Topic: Analysing the impact of Exchange Rate fluctuations on major Stock Market Indices

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Introduction

Objective:

- To identify the relationship between exchange rates and stock market indices of major countries using Econometric models.
- Examine the impact of exchange rate fluctuations on stock market indices and identifying volatility and correlation.

Research Questions:

- How do exchange rate fluctuations affect stock market indices?
- How do the volatility patterns and correlations between exchange rates and stock indices looks like?
- Under different economic regimes, how do these relationships differ?

Motivation & Background of the study

Motivation:

- Global market volatility post Covid pandemic
- Major geopolitical events like conflicts between countries.
- The relationship is still unclear and unexplored
- Potential future implications especially in the Modern Trade war era.

Background:

- Global financial integration/Globalisation
- Currency & stock market dynamics

Literature Review

- **Chkili et al. (2013):**Exchange rate fluctuations do not have impact on stock market returns but changes in stock prices can lead to movements in exchange rate

  Model: Markov switching & VAR models

- **Cenedese et al. (2015):** Stock market return of a country cannot be reliable predictor of currency fluctuations.

  Model: VAR & Cointegration Analysis.

- **Zhang et al. (2020):**During the global financial crisis,there was stronger correlation between exchange rates and stock markets.

  Model: TVP-VAR model

- **Khan et al. (2020):**Both exchange rates and stock markets had higher volatility during COVID-19 pandemic

  Model: GARCH for volatility analysis.

Data Description

Data Source (Yahoo Finance, 01/11/2019- 31/10/2024)

Stock market indices:

- Germany: DAX
- UK: FTSE 100
- India: NIFTY 50
- Japan: Nikkei 225
- US: S&P 100
- China: Shanghai Composite Index
- Singapore: SGX NIKKEI 225

Foreign exchange rates :

CNY/USD, EUR/USD, GBP/USD , INR/USD , JPY/USD , SGD/USD

Methodology & Models

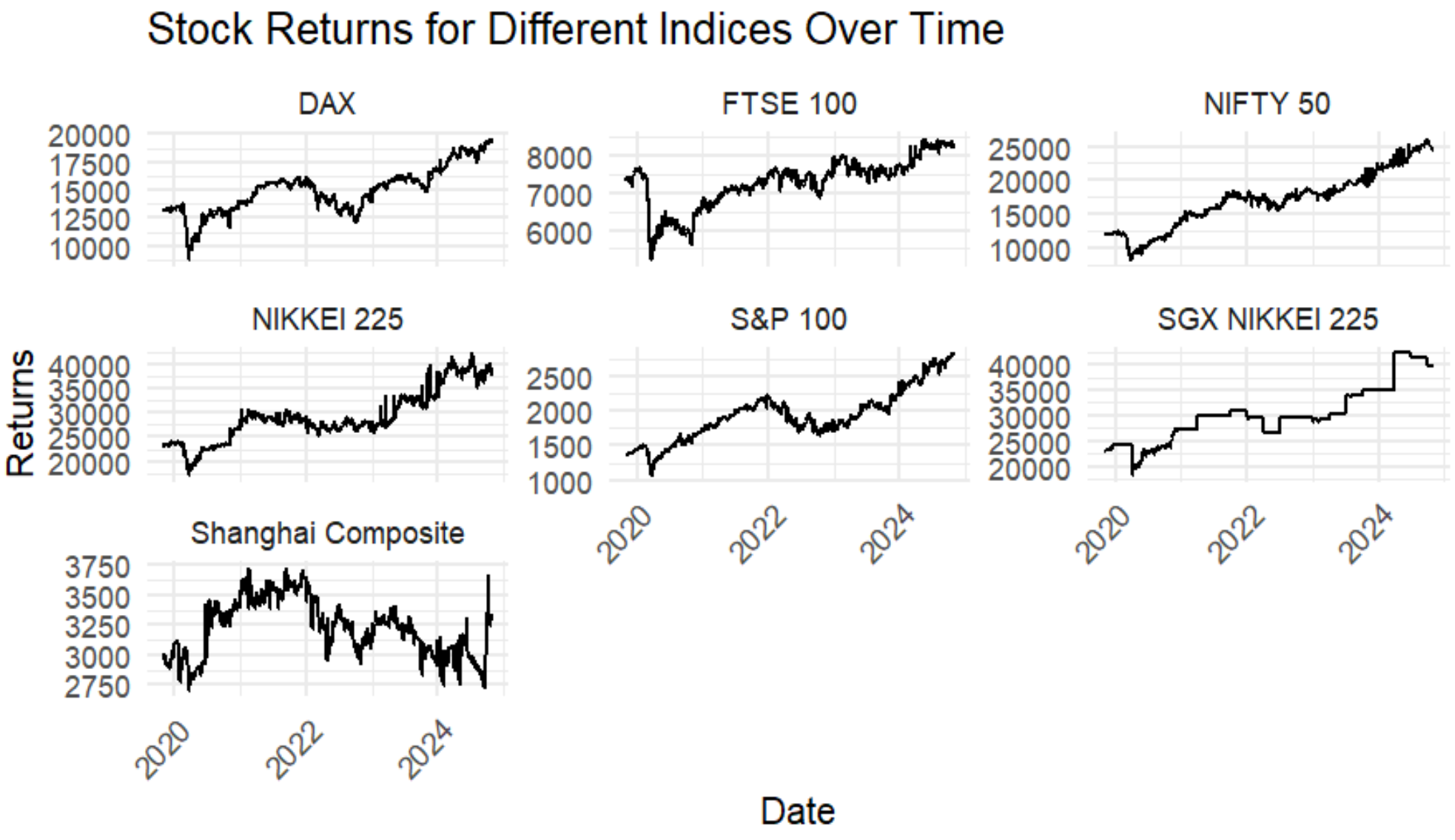
- **Augmented Dickey–Fuller test (ADF)**
- **Autoregressive–Moving-Average(ARMA) Model**
- **Autocorrelation & Partial Autocorrelation Function(ACF & PACF) Plots**
- **Dynamic Conditional Correlation(DCC) GARCH model**
- **Vector Autoregression (VAR)**
- **Markov Switching Model**

Data analysis implemented using **R packages** (tidyr, rmgarch, vars, dplyr, readxl,forecast, rugarch, tsDyn, tseries, MSwM)

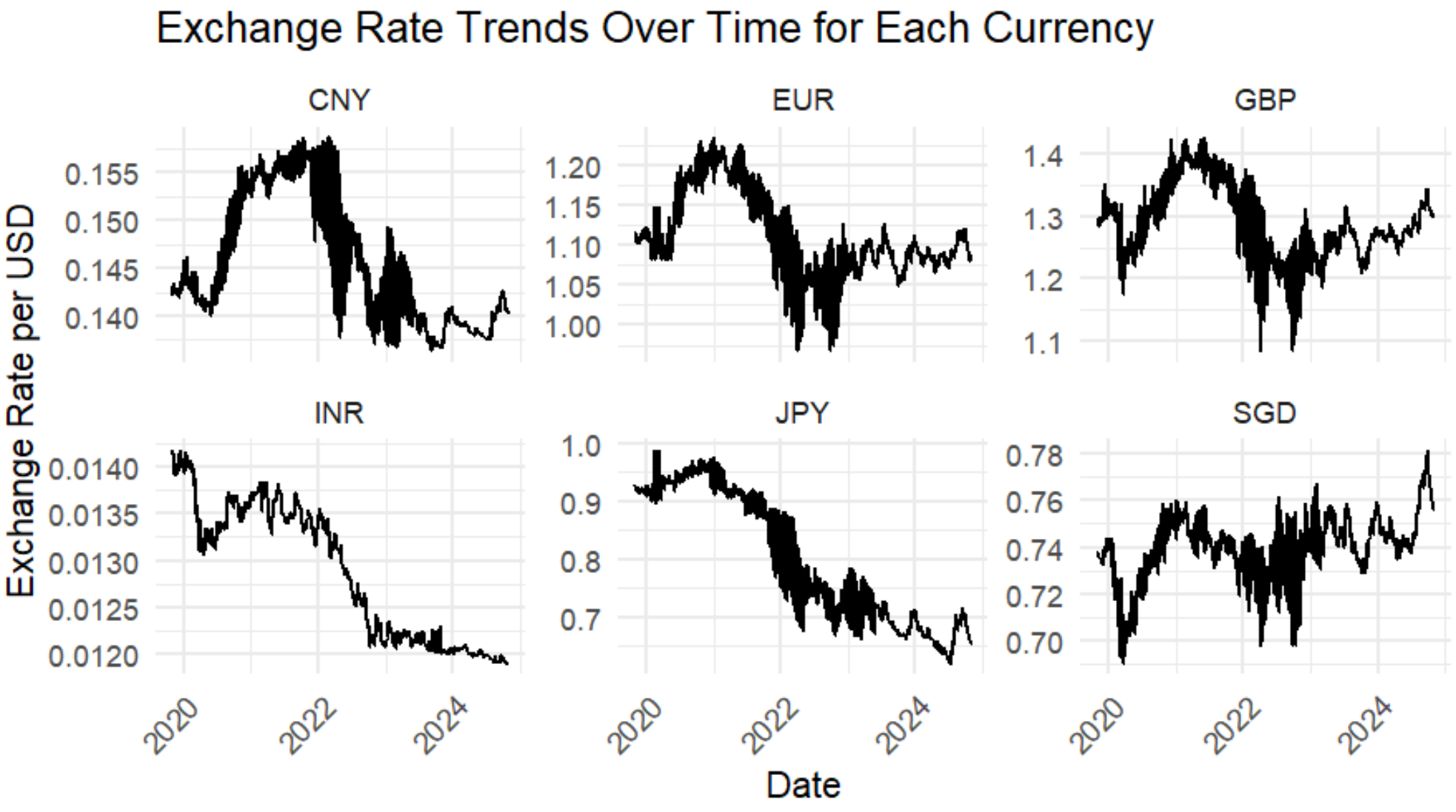
Expected Outcomes

- Understand how geopolitical events influence market volatility and risk aversion.
- Influence of past values in the current values.
- Evaluating the relationship between Exchange rates and stock market Indices.
- Identify patterns and regime shifts in market behavior.
- Provide insights for investors, policymakers, and researchers.

Data results:



Data results:



Stationarity Analysis- ADF test

Objective: To test for stationarity in time series data, otherwise require log-differencing to achieve stationarity.

Results:

- Time series is non-stationary except for FTSE 100 indices with a p-value less than 0.05, indicating it is stationary.
- All other indices & exchange rates have p-values greater than 0.05, indicating non-stationarity.

Reason for non-stationarity:

Data might be influenced by deterministic trends, fluctuations, or other external factors like Exogeneous shocks, Geopolitical events, Heteroskedasticity.

ARMA MODEL

Objective: Identifying the best lag structure

Results:

- Currencies like JPY, GBP, EUR, and CNY show structured autocorrelation patterns.
- Certain currencies & indices like INR, FTSE 100, DAX, & SGX NIKKEI 225 act as a white noise processes with little dependence on past values.
- Nikkei 225 and Shanghai Composite exhibit a mild autocorrelation structure.

Further analysis: Using ACF & PACF Plots

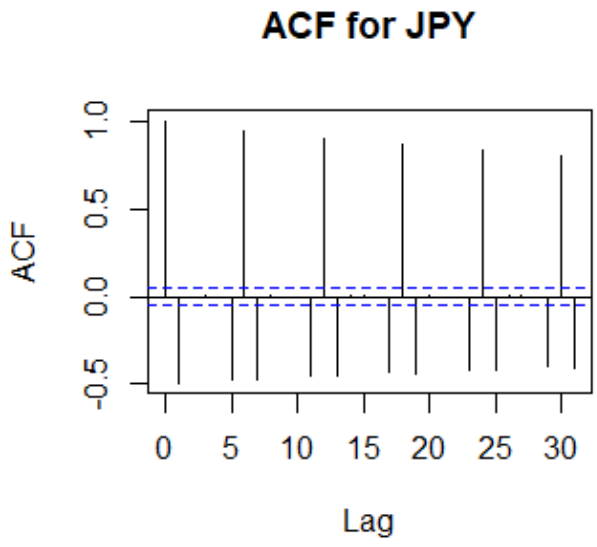
ACF & PACF

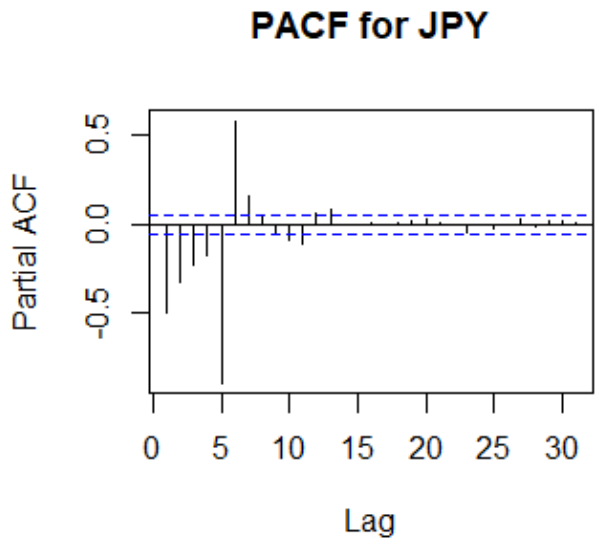
Objective: to visualize dependencies in the data and guide model selection.

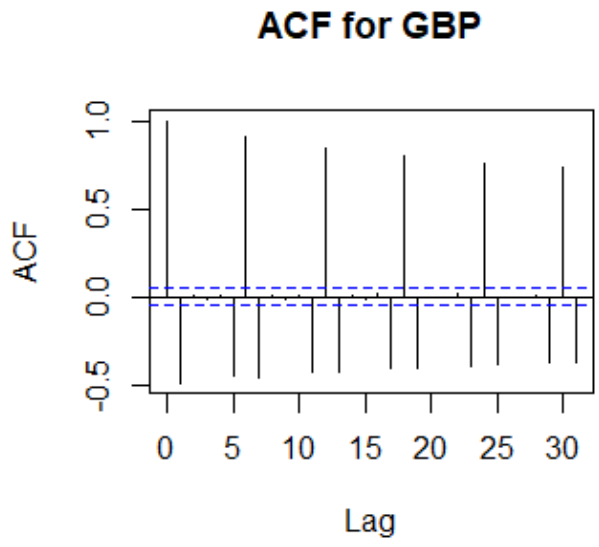
Results:

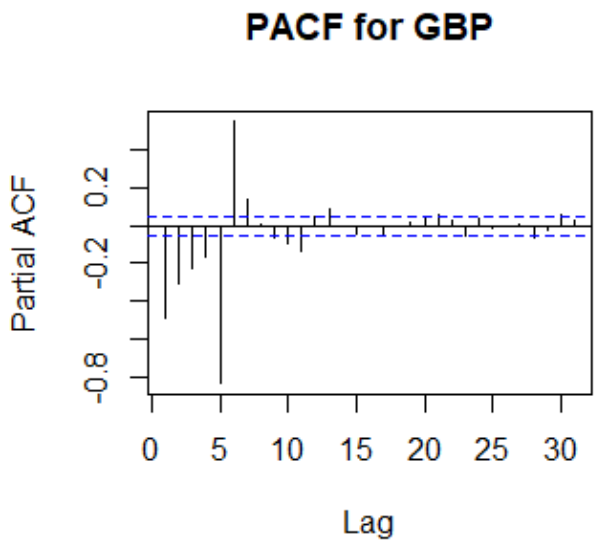
- JPY, GBP, and INR: Significant autocorrelation at early lags suggests strong past dependence.
- EUR and SGD: Significant autocorrelation indicates past values influence future values.
- CNY: Significant autocorrelation suggests past values impact future exchange rates.
- S&P 100, SGX NIKKEI 225, and Shanghai Composite: Significant autocorrelation at early lags indicates past values influence future values.

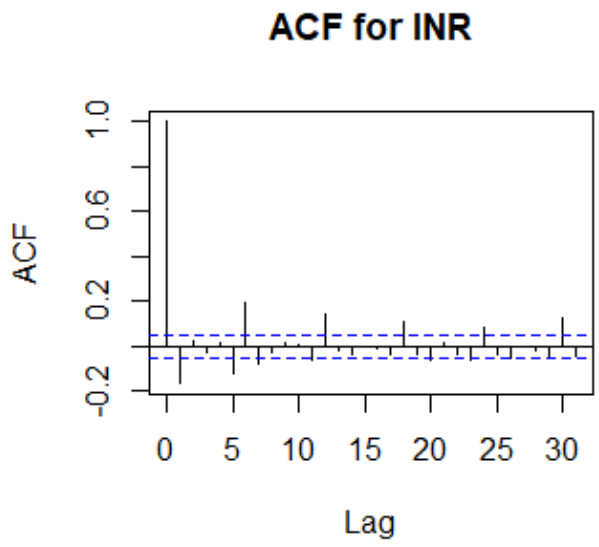
ACF & PACF Plots for JPY, GBP & INR

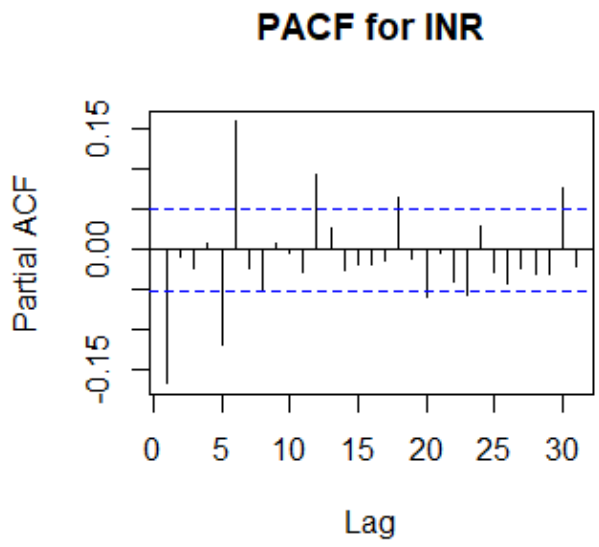




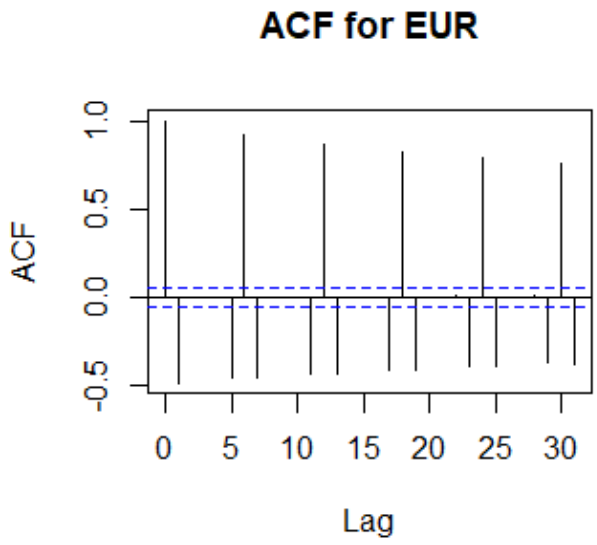


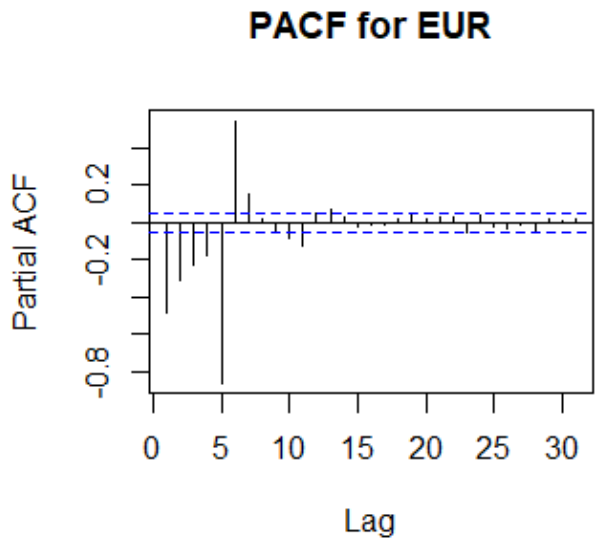


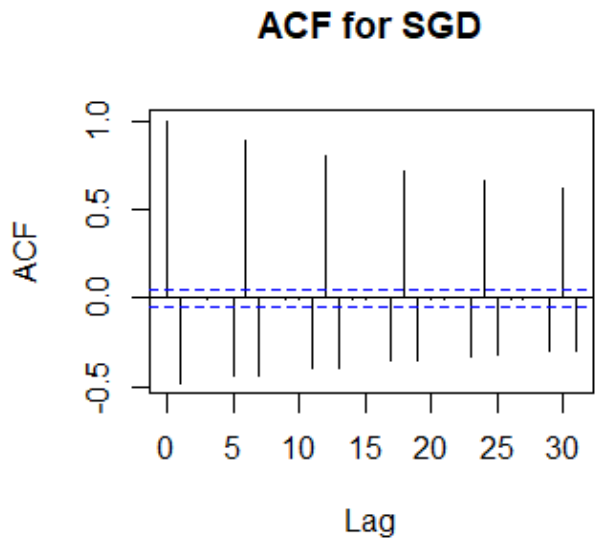


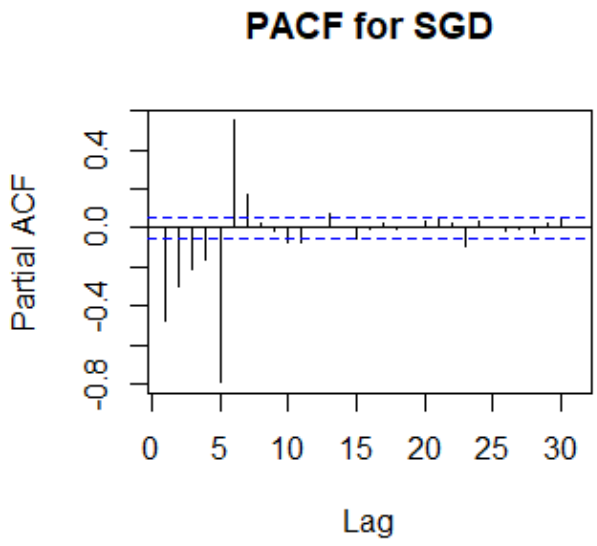


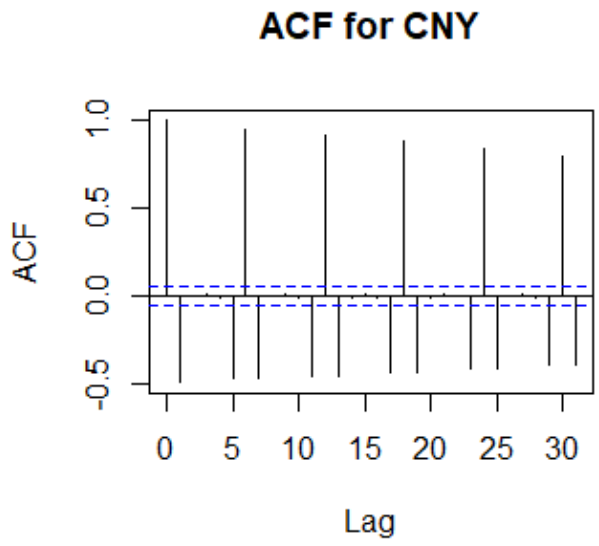
ACF & PACF Plots for EUR,SGD & CNY

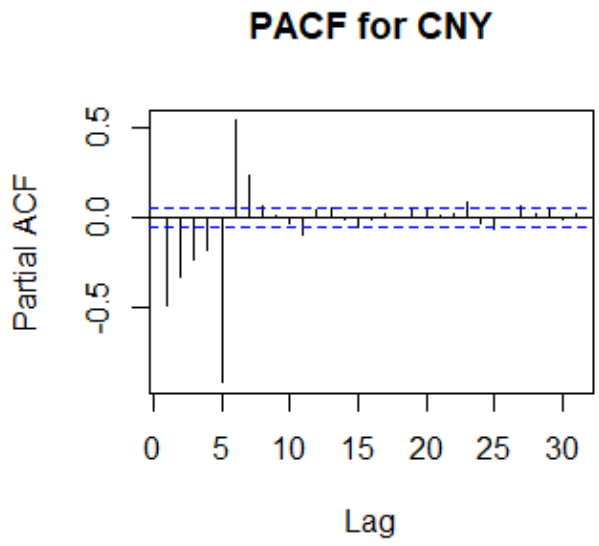




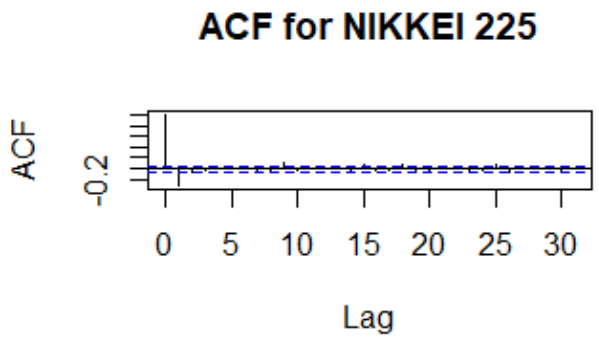


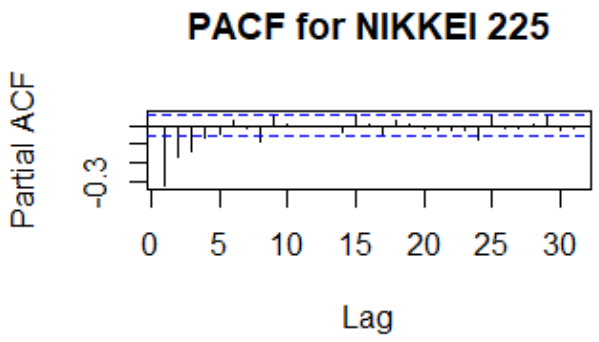


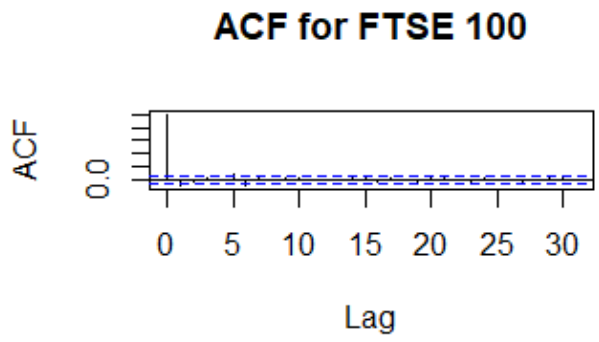


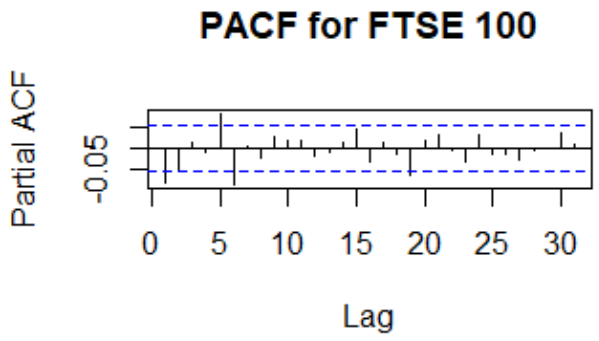


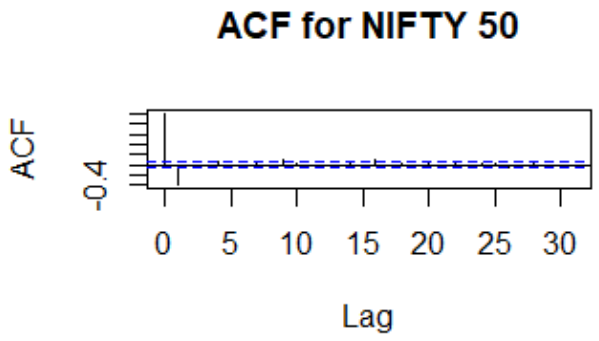
ACF & PACF Plots for NIKKEI 225,FTSE 100,NIFTY50 ,DAX & S&P 100

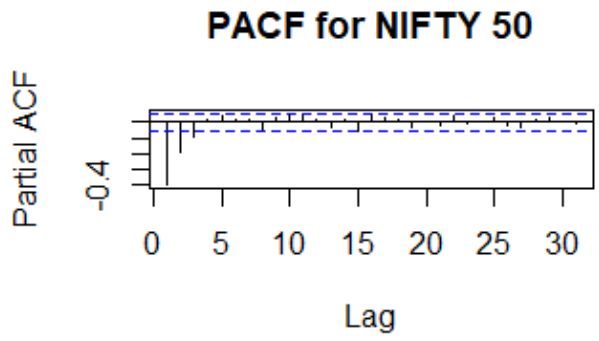


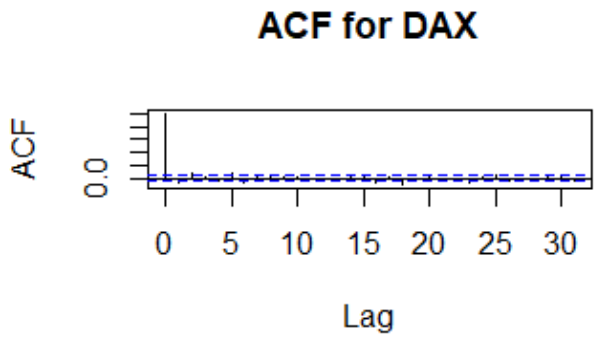


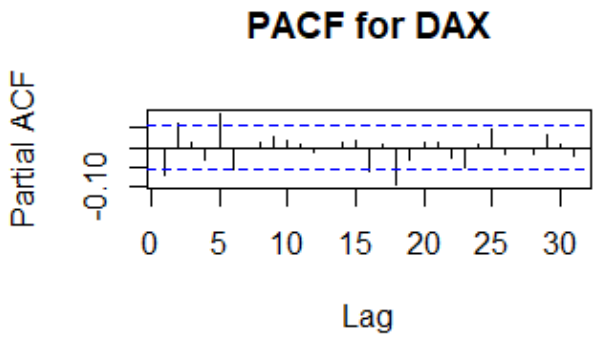


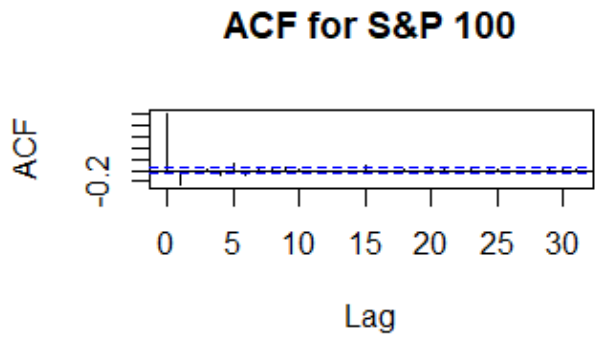




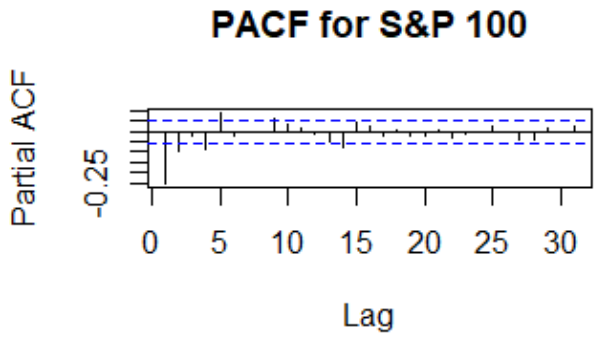


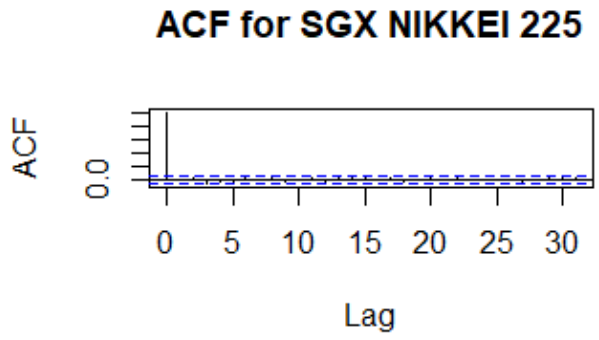


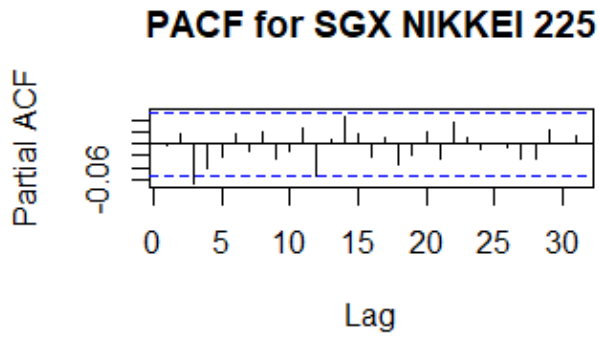


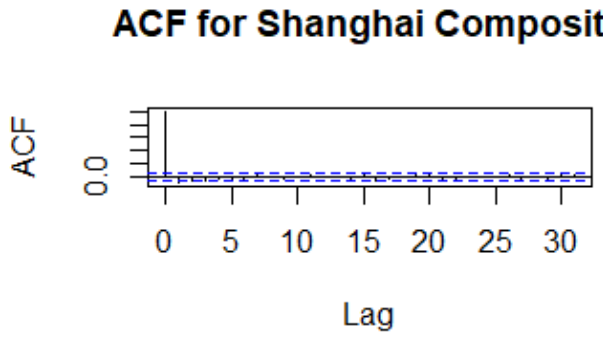


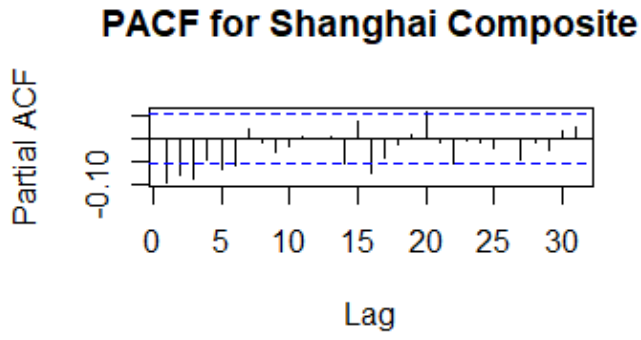
ACF & PACF Plots for S&P 100,SGX NIKKEI 225 & Shanghai Composite











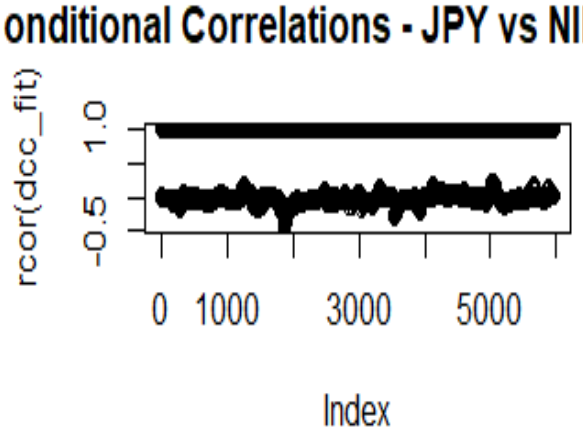
Dynamic Conditional Correlation (DCC) GARCH Model:

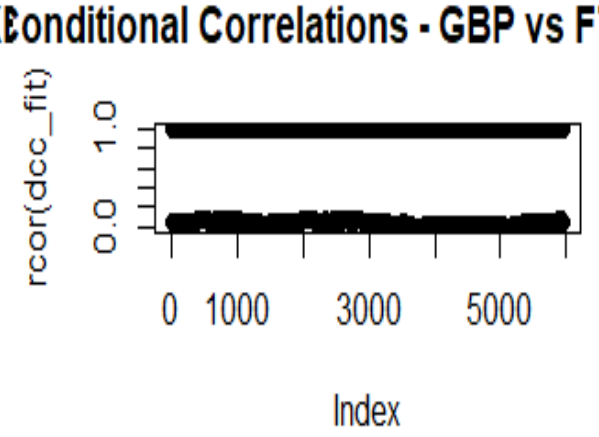
Objective: To model time-varying volatility and capture dynamic correlations between data.

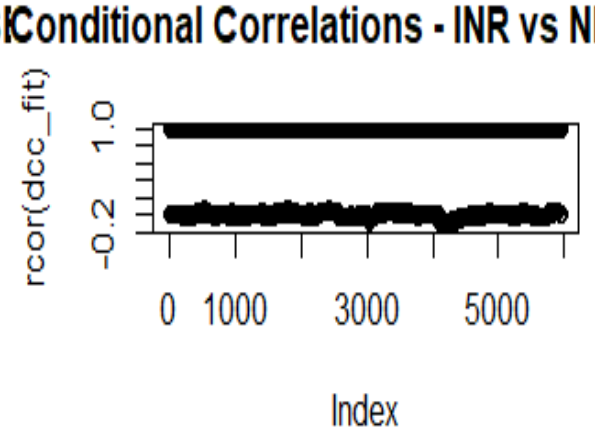
Results:

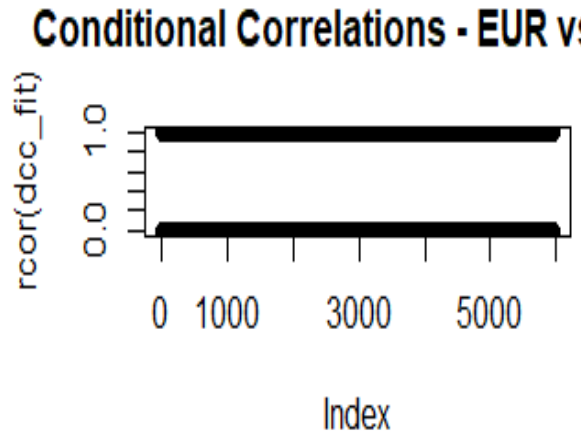
- Effectively captures the time-varying correlations
- Significant α and β, highly correlated
- Strong autoregressive and moving average components in volatility
- Investment Implications and Policy Insights

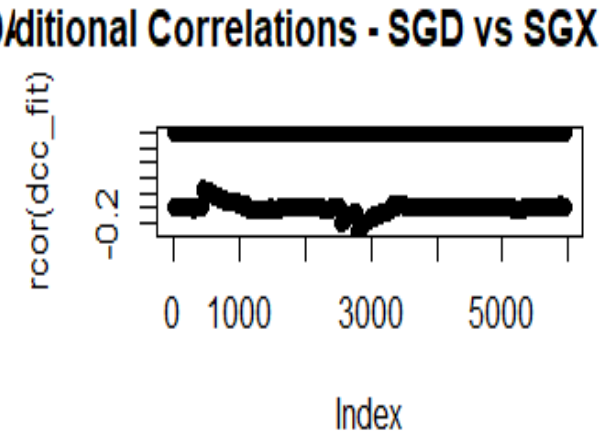
Conditional Correlations Graph

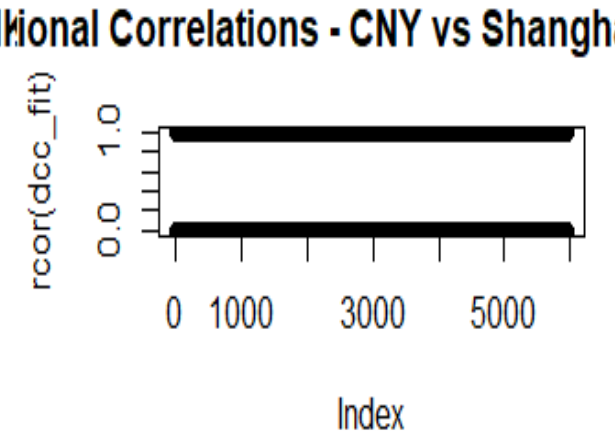












Correlation - Summary Table

Pair	Avg Volatality (Exchange)	Avg Volatility (Stock)	Avg Correlation
JPY vs NIKKEI 225	0.0259	0.0220	-0.0255
GBP vs FTSE 100	0.0192	0.0109	0.0358
INR vs NIFTY 50	0.0027	0.0196	-0.0019
EUR vs DAX	0.0178	0.0125	-0.0055
SGD vs SGX NIKKEI 225	0.0092	0.0071	0.0025
CNY vs Shanghai Composite	0.0130	0.0151	-0.0055

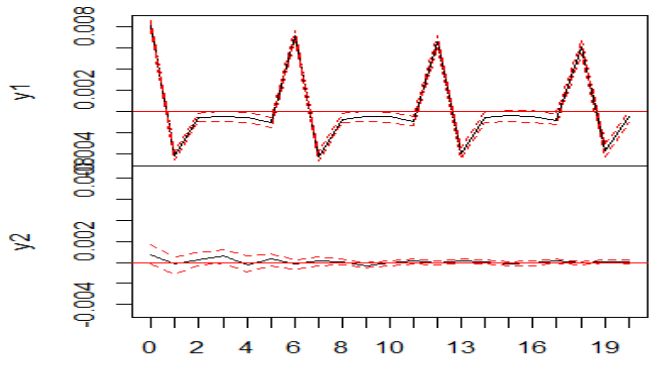
Vector Autoregressive (VAR) MODEL

Objective: Capturing simultaneous modelling of both exchange rates and stock market returns to show mutual influences without assuming causality.

Results:

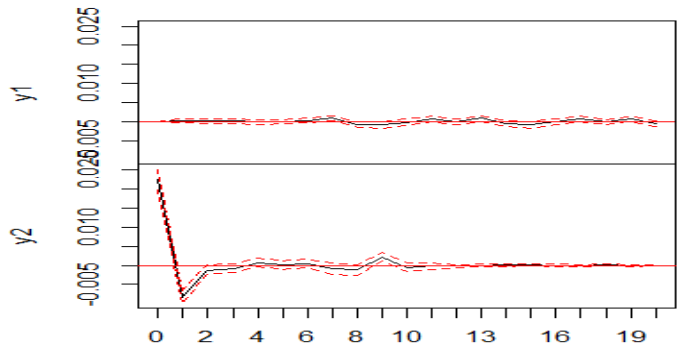
- Shows High likelihood value.
- Low correlation
- High R^2 for India & Japan
- The currencies are strongly influenced by its past values but not the stock market indices.
- Overall dependence differs for each country.

IRF of Exchange Rate on Stock Index for EUR vs DAX



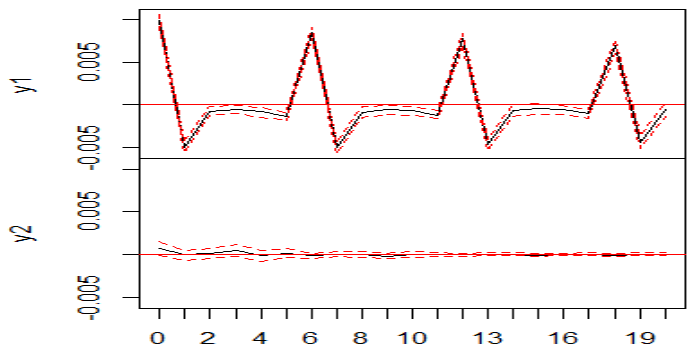
95 % Bootstrap CI, 100 runs

IRF of Exchange Rate on Stock Index for JPY vs NIKKEI 225

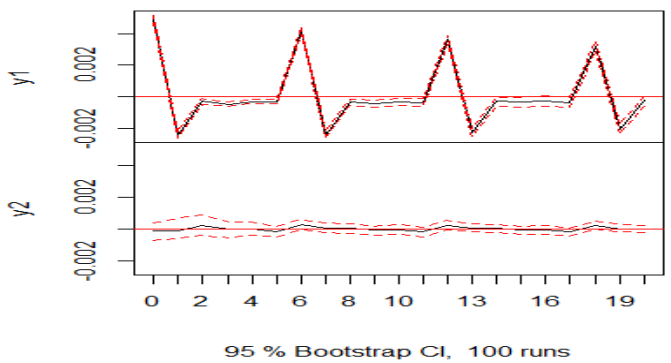


95 % Bootstrap CI, 100 runs

IRF of Exchange Rate on Stock Index for GBP vs FTSE 10(

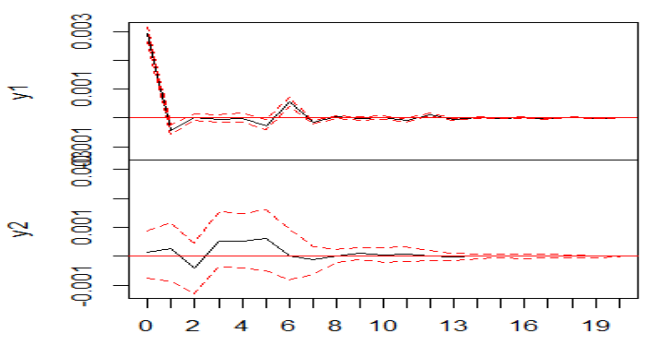


IRF of Exchange Rate on Stock Index for SGD vs SGX NIKKEI 225



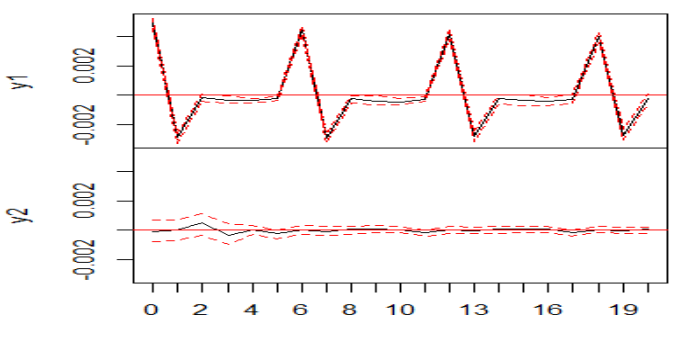
95 % Bootstrap CI, 100 runs

IRF of Exchange Rate on Stock Index for INR vs NIFTY 50



95 % Bootstrap CI, 100 runs

IRF of Exchange Rate on Stock Index for CNY vs Shanghai Composite



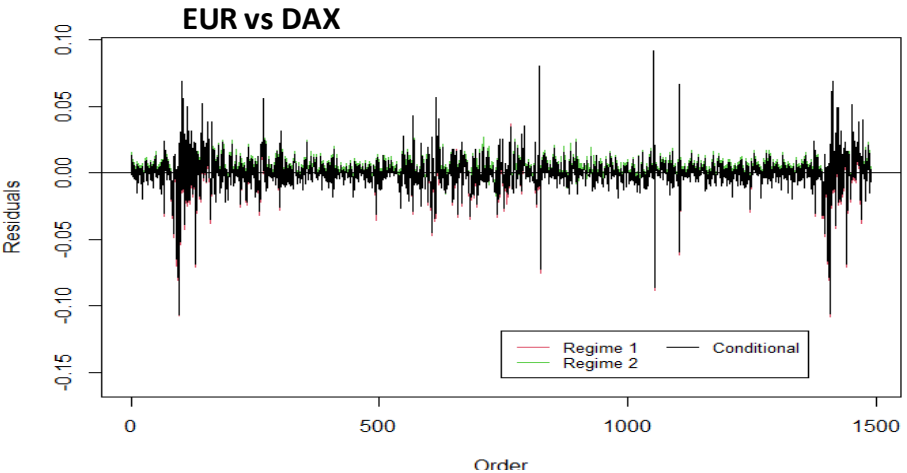
95 % Bootstrap CI, 100 runs

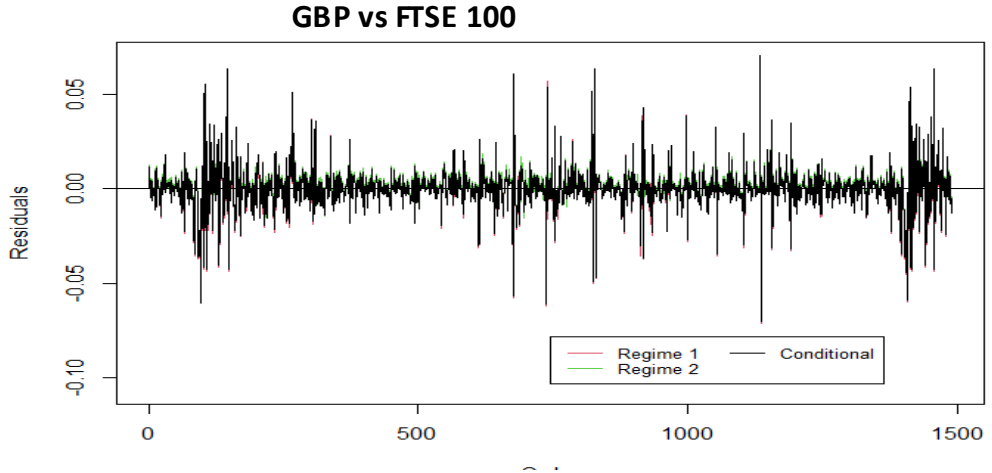
Markov Switching Model

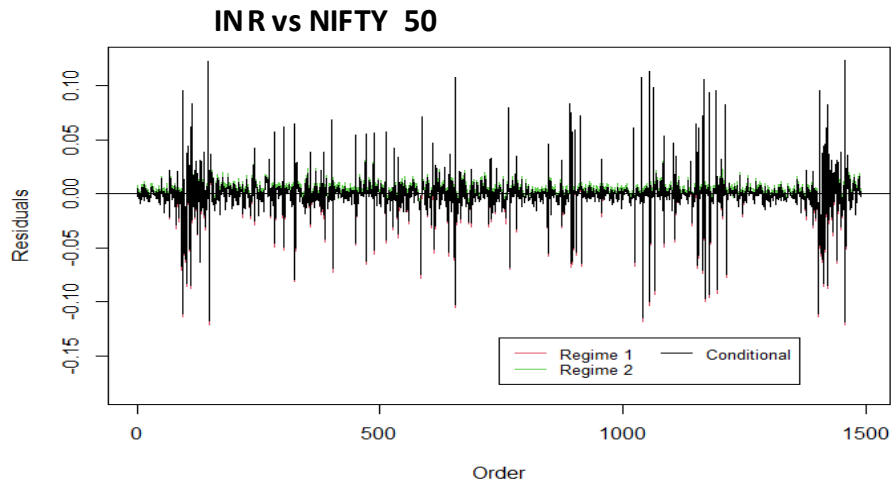
Objective: Analysing how stock markets and exchange rates behave under different market conditions, such as high or low volatility regimes.

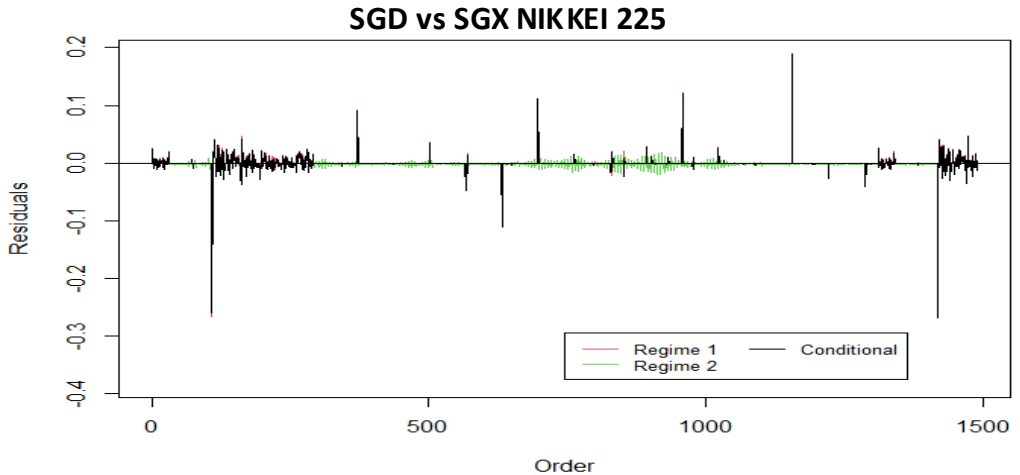
Results:

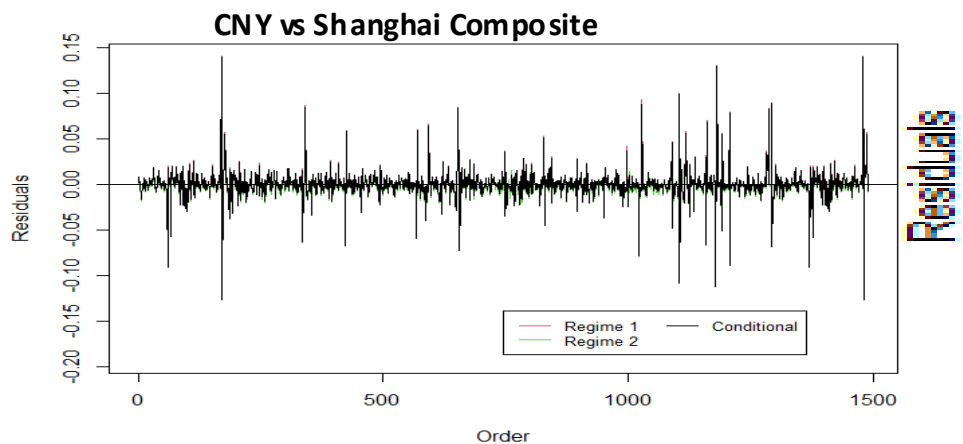
- Coefficients are generally weak, and often not statistically significant.
- High transition probabilities.
- High correlation or zero variance.
- Lack of variability and stability.
- Modelling challenges.

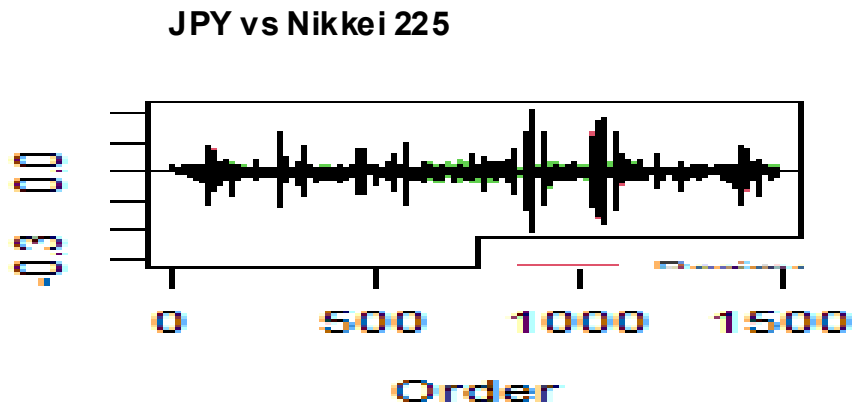

EUR vs DAX
Residuals
Order
Regime 1
Regime 2
Conditional


GBP vs FTSE 100
Residuals
Regime 1
Regime 2
Conditional


INR vs NIFTY 50
Residuals
Order
Regime 1
Regime 2
Conditional


SGD vs SGX NIKKEI 225
Residuals
Order
Regime 1
Regime 2
Conditional


CNY vs Shanghai Composite
Residuals
Order
Regime 1
Regime 2
Conditional


JPY vs Nikkei 225
Order

Findings/Summary:

- **Currency-Market Linkages**: INR-NIFTY 50 and SGD-SGX
- Some pairs (e.g., CNY-Shanghai Composite) exhibit weak interdependence.
- Effects of shocks are generally temporary and stabilize over time.
- Regional events and conditions drive time varying correlations.
- Most currency-stock pairs exhibit regime shifts, while some, like Pound/FTSE 100 or EUR-DAX, show greater stability.

Key Takeaways & Future Research

Key Takeaways:

- Empirical Evidence is Mixed.
- Direction of Causality and Volatility.
- Modelling Challenges
- Emerging Markets vs. Developed Markets

Future Research:

- Incorporating additional economic variables like Interest rates, etc.
- Exploring nonlinear models or alternative regime-switching models for robustness.
- Long-Term Structural Changes, Behavioural Finance factors.

References

- Cenedese, G. *et al.* (2015) 'What do stock markets tell us about exchange rates? ', *Review of Finance*, 20(3), pp. 1045–1080. doi:10.1093/rof/rfv032.

- Chkili, W. and Nguyen, D.K. (2014) 'Exchange rate movements and stock market returns in a regime-switching environment: Evidence for BRICS countries', *Research in International Business and Finance*, 31, pp. 46–56. doi:10.1016/j.ribaf.2013.11.007.

- Huang, Q., Wang, X. and Zhang, S. (2021) 'The effects of exchange rate fluctuations on the stock market and the affecting mechanisms: Evidence from BRICS countries', *The North American Journal of Economics and Finance*, 56, p. 101340. doi:10.1016/j.najef.2020.101340.

- KHAN, K. *et al.* (2020) 'The impact of covid-19 pandemic on stock markets: An empirical analysis of world major stock indices', *The Journal of Asian Finance, Economics and Business*, 7(7), pp. 463–474. doi:10.13106/jafeb.2020.vol7.no7.463.

- Sosa, M. (2018) 'Dynamic linkages between stock market and exchange rate in MILA countries: A Markov regime switching approach (2003-2016)', *Análisis Económico*, 33(83), pp. 57–74. doi:10.24275/uam/azc/dcsh/ae/2018v33n83/sosa.

THANK YOU!