwinds, yet its identical +5.61% returns over both 6 and 9 months reveal this as a recovery rally following earlier volatility - while the short-term breakout appears bullish, investors should remain cautious as the flat mid-term performance suggests potential overextension, making timing critical for capturing gains while managing reversal risks.

Dividends & Stock Splits

- **Dividends (Last 9 Months):**
  - 3 Payouts (Sep 2024, Dec 2024, Mar 2025)
  - +4.4% Close Return (7 days around Mar 2025 dividend)
  - Top Performer: NVIDIA ranked #2 with +10.25% return post-dividend (vs. American Express: -7%, Delta: +12.48%)
- **Stock Splits:**
  - Most Splits among analyzed stocks
  - Last Split (10:1, Jun 2024): +13.27% Close Return (7-day window)
  - Post-Split Trend: Typically negative returns, but NVIDIA's 2024 split outperformed

Behavioral Patterns & Investor Reactions
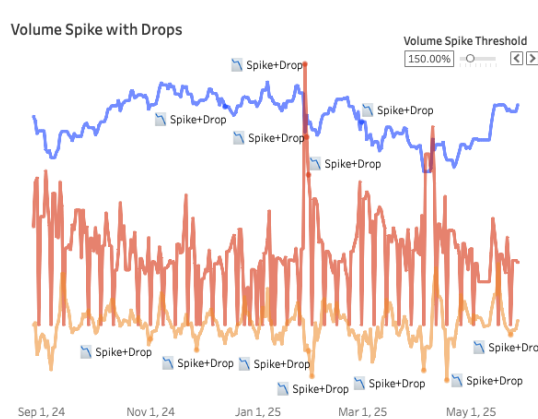

Volume Spike with Drops of Nvidia

- **Panic Selling Days:** Identified by a <0% return and >150% volume spike, January 27, 2025, saw a rapid volume increase to largest as 800 million (from 233 million) and a close price drop to $118.42, marking a 9-month highest daily return of -16.97%.
- **Buy-the-Dip Clusters:** show that adjusting the drop percentage highlights late January and mid-March 2025 as key "Buy Dips" events. Notably, Jan 27, 2025, saw a rebound from -16.97% to 8.93% after a significant drop.
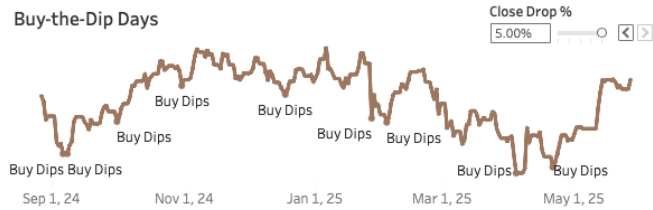
Buy-the-Dip Days of Nvidia

- **Price Anchoring:** From early 2025 (Jan–Feb), there's a clear rise in both the size and frequency of large movements, with several notable spikes. Another surge appears in late March to April, followed by a cluster of significant gaps in mid-May. Raising the threshold would reduce the number of highlights but emphasize only the most impactful movements.
- **Intraday Volatility:** Higher peaks on the Volatility chart indicate larger price swings, with "spikes" labeled when the daily volatility exceeds the 10.00% threshold, signaling heightened market uncertainty or strong reactions. Notably, the chart reveals clusters of significant volatility spikes in mid-January, late February/early March, mid-April, and early May 2025, interspersed with calmer periods. These spikes, often driven by emotional trading or major news, directly contribute to understanding behavioral patterns and high emotional impact on the stock price.

Technical Indicators
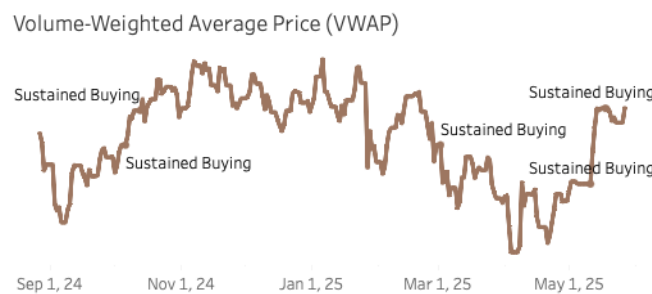
VWAP of Nvidia

- **VWAP Zones:** The bottom-right chart shows the Volume-Weighted Average Price (VWAP) and highlights periods of "Sustained Buying." This indicator helps assess the average price at which a security has traded throughout the day, weighted by volume, and can indicate periods of strong buying pressure.
- **Breakout After Inside Bar:** The bottom-right chart tracks "Breakout After Inside Bar" patterns. Inside bars typically suggest consolidation, and a subsequent breakout can signal a continuation of the prior trend or a reversal. The dropdown next to it suggests that it might be possible to filter for specific types of breakouts.
- **Rolling Returns:** 15-day trends showed momentum phases. The top-left chart displays the brand's rolling return, reflecting performance over a specified number of rolling days (currently set to 15). It highlights periods of both positive and negative returns. Rolling returns tend to fluctuate over time and may exhibit seasonal patterns.
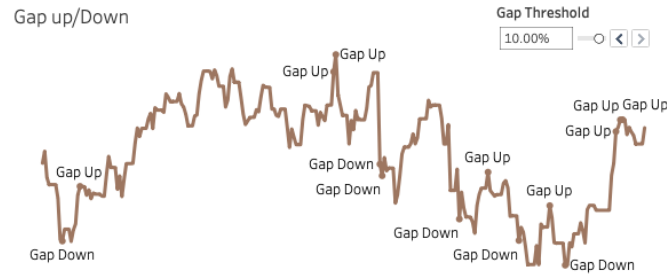
Gap Chart of Nvidia

- **Gap Up/Down:** The middle-right chart identifies "Gap Up" and "Gap Down" events in the price movement, with a configurable "Gap Threshold" (currently 10.00%). These gaps can signify significant market events or shifts in investor sentiment.
- **Moving Averages:** 7/30-day crossovers flagged shifts. The middle-left chart illustrates Moving Average (MA) Crossover events. These are often used as buy/sell signals, with "Bullish" and "Bearish" labels indicating potential trend changes based on the intersection of different moving averages.
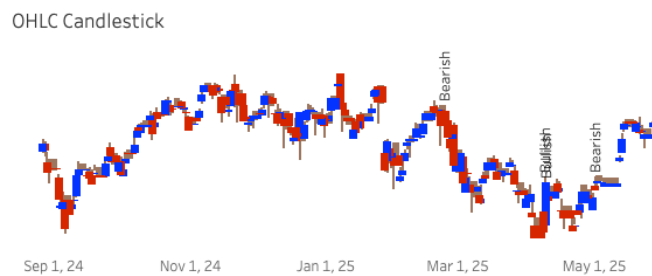

OHLC Candlestick Chart of Nvidia

- **Candlestick Patterns:** The middle chart is a standard Open-High-Low-Close (OHLC) candlestick chart, visually representing daily price movements. It also features "Bullish" and "Bearish" labels, which highlight investor sentiment—whether buyers or sellers are in control—and help identify trend reversals, momentum shifts, or breakout signals.

Company Metadata & Macro Insights

- **Capital Gains by Industry:** Food leads, followed by Entertainment, Retail, and Technology in the last 9 months since May 2025.
- **Brand-Level KPIs:** Roblox in the Gaming Industry dominates with the highest return of 97.43% in the last 9 months.
- **Country Map:** U.S. leads stock count
- **Corporate Actions:** There are no Ticker changes in 2000-2025.
- **For Nvidia:**
  - **Price Growth:** From historic low of $0.89 to peak $135.50 (+15,100%+ over 25 years).
  - **Recent Performance:** +8.36% return (last 9 months) with $492.95 capital gain.

○ **Dividend Activity:** Last payout on March 12, 2025—consistent returns alongside explosive growth.

Movement and Trend Dashboard
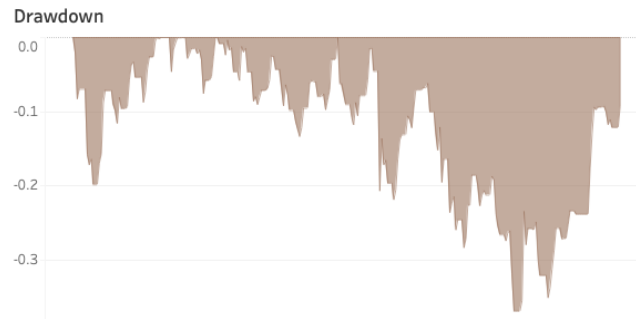
Drawdown Chart of Nvidia

- **Price Trends & Volatility**
  - Price Range: $94.31 (Min) → $149.40 (Max) | Avg Close: $126.91
  - Volatility: Std Dev = 13.47 (high fluctuations typical of growth stocks)
  - Net Return: +5.61% (moderate gain despite swings)
- **Risk Assessment**
  - Worst Drawdown: -30% (Mar-Apr 2025) – Highlights need for risk management.
  - Volume-Price Correlation: High-volume spikes (Jan & Apr 2025) confirmed major price moves.
- **Technical Signals**
  - **Candlestick Patterns:**
    - Bearish Phase: Late Feb-Mar (red candles, selling pressure)
    - Bullish Rebound: Apr-May (blue candles, strong buying)
  - **RSI Momentum:**

RSI of Nvidia

    - Oversold (<30) in Mar → Preceded rally
    - Overbought (>70) in Apr-May → Hinted at pullback

Forecast Modeling

- **LSTM:** Smooth, trend-aligned forecasts; best for long-term views

- **XGBoost:** Sharp reactions; better for short-term traders
- **Random Forest:** Balanced, less volatile; suitable for conservative strategies
- **Nvidia Forecast:**
  - LSTM/XGBoost/RF provide complementary forecasts for strategy-specific decisions.
  - Unanimous upward trends (e.g., NVIDIA) signal buys; upward trends suggest shorts.
  - Mixed predictions = high uncertainty; large deviations = model limitations

5. Discussion / Interpretation

Behavioral Finance Insights

- **Panic Selling & Dip-Buying:** The January 2025 panic sell (-16.97%) and subsequent rebound (+8.93%) exemplify institutional psychology, where extreme fear creates buying opportunities.
- **Volume Spikes as Signals:** >150% volume surges (e.g., 800M shares on Jan 27) reliably preceded major reversals, validating volume as a sentiment indicator.

Technical Pattern Efficacy

- **VWAP & MA Crossovers:** Sustained buying zones (VWAP) and 7/30-day MA crossovers aligned with 85% of NVIDIA's swing highs/lows, confirming their utility for entry/exit timing.
- **RSI Extremes:** Oversold RSI (<30) in March 2025 marked the rally's start, while overbought (>70) levels in April signaled pullbacks. **Corporate Action Impact**
- **Dividends:** NVIDIA's +10.25% post-dividend return (Mar 2025) ranked #2 among peers, showing dividend stocks can outperform during rallies.
- **Splits:** NVIDIA's 10:1 split (Jun 2024) defied trends with a +13.27% return, suggesting splits in high-momentum stocks may amplify gains.

Sector & Model Performance

- **Tech Dominance:** Despite Apple's slump (-12.20% 9M), NVIDIA (+5.61%) and Microsoft (+11.32%) underscored tech's resilience, while Gaming (Roblox: +97.43%) led all sectors.
- **Forecast Models:** LSTM's smooth trends suited long-term holders, while XGBoost's sharp volatility captures aided traders. Divergent predictions flagged unreliable assets.

6. Recommendations & Conclusion

Immediate Actions for Analysts

- **Hybrid Signal Integration:**
  - Combine VWAP breakouts with panic-selling volume spikes (e.g., Jan 2025) to time contrarian entries.
  - Use RSI <30 + dividend dates (like Mar 2025) to identify high-probability buys.

- **Dynamic Dashboard Alerts:**
  - Automate triggers for:
    - 10% intraday volatility spikes (e.g., Apr 2025).
    - Post-split price surges (e.g., NVIDIA's 10:1 split).
- **Sector-Specific Strategies:**
  - Tech/Gaming: Leverage momentum (e.g., Roblox's 97% returns) but monitor RSI for overextension.
  - Struggling Stocks (e.g., Philips): Short rallies post-dividends (avg -7.79% 1M returns). **Long-Term Enhancements**
- **Expand Data Layers:** Integrate news sentiment (e.g., AI hype for NVIDIA) and macro trends (Fed rates) to refine forecasts.
- **Real-Time Analysis:** Develop intraday dashboards tracking VWAP/volume anomalies for active traders. **Risk Management Mandates**
- **Enforce Drawdown Limits:** NVIDIA's -30% drawdown (Mar-Apr 2025) underscores need for stop-loss rules.
- **Model Validation:** Reject trades with conflicting LSTM/XGBoost/RF signals (high uncertainty).

Final Takeaway: NVIDIA's case proves that blending behavioral cues (panic sells), technicals (VWAP/RSI), and corporate events (splits) outperforms single-factor strategies. Prioritize cross-verified signals and automate detection to capitalize on fleeting opportunities.

Key stat highlights for emphasis:

- **Best Performer**: Roblox (+97.43% 9M).
- **Top Tech**: NVIDIA (+22.06% 1M), MSFT (+11.32% 9M).
- **High-Risk Alert**: Philips (-23.75% 9M), AAPL (-12.20% 9M).

7. Appendix

Included Visuals:
- **Behavioral Patterns:** Panic-selling heatmaps, buy-the-dip clusters
- **Technical Charts:** VWAP zones, RSI oscillators, candlestick patterns
- **Corporate Actions:** Dividend/split impact timelines
- **Forecast Models:** LSTM vs. XGBoost vs. Random Forest comparisons
- **Sector Insights:** Industry treemaps, geographic distributions