

Analysis for predicting FX Market Trends

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Introduction

Aim: Forecast the short-term return trends of the top three mainstream currency pairs (USD/GBP, USD/JPY, USD/EUR) to support trading, investment, and hedging decisions for both retail and institutional investors

Data Selection:

- Dewey Global FX Rates (USD Base) including Daily exchange rates normalized to USD from 2014 to 2024
- Wall Street Journal FX Data (8 Major currencies pairs Daily rates) from 2024 to now
- Central Charts Forex Exchange Data (Web Scraping via Selenium Extraction) to ensure the currency pair trading volume & liquidity

Exploratory Data Analysis

Data Processing Procedure

Extreme Value Handling

Applied a Sigma Filter to remove outliers by limiting values to within 3 standard deviations from the mean—ensuring more reliable trend detection.

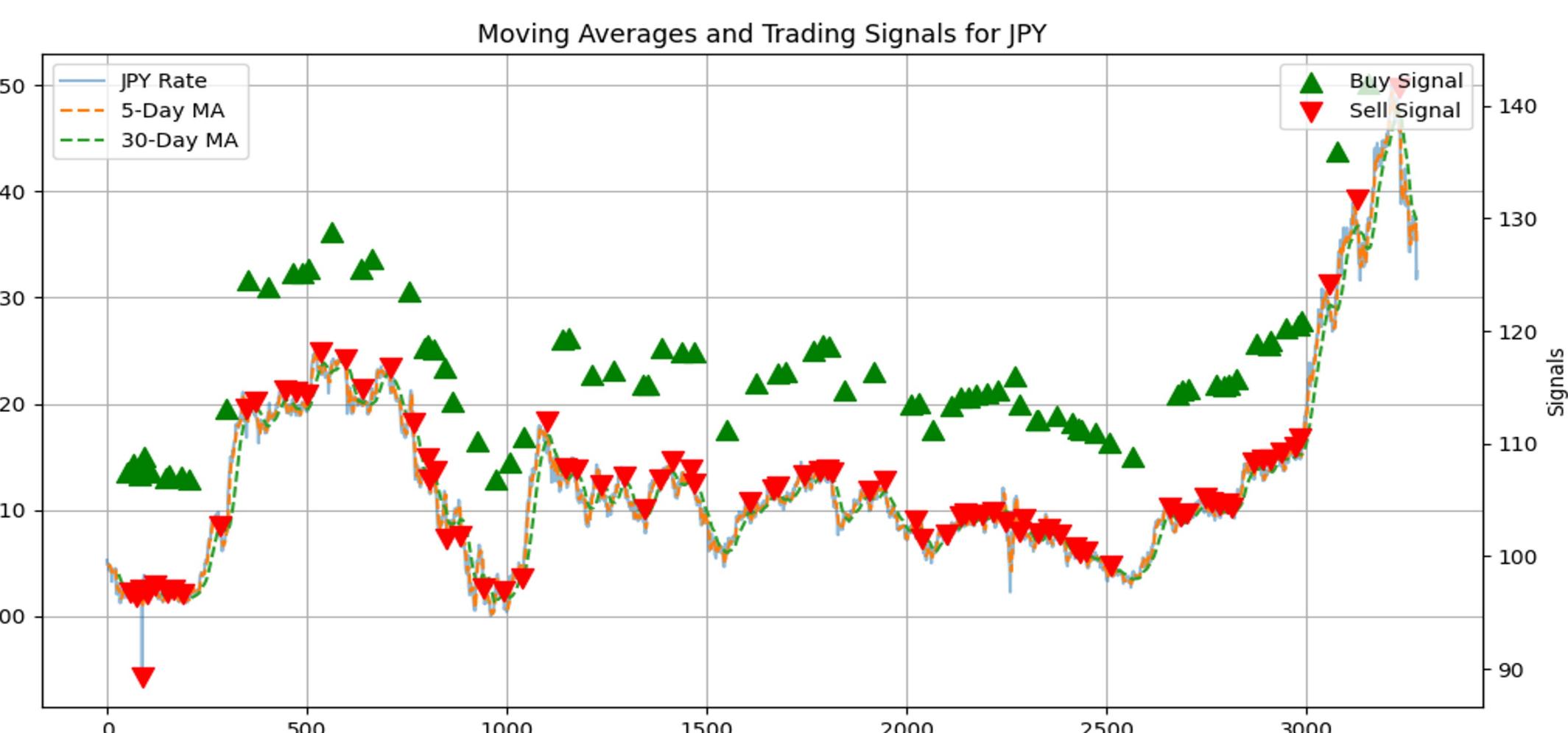
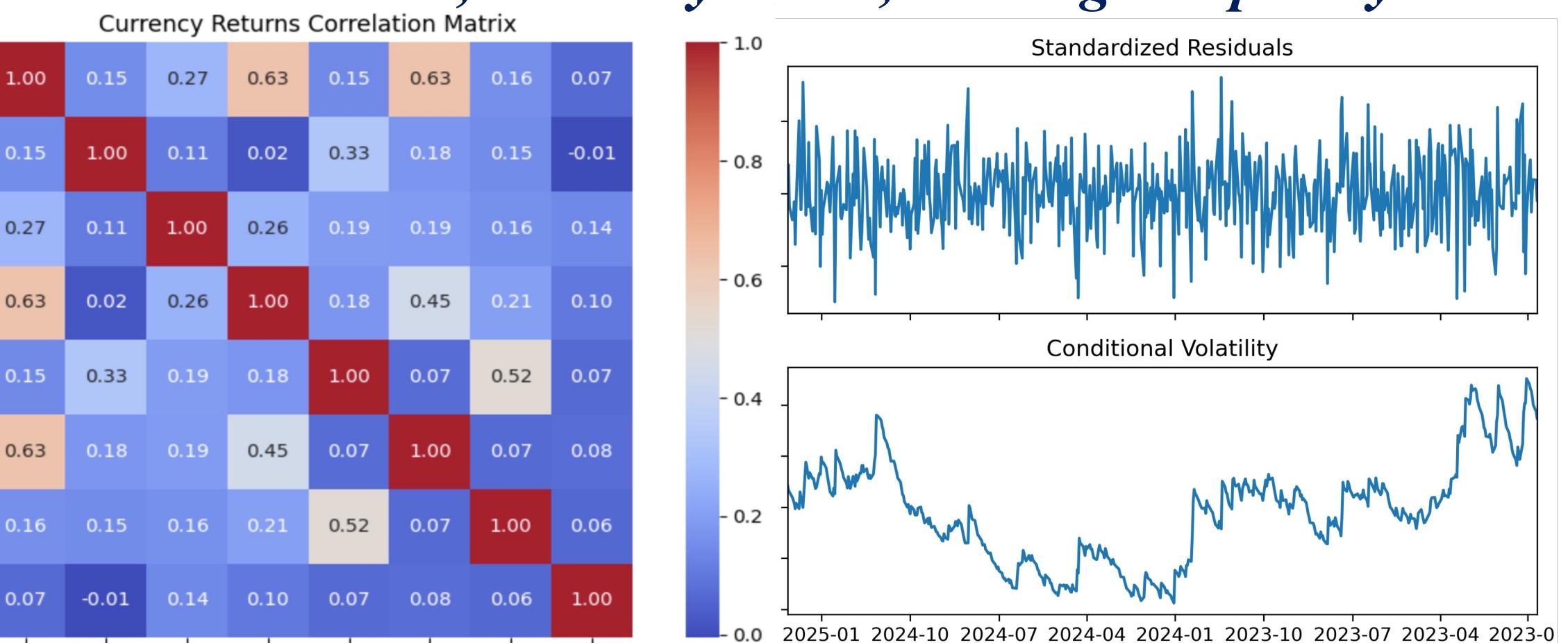
Standardization

Used Z-score normalization to bring currency data onto a comparable scale, which improves interpretability and consistency across different exchange rate magnitudes.

Currency Selection Strategy

Leveraged the correlation matrix alongside trading signal patterns to identify the top 3 attractive currency pairs—USD/GBP, USD/JPY, and USD/EUR—as the primary focus for further modeling and prediction

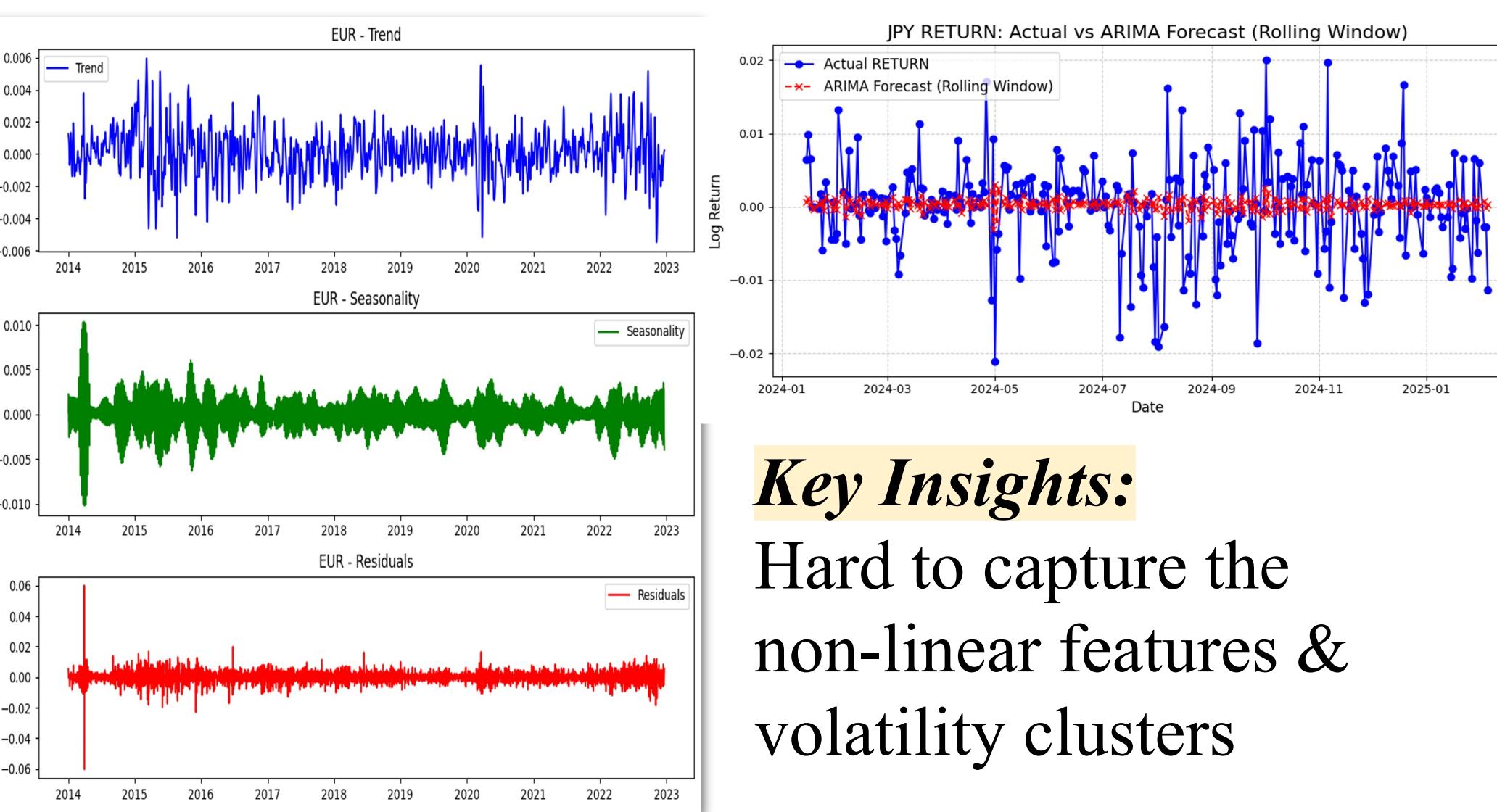
Correlation Matrix, Volatility Track, Trading Frequency



Method Selection

Baseline Model (ARIMA)

- Model short-term linear dependencies in stationary return series
- Procedure: A. STL Analysis (to identify the seasonality & trend using LOESS)
- B. Implement auto.arima to identify the most suitable model & conduct residual analysis



Key Insights:

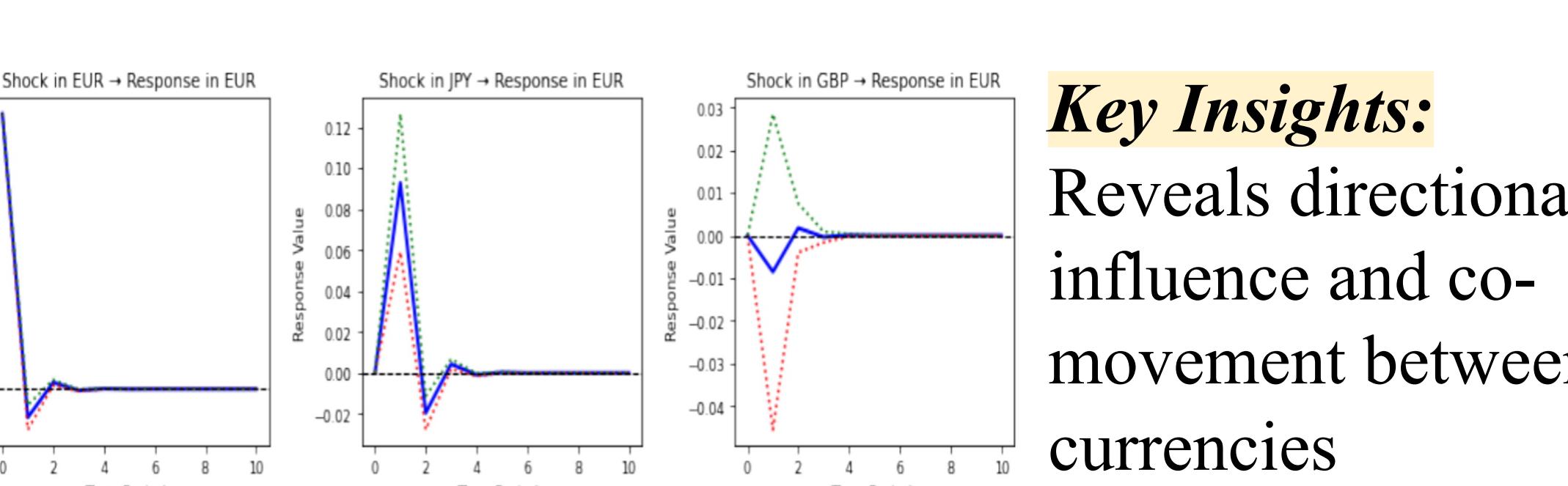
Hard to capture the non-linear features & volatility clusters

GARCH + ARIMA

- Integrate return modeling (ARIMA) with volatility modeling (GARCH) for a more comprehensive view of FX dynamics
- Procedure:
 - Sequentially model returns via ARIMA
 - Estimate volatility structure via GARCH on ARIMA residuals

Vector Autoregression (VAR Model)

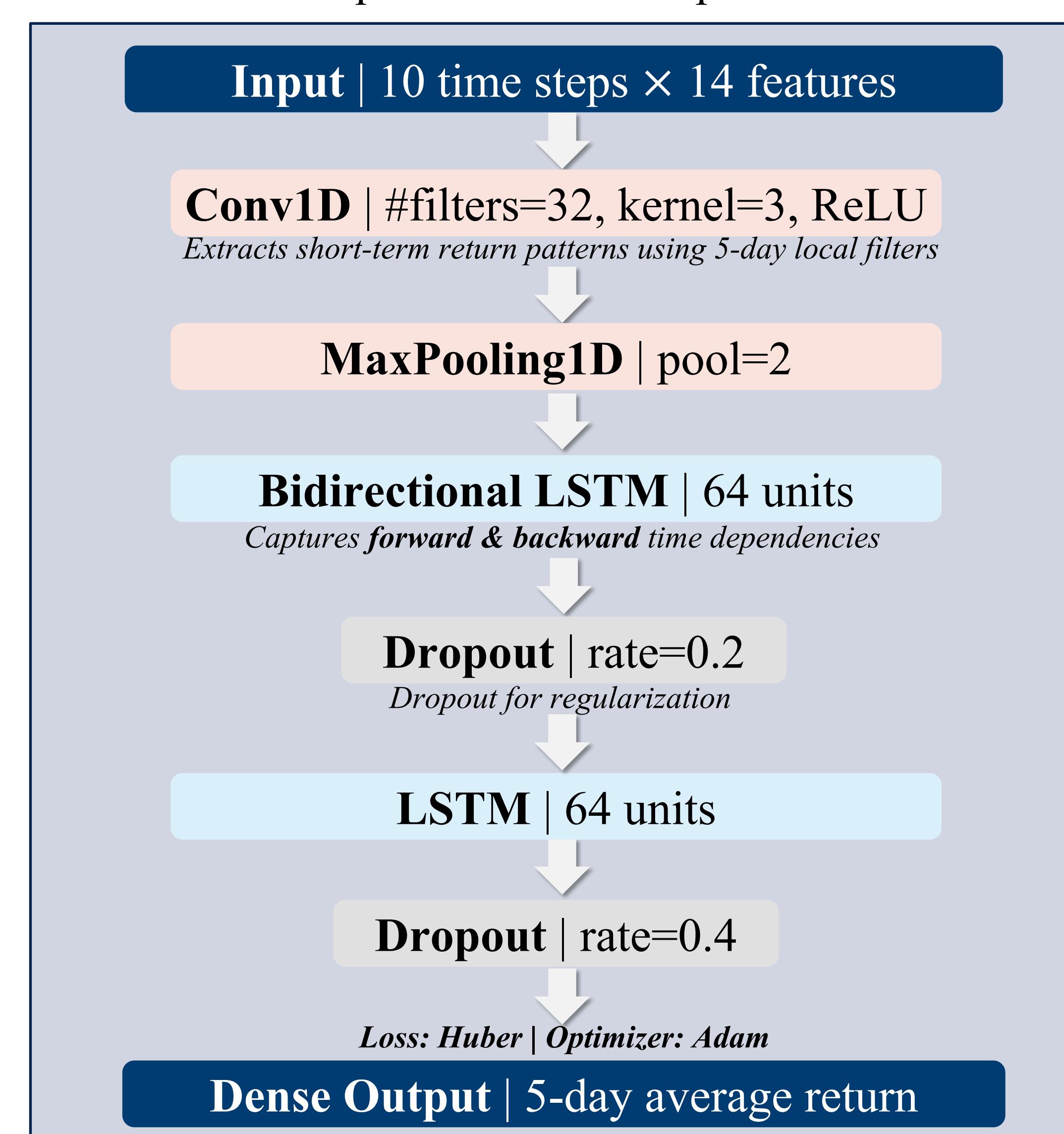
- Model interdependencies among multiple currency return series (EUR, GBP, JPY)
- Procedure:
 - Verify stationarity of series & Select optimal lag structure using AIC/BIC
 - Fit multivariate model using OLS & Conduct impulse response analysis and examine residual correlation structure



Model Architecture

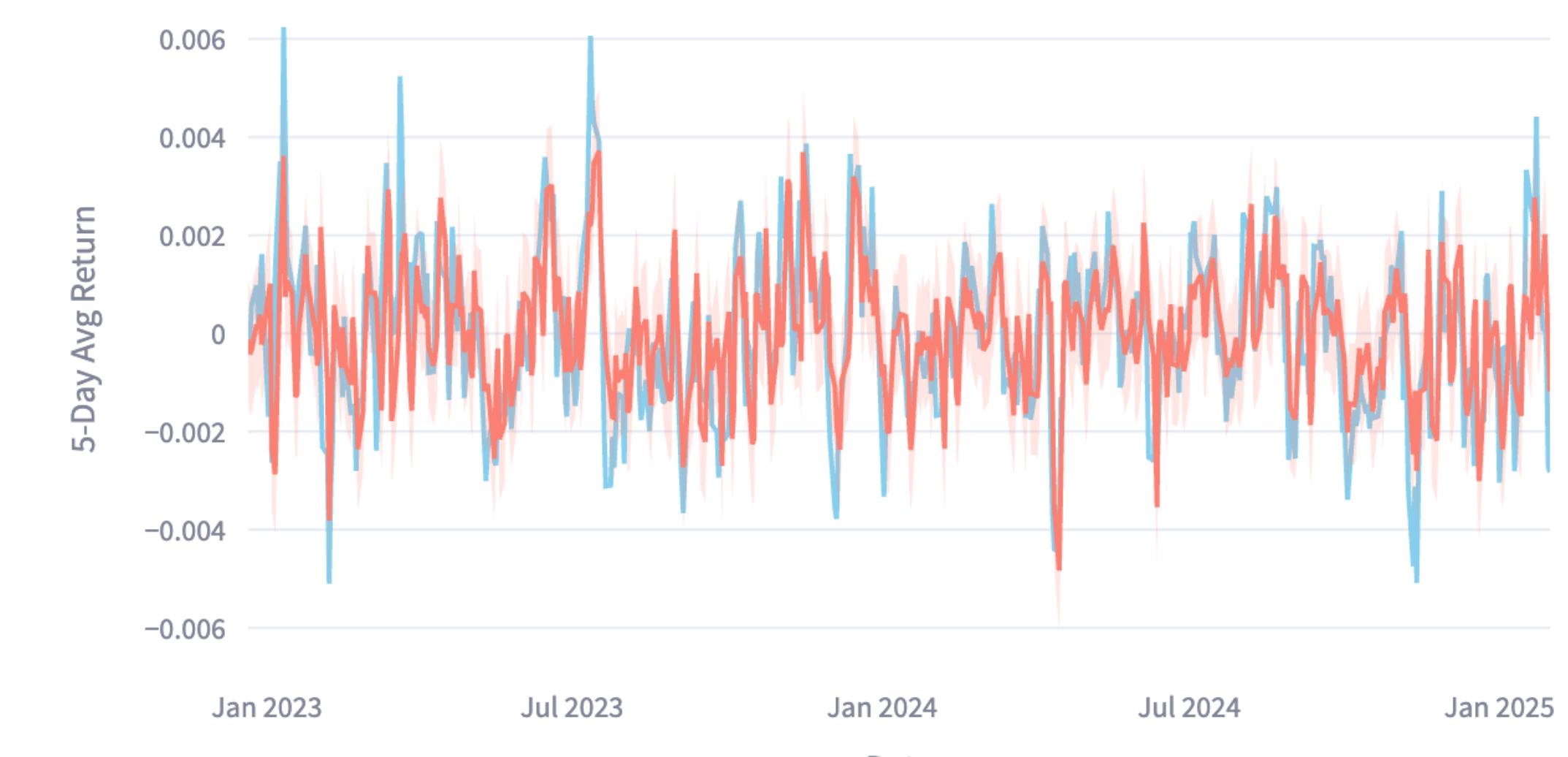
Goal: Leverage combined-model to predict 5-day average returns for EUR, GBP, JPY

Model: Combines CNN & Bi-LSTM to capture both short-term and sequential FX return patterns



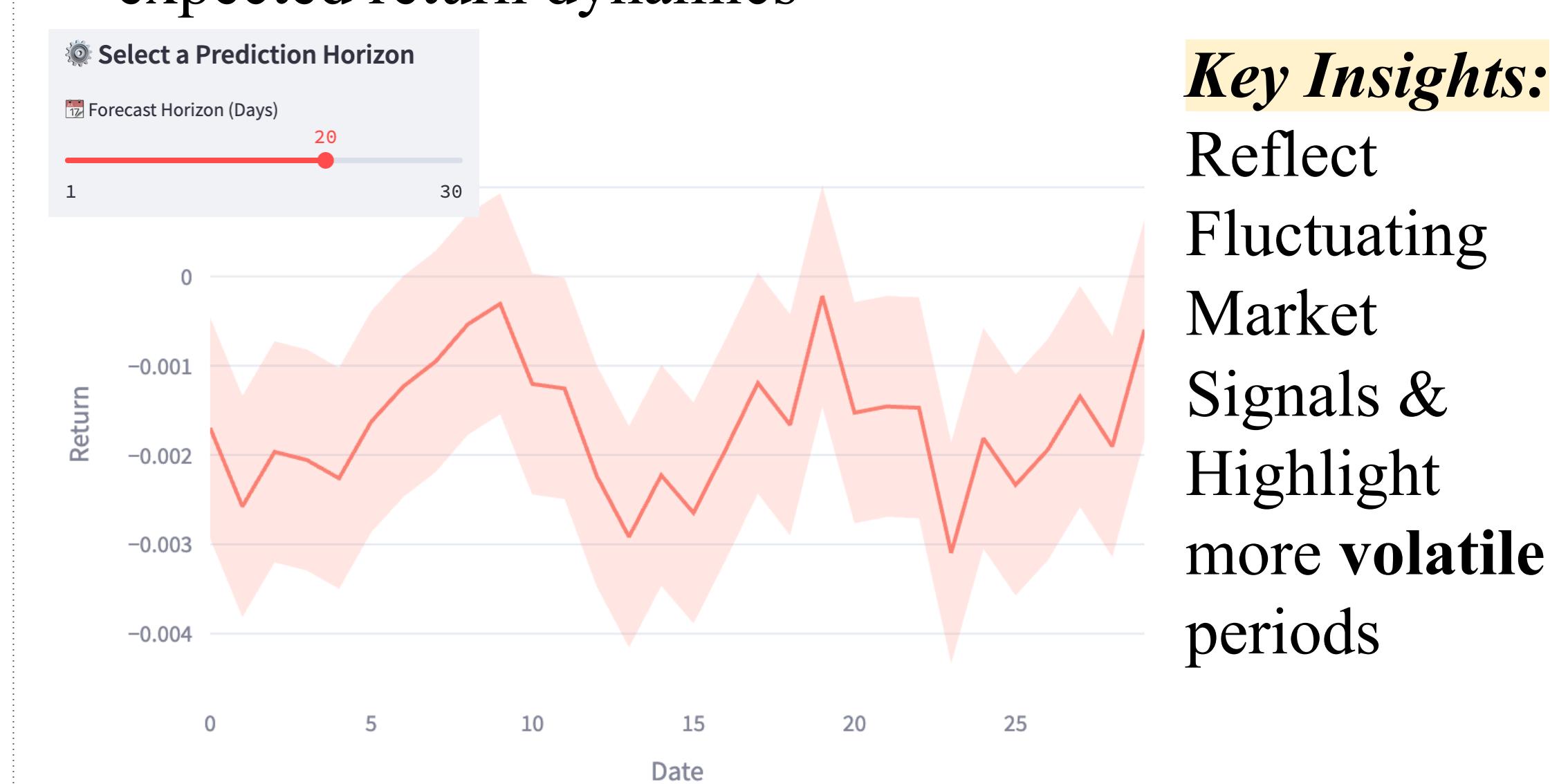
Features & Evaluation

- Integrates rich technical indicators (MA, RSI, Momentum, Volatility, Z-Score, Lagged Targets) to enhance predictive depth and responsiveness.
- Achieves strong performance on real-world data with an R^2 of 0.49, significantly improving over baseline econometric models
- Visualizes model uncertainty using ± 1 RMSE confidence bands, helping users interpret prediction reliability over time
- Outperforms traditional models in capturing nonlinear behaviors, regime shifts, market volatility



Future Prediction Range using LSTM

- Allows users to interactively forecast 5-day average returns for EUR, GBP and JPY
- Predictions are displayed with ± 1 RMSE confidence bands, providing an intuitive sense of uncertainty and volatility
- Enables retail investors to evaluate market sentiment and prepare informed trading strategies based on expected return dynamics



Implementation for Retail Investors' Strategy

- Designed an intuitive trading simulator tailored for non-technical users
- Allows users to:
 - Customize a buy/sell threshold based on their personal risk tolerance or market entry strategy
 - Experiment with strategy logic: if predicted return > threshold (long); < (short); else hold the currency pair



Conclusion

The LSTM-based model captures both linear and non-linear FX trends, outperforming traditional approaches. Through an interactive dashboard, we turn forecasts into actionable insights, demonstrating how deep learning supports real-world financial decisions.

Data Sources: Dewey-Global FX Rate, Central Exchanges FX Rates

Dashboard: <https://fxforecast-dashboard.streamlit.app/>

Key Insights:
Reflect Fluctuating Market Signals & Highlight more volatile periods

Key Insights:
Demonstrates how LSTM-driven predictions can be translated into practical trading signals