Evaluating The Asymmetric Effects of Global Geopolitical Risk and Exchange Rate Fluctuations on The NSE NIFTY 50 INDEX: A Time-series Analysis

[1]Ms. Shinjini Basu, [2]Dr. Pallab Pyne
[1]Special Lecturer, [2]Assistant Professor
[12]Department of Commerce
[12]Harimohan Ghose College, Kolkata, India

***Abstract*—In an era of global financial integration, emerging economies are increasingly exposed to external geopolitical uncertainties and currency fluctuations. The abrupt shifts in global geopolitical environments and exchange rate movements frequently alter domestic capital market mechanisms, inducing unexpected fluctuations in equity return dynamics. The present study examines the asymmetric impacts of global geopolitical uncertainties and USD/INR fluctuations on the Indian equity market, specifically on the benchmark NSE Nifty50Index. Utilising a daily dataset of 2452 observations spanning June6, 2016 to June8, 2026, the paper applied an ML-EGARCH modelling framework under a Generalised Error Distribution (GED) specification by employing the EViews12 software to statistically evaluate how external geopolitical risks and USD/INR exchange rate returns affect domestic equity returns. The models yielded an acceptable model fit for the daily time-series data, with an Adjusted R-squared of 8.00% for aggregate GPR model and 7.96% for disaggregated GPR model. Findings demonstrated that R_USD_INR exhibited strong statistically significant negative relationship (coefficient -0.637307, p-value0.0000 for aggregate GPR model; coefficient -0.635072, p-value0.0000 for disaggregated GPR model; both significant at 1% level) with R_NIFTY. From aggregate GPR regression model, GPR_TOTAL demonstrated significant negative but negligible relationship with R_NIFTY (coefficient -0.000621, p-value0.0097; significant at 1% level). From disaggregated GPR regression model, GPR_THREATS demonstrated weak, negative, marginally significant relationship with R_NIFTY (coefficient -0.000358, p-value0.0791, significant at 10% level) and GPR_ACTIONS demonstrated insignificant relationship with R_NIFTY (coefficient -0.000275, p-value0.1834). Furthermore, the variance equation estimations for both models confirmed highly significant ARCH and GARCH parameters alongwith a negative, statistically significant asymmetry coefficient (p-value0.0000), confirming the presence of significant leverage effects, where negative shocks trigger greater volatility than positive shocks. Consequently, these empirical insights highlight the vulnerabilities inherent in the Indian equity market, necessitating the implementation of advanced derivative-based hedging frameworks.**

***Index Terms*—Nifty 50, NSE, Geopolitical Risk, Exchange Rate, USD/INR, EGARCH modelling, Generalised Error Distribution (GED), Asymmetric volatility**

I. Introduction

In today's integrated global financial ecosystem, the emerging economies are highly sensitive to the external uncertainties that extends to the capital markets and trade flows. A major factor among the uncertainties is the rising Global Geopolitical Risk (GPR) - a complex mix of systemic threats, active localised conflicts, and coordinated international actions that induce rapid cross-border financial instability. Simultaneously, exchange rate fluctuations and foreign exchange volatilities play a crucial role in the domestic equity and capital market movements. Given India's leading position as one of the world's top destinations for foreign capital and Foreign Direct Investments (according to the report of India Brand Equity Foundation, 2026), the Indian equity market often gets affected by the global macroeconomic uncertainties and exchange rate fluctuations that heavily alter the domestic equity prices. Although conventional asset pricing models generally assume a linear, symmetric distribution of macroeconomic risks; the real-world financial markets exhibit complex non-linear interdependencies. Systemic disruptions arising from geopolitical tensions or sudden exchange rate depreciation give rise to asymmetric volatilities in domestic capital markets and equity returns. Consequently, it becomes imperative to analyse the asymmetric sensitivity of Indian equity returns to the global geopolitical turbulence and currency fluctuations, providing crucial insights for risk management and financial stability.

II. Literature Review

This paper focuses on the empirical evaluation of the impacts of global geopolitical uncertainties and exchange rate shocks to examine the asymmetric effects on NSE Nifty Index.
Therefore, the studies relevant to our research objectives were selected and studied in detail which have been listed below for the Systematic Literature Review:

Sl. No.	Year	Author(s)	Focus of the Paper	Findings
1	2025	SenGupta, S., & Debnath, M.	The paper investigated the dynamic short-run and long-run impacts of global country-specific geopolitical risk shocks on 28 broad and sectoral indices from the National Stock Exchange of India between July 1990 and February 2025.	Results showed that global GPR shocks induced significant negative responses in most broad and resource-oriented indices, while Microcap 250, Auto, Tourism, Capital Markets and Defence experienced positive long-run gains. GPRT shocks boosted Manufacturing and Media but Commodities, Metal and MNC were unchanged, GPRA decreased

				FMCG and erased Media's late-stage uplift. India-specific shocks were mostly anticipated and statistically insignificant.
2	2026	Pradeep, S.	The study investigated how geopolitical risks affect stock market volatility in India and other E7 economies (Brazil, Russia, China, South Africa, Mexico, and Turkey). The study also focused on the IT, Auto, Energy, FMCG and Pharma sectoral indices for India. Time period spanned from January 2015 to December 2025 covering major geopolitical events.	The paper used GARCH-family models (EGARCH and TGARCH) to capture volatility clustering and asymmetric effects. Findings showed that geopolitical risks significantly increased volatility; India displayed strong sectoral heterogeneity; Auto and Pharma returns are severely hit by realised GPR Acts. FMCG is more vulnerable to prolonged GPR threats, IT sector volatility dropped during high GPR, Energy sector responded to oil and exchange rate volatility.
3	2026	Kumar, A.	The research work was conducted to test the impact of macroeconomic variables on the Indian stock market from April 2009 to March 2023. Crude oil	The findings indicated moderate efficiency in the Indian stock market, highlighted by the consistent GDP-Nifty50 relationship. Findings showed

			prices, exchange rates, gold prices, foreign exchange reserves, inflation rates, trade balances, GDP, and Nifty50 stock prices. Multiple regression, Augmented Dickey-Fuller test, and Granger causality tests using Eviews software were considered.	that only forex reserves have a statistically significant correlation with Nifty 50 prices, while others showed insignificant results. NSE Nifty 50 Granger caused GDP but GDP did not Granger cause Nifty 50; Forex reserves Granger caused GDP.

4	2024	Meher, B. K., Kumar, S., Anand, A., Popescu, v., Birau, R., & Gil, M. T.	To analyse the long-term and short-term impacts of global, historical, and country-sepcific Geopolitical Risk indices, along with the Indian News-based Policy Uncertainty Index, on major Indian stock market indices (Nifty 50 and Sensex) using monthly data from 01/2003-09/2023. The study applied ARDL Model and Johansen co-integration process, to ascertain the existence of a long-term relationship among the variables	Findings indicated that both ARDL tests and Johansen cointegration process confirmed a definitive long-run relationship among the variables. GPRH, GPRH THREATS and country-specific GPR Index for India showed negative impact on Indian stock returns. In contrast, the Policy Uncertainty Index did not yield statistically significant long-run results in the regression model. The adverse effect of GPR varied based on stock characteristics, which is mitigated across the economic cycle, and gradually diminished toward the bottom end of the stock return distribution.
5	2023	Kannan, K., & Sangeetha, K.	To examine the relationship between macroeconomic variables (inflation rates, CPI rates, gold and silver price changes, exchange rates, crude oil prices, industrial	Findings showed that inflation, CPI, gold and silver price changes failed to display any statistically significant direct impact on the returns of the

			production index, money supply and trade balance) and the returns of the Nifty 50 index using quantitative methods and stationarity analysis (ADF tests) for the period 2018-2022.	aggregate Nifty 50 index. The results had implications for portfolio management, risk assessment, and investment strategies in the Indian stock market.
6	2025	Goel, H., Bajaj, P., Gupta, S., AlKhawaja, A., & Dsouza, S.	The paper investigated the short-run and long-run asymmetric impacts of gold prices, crude oil prices, and the USD/INR exchange rate on India's Nifty 50 index during the Russia-Ukraine war from February2022 to October2024 using a Nonlinear Autoregressive Distributed Lag (NARDL) model.	Only negative gold price shocks significantly impacted the Nifty 50 index, while positive shocks appear inert. In contrast, the short-run results highlight that both USD/INR appreciations and depreciations negatively impacted the index. The results also showed that short-run decline in gold prices are associated with positive response in equity markets, reflecting hedging behaviour in investors. Crude oil fluctuations did not show any significant statistical impact in both short-run and long-run. Diagnostic checks confirmed stable long-run co-integrating

				relationship among the studied variables. These findings offered insights for investors and policymakers for developing risk mitigation strategies.

III. Research Gap

Despite the existing extensive literature volume addressing the interdependencies between the global macroeconomic variables and Indian stock market returns, significant gaps were found that the present study intends to address:

1. There exists a critical shortage of empirical evidence exploring how the differential impacts of the aggregate Geopolitical Risk Index in comparison to the sub-indices, i.e., the Geopolitical Risk Threats Index and the Geopolitical Risk Actions Index on the Nifty 50 Index returns. This gap has been studied in detail in our present study to examine the asymmetric effects of the aggregate and sub-indices measuring the Global Geopolitical Risk.
2. The existing literature revealed the lack of a unified model to empirically analyse the individual impacts of the USD/INR exchange rate fluctuations and Geopolitical Risk sub-indices on the Nifty 50 Index. Thus, the present study becomes relevant to study these independent variables separately to examine the long-run relationships among the variables.
3. While existing literatures studied the interdependent relationships among stock market returns, exchange rates and global GPR indices ((*Kannan & Sangeetha*, 2022; *Kumar*, 2023; *Goel et al.,* 2024), a significant limitation was identified in capturing the whole impact of the global geopolitical and macroeconomic uncertainties on the Indian stock market returns. The present study bridges the research gap by selecting the data period from June 2016 to June 2026 to analyse these relationships during the highly volatile periods covering the 2016 global policy shifts, the 2020 pandemic abnormalities, the 2022 Russia-Ukraine war impacts and the consecutive 2024-2026 supply chain crises.

IV. Research Objectives

To address the identified Research Gaps in our study, the research paper aims to empirically examine the interdependencies between the global geopolitical uncertainties, exchange rate fluctuations and NSE Nifty 50 Index during the highly volatile time period. To achieve this objective, following specific objectives are given:

1. To examine the effects of USD/INR exchange rate fluctuations on Nifty 50 Index returns.
2. To examine the impact of the aggregate Geopolitical Risk Index on Nifty 50 Index returns.

3. To investigate how the disaggregated Geopolitical Risk Indices, i.e., Geopolitical Risk Threats and Geopolitical Risk Actions Indices display asymmetric effects on Nifty 50 Index returns.
4. To evaluate the combined impact of USD/INR exchange rate fluctuations and Geopolitical Risk (aggregate GPR Index and disaggregated GPR Indices, i.e., GPR Threats and GPR Actions Indices) on Nifty 50 Index returns.

V. Research Hypothesis

To study the above Research Objectives, following Research Hypotheses are formulated:

For Research Objective 1:
H01: USD/INR exchange rate returns have no significant impact on Nifty 50 index returns.
H11: USD/INR exchange rate returns have a significant impact on Nifty 50 index returns.

For Research Objective 2:
H02: Aggregate GPR Index has no significant impact on Nifty 50 index returns.
H12: Aggregate GPR Index has a significant impact on Nifty 50 index returns.

For Research Objective 3:
H03: GPR Threats Index and GPR Actions Index have no significant impact on Nifty 50 index returns.
H13: GPR Threats Index and GPR Actions Index have significant impact on Nifty 50 index returns.

For Research Objective 4 (Aggregate GPR Index):
H04: The combined impact of USD/INR exchange rate returns and aggregate GPR Index has no significant impact on Nifty 50 index returns.
H14: The combined impact of USD/INR exchange rate returns and aggregate GPR Index has a significant impact on Nifty 50 index returns.

For Research Objective 4 (Disaggregated GPR Indices):
H05: The combined impact of USD/INR exchange rate returns, GPR Threats Index and GPR Actions Index has no significant impact on Nifty 50 index returns.
H15: The combined impact of USD/INR exchange rate returns, GPR Threats Index and GPR Actions Index has a significant impact on Nifty 50 index returns.

VI. Research Methodology

1. Research Design:

This paper adopted an econometric research design to empirically evaluate the asymmetric impacts of global geopolitical uncertainties and exchange rate volatility on NSE Nifty 50 Index returns. The research paper utilised a secondary data consisting high-frequency daily closing prices and index values retrieved from reputable financial databases, to empirically examine the impact using an Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) econometric model to perform the regression analysis by employing the EViews12 software.

2. Variable and Data Specification:

The research study utilised a dataset of daily time-series observations to ensure empirical robustness. The daily historical data series of 2452 observations over approx. ten-year period i.e., from 6th June 2016 to 8th

June 2026, was collected, covering significant macroeconomic and geopolitical disruptions. The research study is based on secondary data collected from verified national and international institutional databases. The dependent variable representing the daily historical closing prices of the NSE Nifty 50 Index were retrieved directly from the official historical database of the National Stock Exchange (NSE) of India. Daily return series (Rt) were subsequently calculated using the log-difference method [Rt = ln(Pt/Pt-1), where Pt denotes closing index value on day t].

The independent geopolitical uncertainty variables, i.e., the aggregate Geopolitical Risk Index, along with the disaggregated sub-indices, the Geopolitical Risk Threats Index and the Geopolitical Risk Acts Index, consisting daily observations were obtained from the official repository of Matteo Iacoviello (Caldara and Iacoviello (2026)). The independent foreign exchange rate variable, i.e., the USD/INR currency rate daily historical closing prices were obtained from the Database on Indian Economy (DBIE) framework (Reserve Bank of India, 2026). To maintain consistency across variables, the raw daily historical closing USD/INR exchange rates were converted into log returns using the log-difference method [ERt = ln(Pt/Pt-1), where Pt denotes the closing spot exchange rate on day t].

3. Data Validation and Stationarity Analysis

To verify the statistical properties of the time-series data and mitigate any risks of spurious regression results, the Augmented Dickey-Fuller (ADF) unit root test was implemented. The dependent and independent variables were tested under assumption of an exogenous constant and linear trend with optimal lag lengths determined automatically by the Schwarz Information Criterion. The empirical findings are given below:

Null Hypothesis: R_NIFTY has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-52.05222	0.0000
Test critical values:	1% level	-3.961789	
	5% level	-3.411641	
	10% level	-3.127694	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(R_NIFTY)
Method: Least Squares
Sample (adjusted): 6/08/2016 6/08/2026
Included observations: 2451 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R_NIFTY(-1)	-1.050808	0.020188	-52.05222	0.0000
C	0.062397	0.041672	1.497324	0.1344
@TREND("6/06/2016")	-1.49E-05	2.94E-05	-0.505972	0.6129

R-squared	0.525345	Mean dependent var	-0.000752
Adjusted R-squared	0.524958	S.D. dependent var	1.494660
S.E. of regression	1.030169	Akaike info criterion	2.898547
Sum squared resid	2597.937	Schwarz criterion	2.905651
Log likelihood	-3549.169	Hannan-Quinn criter.	2.901128
F-statistic	1354.717	Durbin-Watson stat	1.996697
Prob(F-statistic)	0.000000		

Null Hypothesis: R_USD_INR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-50.41925	0.0000
Test critical values:	1% level	-3.961789	
	5% level	-3.411641	
	10% level	-3.127694	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(R_USD_INR)
Method: Least Squares
Sample (adjusted): 6/08/2016 6/08/2026
Included observations: 2451 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R_USD_INR(-1)	-1.019995	0.020230	-50.41925	0.0000
C	0.001937	0.012805	0.151244	0.8798
@TREND("6/06/2016")	1.07E-05	9.04E-06	1.181634	0.2375

R-squared	0.509429	Mean dependent var	0.000407
Adjusted R-squared	0.509028	S.D. dependent var	0.451950
S.E. of regression	0.316679	Akaike info criterion	0.539365
Sum squared resid	245.4986	Schwarz criterion	0.546469
Log likelihood	-657.9915	Hannan-Quinn criter.	0.541947
F-statistic	1271.052	Durbin-Watson stat	1.998809
Prob(F-statistic)	0.000000		

Null Hypothesis: GPR_TOTAL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.651297	0.0000
Test critical values:	1% level	-3.961793	
	5% level	-3.411644	
	10% level	-3.127695	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GPR_TOTAL)
Method: Least Squares
Sample (adjusted): 6/13/2016 6/08/2026
Included observations: 2448 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GPR_TOTAL(-1)	-0.174550	0.018086	-9.651297	0.0000
D(GPR_TOTAL(-1))	-0.448629	0.023904	-18.76815	0.0000
D(GPR_TOTAL(-2))	-0.278025	0.024553	-11.32329	0.0000
D(GPR_TOTAL(-3))	-0.181366	0.023465	-7.729184	0.0000
D(GPR_TOTAL(-4))	-0.116868	0.020128	-5.806248	0.0000
C	15.59558	2.323455	6.712237	0.0000
@TREND("6/06/2016")	0.005605	0.001320	4.244867	0.0000

R-squared	0.287707	Mean dependent var	0.055593
Adjusted R-squared	0.285956	S.D. dependent var	49.07349
S.E. of regression	41.46764	Akaike info criterion	10.29056
Sum squared resid	4197459.	Schwarz criterion	10.30715
Log likelihood	-12588.64	Hannan-Quinn criter.	10.29659
F-statistic	164.3268	Durbin-Watson stat	2.001162
Prob(F-statistic)	0.000000		

Null Hypothesis: GPR_THREATS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.57914	0.0000
Test critical values:	1% level	-3.961793	
	5% level	-3.411644	
	10% level	-3.127695	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GPR_THREATS)
Method: Least Squares
Sample (adjusted): 6/13/2016 6/08/2026
Included observations: 2448 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GPR_THREATS(-1)	-0.206895	0.019557	-10.57914	0.0000
D(GPR_THREATS(-1))	-0.425865	0.024551	-17.34613	0.0000
D(GPR_THREATS(-2))	-0.258056	0.024919	-10.35571	0.0000
D(GPR_THREATS(-3))	-0.167672	0.023669	-7.084078	0.0000
D(GPR_THREATS(-4))	-0.095075	0.020180	-4.711247	0.0000
C	22.00182	3.117858	7.056708	0.0000
@TREND("6/06/2016")	0.007116	0.001782	3.992339	0.0001

R-squared	0.292466	Mean dependent var	0.047980
Adjusted R-squared	0.290727	S.D. dependent var	68.46589
S.E. of regression	57.66083	Akaike info criterion	10.94989
Sum squared resid	8115768.	Schwarz criterion	10.96648
Log likelihood	-13395.66	Hannan-Quinn criter.	10.95592
F-statistic	168.1688	Durbin-Watson stat	2.004599
Prob(F-statistic)	0.000000		

Null Hypothesis: GPR_ACTIONS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.237035	0.0000
Test critical values:	1% level	-3.961793	
	5% level	-3.411644	
	10% level	-3.127695	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GPR_ACTIONS)
Method: Least Squares
Sample (adjusted): 6/13/2016 6/08/2026
Included observations: 2448 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GPR_ACTIONS(-1)	-0.168115	0.018200	-9.237035	0.0000
D(GPR_ACTIONS(-1))	-0.489706	0.024077	-20.33953	0.0000
D(GPR_ACTIONS(-2))	-0.304663	0.024782	-12.29366	0.0000
D(GPR_ACTIONS(-3))	-0.229111	0.023662	-9.682690	0.0000
D(GPR_ACTIONS(-4))	-0.123304	0.020146	-6.120590	0.0000
C	9.846632	2.386278	4.126356	0.0000
@TREND("6/06/2016")	0.007091	0.001683	4.214374	0.0000

R-squared	0.309497	Mean dependent var	0.076112
Adjusted R-squared	0.307800	S.D. dependent var	63.25610
S.E. of regression	52.62816	Akaike info criterion	10.76724
Sum squared resid	6760894.	Schwarz criterion	10.78383
Log likelihood	-13172.10	Hannan-Quinn criter.	10.77327
F-statistic	182.3509	Durbin-Watson stat	2.010919
Prob(F-statistic)	0.000000		

Source: Unit Root Test Results of the Studied Variables from EViews12 software Compiled by Author

The above empirical findings reveal that the test statistics for all five studied variables, namely Nifty 50 Returns (R_NIFTY= -52.05222), USD/INR Exchange Rate Returns (R_USD_INR= -50.41925), Aggregate Geopolitical Risk (GPR_TOTAL= -9.651297), GPR Threats (GPR_THREATS= -10.57914), and GPR Actions (GPR_ACTIONS= -9.237035), yielded highly negative and statistically significant values. Since the corresponding p-values for all series are 0.0000, the null hypothesis of a unit root is rejected at 1% significance level. Consequently, all the study variables are integrated of order zero, established as I(0) variables, which satisfied the foundational requirements for applying regression analysis with the estimation of the Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) econometric model.

4. Model Selection and Theoretical Justification

To examine the asymmetric effects of global geopolitical risks and exchange rate volatilities on the NSE Nifty 50 index returns, the present study utilised an Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) framework, estimated by the Maximum Likelihood (ML) approach using the Marquardt optimisation algorithm, for the equity return regression models. The selection of the EGARCH specification with Maximum Likelihood estimation over the standard linear Ordinary Least Squares (OLS) regression model was based on critical econometric justifications:

a. By transforming the raw daily historical closing NSE Nifty 50 Index prices and the raw daily historical closing USD/INR exchange rates into their natural logarithms to compute daily returns, the estimated variables captured continuous changes which helped in interpreting their impacts on the equity returns by directly checking the percentage-to-percentage dynamics of the variable results.
b. The unit root test results of the variables displayed the robust evidence of stationarity in their level forms, which satisfied the foundational requirements for directly applying the EGARCH econometric regression model ensuring that conditional variance can be measured effectively without any risk of spurious regression results.
c. The high-frequency macroeconomic datasets often exhibit heteroskedasticity risks and volatility clustering. By utilising the EGARCH model, these clustering patterns are controlled and inherent asymmetric volatility responses, inherent in financial returns, are also captured effectively.

5. Empirical Equations Estimation

Based on the specified theoretical framework, separate structural equations are formulated for Nifty 50 index returns to identify the separate macroeconomic determinants. Notably, the regression models handled the global geopolitical risk components differently; while the first return model evaluated the aggregate macroeconomic impact using the GPR_TOTAL Index, the second model used the disaggregated sub-indices, i.e., the GPR_THREATS and the GPR_ACTIONS to capture the varying volatility dynamics.

a. Aggregate Geopolitical Risk Regression Model

$$R\_NIFTY_t = B0 + B1R\_USD\_INR_t + B2GPR\_TOTAL_t + u1,t$$

b. Disaggregated Geopolitical Risk Regression Model

$$R\_NIFTY_t = A0 + A1R\_USD\_INR_t + A2GPR\_THREATS_t + A3GPR\_ACTIONS_t + u2,t$$

Where, R_NIFTY_t represents the daily logarithmic returns of the NSE Nifty 50 Index at time t; B0 and A0 represent the intercept constant terms for Model A and Model B, respectively; B1 to B2 and A1 to A3 represent the estimated regression coefficients for Model A and Model B, respectively; $R\_USD\_INR_t$ represents the daily returns of the USD/INR exchange rate at time t; GPR_TOTAL_t represents the Aggregate Geopolitical Risk Index value at time t; $GPR\_THREATS_t$ represents the Geopolitical Risk Threats Index value at time t; $GPR\_ACTIONS_t$ represents the Geopolitical Risk Actions Index value at time t; and u1,t and u2,t represent the stochastic error terms at time t for Model A and Model B, respectively.

Empirical Results and Discussion

Table 1: Descriptive Statistics of all the Studied Variables for the Sample

Sample: 6/06/2016 6/08/2026

	R_NIFTY	R_USD_INR	GPR_TOTAL	GPR_THREATS	GPR_ACTIONS
Mean	0.042274	0.014674	128.1848	148.0444	109.6254
Median	0.067360	0.007182	117.1570	133.3901	93.68429
Maximum	8.400291	2.315629	540.1633	797.7524	627.3322
Minimum	-13.90375	-1.964840	9.491598	7.892561	7.844113
Std. Dev.	1.031031	0.316664	61.45390	79.42426	77.93495
Skewness	-1.391390	0.293465	1.794538	2.065130	1.945238
Kurtosis	25.05861	7.150142	9.039081	11.68005	9.468282
Jarque-Bera	50503.63	1794.881	5042.127	9440.433	5820.892
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	103.6566	35.98008	314309.1	363004.8	268801.6
Sum Sq. Dev.	2605.472	245.7767	9256401.	15461432	14887023
Observations	2452	2452	2452	2452	2452

Table 1 presents the Descriptive Statistics for the dependent variable (R_NIFTY), the four independent global geopolitical uncertainty and exchange rate volatility variables (R_USD_INR, GPR_TOTAL, GPR_THREATS, and GPR_ACTIONS) over the study period from 6th June 2016 to 8th June 2026, for a total of 2452 daily observations. The Mean daily return stands at 0.042274 for the R_NIFTY, highlighting the historical baseline return dynamics of the Indian equity market. For the independent variables, the mean return stands at 0.014674 (R_USD_INR), 128.1848 (GPR_TOTAL), 148.0444 (GPR_THREATS), and 109.6254 (GPR_ACTIONS) shows their historical baseline. This reveals that threat perceptions maintain a structurally higher average baseline compared to actual realised conflicts during the sample period. Notably, a very high volatility is seen in the GPR_THREATS index (standard deviation 79.42426 with maximum value 797.7524; minimum value 7.892561) and GPR_ACTIONS (standard deviation 77.93495), indicating severe sensitivity of global geopolitical uncertainties to sudden geopolitical shocks. In comparison, the dependent R_NIFTY return series demonstrated steady volatility (standard deviation 1.031031) representing long-term economic growth, while R_USD_INR returns provide a very small standard deviation (0.316664) which indicates a tightly managed exchange rate return series.

All the studied variables exhibited positive skewness values except for the dependent variable R_NIFTY (-1.391390), which shows a long left-tail typical of sudden stock market corrections. From the Kurtosis values, all the variables were highly leptokurtic, with values much above 3- ranging from 7.150142 (R_USD_INR) upto a striking 25.05861 (R_NIFTY) – confirming heavy tails and a significant presence of extreme outliers. Looking at the Jarque-Bera test for every variable in the dataset, the probability value is 0.000000 (<0.01) where the null hypothesis of normality is strongly rejected at the 1% significance level for all data series. Overall, the Descriptive Statistics showed non-normal, leptokurtic, and highly skewed nature

for the macroeconomic and geopolitical variables data series which justified the use of logarithmic transformations for return calculations and the integration of an asymmetric EGARCH volatility specification to stabilise variance and prevent outlier distortion during the regression model estimation.

Table 2: Comprehensive Pearson Correlation Matrix of all the studied variables

	R NIFTY	R USD INR	GPR TOTAL	GPR THREATS	GPR ACTIONS
R NIFTY	1.000000	-0.303051	-0.033064	-0.034457	-0.026263
R USD INR	-0.303051	1.000000	0.031995	0.040243	0.016463
GPR TOTAL	-0.033064	0.031995	1.000000	0.902915	0.787784
GPR THREATS	-0.034457	0.040243	0.902915	1.000000	0.486249
GPR ACTIONS	-0.026263	0.016463	0.787784	0.486249	1.000000

Table 2 presents the Comprehensive Pearson Correlation Matrix illustrating the correlation coefficient values among the dependent variable (R_NIFTY) and the studied independent variables (R_USD_INR, GPR_TOTAL, GPR_THREATS, and GPR_ACTIONS) providing an initial insight into the associations within the model and checking for potential multicollinearity problems. The table showed that R_NIFTY exhibited a clear negative relationship with R_USD_INR (-0.303051); which justified the economic theory that when the Indian Rupee depreciates against the US Dollar, domestic equity returns also decrease simultaneously. Interestingly, R_NIFTY showed mild negative correlation with the aggregate GPR_TOTAL (-0.033064), and with the disaggregated geopolitical risk indices, i.e., GPR_THREATS (-0.034457) and GPR_ACTIONS (-0.026263). This typically demonstrates that the global geopolitical risks, threat perceptions and realised conflicts create immediate negative effects on the Indian equity stock returns.
Looking at the relationship between the exchange returns and geopolitical risks, R_USD_INR showed a very negligible near-zero association with GPR_TOTAL (0.031995) , GPR_THREATS (0.040243), and GPR_ACTIONS (0.016463), indicating that daily exchange rate returns move almost independently from global geopolitical risks.

Regarding the relationship among the independent geopolitical risk variables, a very high positive correlation is observed between GPR_TOTAL and GPR_THREATS (0.902915) as well as between GPR_TOTAL and GPR_ACTIONS (0.787784). This reflects the strong co-movement across global risk dimensions, proving that periods of increased global geopolitical instability occur simultaneously with upward movements in both threats and realised conflicts. Since the correlation coefficients are higher than the conventional econometric threshold of 0.70, the values justified the use of separate, independent regression models, one with the aggregate GPR_TOTAL and another with the sub-indices GPR_THREATS and GPR_ACTIONS, to mitigate any severe multicollinearity risks. Though a moderate positive correlation between GPR_THREATS and GPR_ACTIONS (0.486249) is displayed, the coefficient remained well below 0.70 threshold. This indicated that while there is moderate correlation between the two variables due to their common geopolitical linkage, they still retain sufficient independent variance. Therefore, the models confirms that the structural specifications are free from any major multicollinearity issues ensuring sufficient reliability on the econometric regression results.

Table 3 and 4 showing the EGARCH Volatility Modelling (Maximum Likelihood under GED Specification) Regression Results for both the Models

Dependent Variable: R_NIFTY
Method: ML ARCH - Generalized error distribution (GED) (BFGS / Marquardt steps)
Sample (adjusted): 6/07/2016 6/08/2026
Included observations: 2452 after adjustments
Convergence achieved after 35 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.144880	0.033487	4.326487	0.0000
R_USD_INR	-0.637307	0.045897	-13.88569	0.0000
GPR_TOTAL	-0.000621	0.000240	-2.585803	0.0097
Variance Equation				
C(4)	-0.137565	0.018002	-7.641717	0.0000
C(5)	0.159428	0.021484	7.420710	0.0000
C(6)	-0.099278	0.013287	-7.471964	0.0000
C(7)	0.967992	0.006148	157.4423	0.0000
GED PARAMETER	1.456310	0.048634	29.94396	0.0000

R-squared	0.080762	Mean dependent var	0.042274
Adjusted R-squared	0.080011	S.D. dependent var	1.031031
S.E. of regression	0.988924	Akaike info criterion	2.396053
Sum squared resid	2395.049	Schwarz criterion	2.414991
Log likelihood	-2929.561	Hannan-Quinn criter.	2.402935
Durbin-Watson stat	2.138811		

Table 3: Aggregate Geopolitical Risk Regression

Dependent Variable: R_NIFTY
Method: ML ARCH - Generalized error distribution (GED) (BFGS / Marquardt steps)
Sample (adjusted): 6/07/2016 6/08/2026
Included observations: 2452 after adjustments
Convergence achieved after 38 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(5) + C(6)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(7)*RESID(-1)/@SQRT(GARCH(-1)) + C(8)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.148344	0.031542	4.703052	0.0000
R_USD_INR	-0.635072	0.045958	-13.81839	0.0000
GPR_THREATS	-0.000358	0.000204	-1.755847	0.0791
GPR_ACTIONS	-0.000275	0.000207	-1.330249	0.1834
Variance Equation				
C(5)	-0.137462	0.018100	-7.594552	0.0000
C(6)	0.159441	0.021631	7.370818	0.0000
C(7)	-0.098933	0.013281	-7.449262	0.0000
C(8)	0.968253	0.006136	157.7916	0.0000
GED PARAMETER	1.453968	0.048594	29.92054	0.0000

R-squared	0.080677	Mean dependent var	0.042274
Adjusted R-squared	0.079551	S.D. dependent var	1.031031
S.E. of regression	0.989171	Akaike info criterion	2.396238
Sum squared resid	2395.269	Schwarz criterion	2.417544
Log likelihood	-2928.788	Hannan-Quinn criter.	2.403981
Durbin-Watson stat	2.138874		

Table 4: Disaggregated Geopolitical Risk Regression

Table 3 and 4 display the empirical estimation results of the asymmetric EGARCH regression models, estimated using the Maximum Likelihood (ML) Approach under a Generalised Error Distribution (GED) specification with the BFGS optimisation algorithm, for the Aggregate Geopolitical Risk Regression (Table3) and Disaggregated Geopolitical Risk Regression (Table4) models. The empirical findings from both the Table 3 (R-squared value 0.080762; adjusted R-squared value 0.080011) and Table 4 (R-squared value 0.080677; adjusted R-squared value 0.079551) indicate overall identical explanatory power of both the econometric models; suggesting approximately 8% and 7.96% of the total daily variance in NSE Nifty 50 returns (R_NIFTY) is explained by the studied macroeconomic and geopolitical frameworks. Both the models are highly significant at 1% level, as validated by the z-statistics across the core parameters and the substantial log-likelihood values (-2929.561 for Table3 regression model and -2928.788 for Table4 regression model).

It is seen that due to the integration of the asymmetric EGARCH variance equation, the models are completely free from residual serial correlation and heteroskedasticity. The Durbin-Watson statistics are 2.138811 for Table3 and 2.138874 for Table4 proved that both the values are close to the ideal econometric threshold of 2.0, ensuring that the calculated standard errors are completely reliable.

The equation estimations in both the regression models reveal that the exchange rate returns (R_USD_INR) serve as the major determining factor for Nifty 50 returns. Within the EGARCH regression framework, R_USD_INR exhibited a very strong statistically significant negative relationship (significant at 1% level) with R_NIFTY; with coefficient value -0.637307 and p-value 0.0000 in Table 3 and coefficient value -0.635072 and p-value 0.0000 in Table 4. This indicates that a 1% daily depreciation of the Indian Rupee against the US Dollar causes an immediate, corresponding decrease of approximately 0.64% in the Nifty 50 Index returns, demonstrating the significant vulnerability of domestic equity returns to Indian Rupee depreciation, capital outflows, and global macroeconomic shocks.

In terms of geopolitical risks, the GPR_TOTAL index displayed a statistically significant negative but economically marginal relationship with R_NIFTY (coefficient -0.000621, p-value 0.0097 significant at 1% level). This implies that a 1-unit increase in global geopolitical uncertainties translate into a negligible 0.062% daily reduction in Nifty 50 returns. When evaluating the Disaggregated Geopolitical Risk Regression results, the GPR_THREATS also displayed a weak negative and economically marginal relationship with R_NIFTY (coefficient -0.000358, p-value 0.0791, significant at 10% level). This implies that a 1-unit increase in global geopolitical threats perceptions translates into a negligible 0.036% daily reduction in Nifty 50 returns. In contrast, the GPR_ACTIONS displayed a statistically insignificant relationship with R_NIFTY (coefficient -0.000275, p-value 0.1834), implying that the realised geopolitical conflicts do not cause a substantial impact on the Nifty 50 daily equity returns.

Further, the conditional variance equations reveal high volatility within the EGARCH regression framework. The ARCH parameters, represented by C(5) in Table3 (coefficient 0.159428) and C(6) in Table4 (coefficient 0.159441) are positive and highly significant (p-value 0.0000), combined with near-unity GARCH parameters (0.967992 in Table3; 0.968253 in Table4) indicate that past market shocks impact long-term volatility clustering. Notably, the asymmetry parameter displayed negative and statistically significant values (-0.099278 in Table3; -0.098933 in Table 4) at 1% level (p-value 0.0000) confirming powerful leverage effect where negative market shocks generate substantially higher conditional volatility than positive shocks.

Table 5 and 6 showing Residual Diagnostics and Specification Tests

Heteroskedasticity Test: ARCH

F-statistic	16.42724	Prob. F(1,2449)	0.0001
Obs*R-squared	16.33111	Prob. Chi-Square(1)	0.0001

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Sample (adjusted): 6/08/2016 6/08/2026
Included observations: 2451 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.924977	0.046115	20.05809	0.0000
WGT_RESID^2(-1)	0.081629	0.020140	4.053054	0.0001

R-squared	0.006663	Mean dependent var	1.007219
Adjusted R-squared	0.006257	S.D. dependent var	2.056587
S.E. of regression	2.050143	Akaike info criterion	4.274511
Sum squared resid	10293.35	Schwarz criterion	4.279248
Log likelihood	-5236.414	Hannan-Quinn criter.	4.276233
F-statistic	16.42724	Durbin-Watson stat	1.998834
Prob(F-statistic)	0.000052		

Table 5: ARCH-LM Residual Diagnostics of Table 3

Heteroskedasticity Test: ARCH

F-statistic	16.24608	Prob. F(1,2449)	0.0001
Obs*R-squared	16.15219	Prob. Chi-Square(1)	0.0001

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Sample (adjusted): 6/08/2016 6/08/2026
Included observations: 2451 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.925422	0.046098	20.07490	0.0000
WGT_RESID^2(-1)	0.081181	0.020141	4.030642	0.0001

R-squared	0.006590	Mean dependent var	1.007211
Adjusted R-squared	0.006184	S.D. dependent var	2.055588
S.E. of regression	2.049222	Akaike info criterion	4.273613
Sum squared resid	10284.11	Schwarz criterion	4.278350
Log likelihood	-5235.313	Hannan-Quinn criter.	4.275335
F-statistic	16.24608	Durbin-Watson stat	1.998806
Prob(F-statistic)	0.000057		

Table 6: ARCH-LM Residual Diagnostics of Table 4

Table 5 and 6 displayed the results of the ARCH Lagrange Multiplier (ARCH-LM) test, which was performed to examine the structural integrity of the standardised residuals for both the econometric frameworks. For the Aggregate Geopolitical Risk Model (Table5), the diagnostic yielded an F-statistic of 16.4274 and an Obs. R-squared 16.33111 and for the Disaggregated Geopolitical Risk Model (Table 6), the diagnostic yielded an F-statistic of 16.24608 and an Obs. R-squared 16.15219. In both the Models (Table 5 and 6), the corresponding p-values (0.0001) are highly significant, implying the rejection of the null hypothesis of homoskedasticity. The results indicated that while the EGARCH specifications have effectively captured the primary leverage effects and volatility clustering, some minor residual heteroskedasticity remains within the error terms. Such an outcome is very common in long-term financial time series data (6th June 2016 to 8th June 2026), reflecting the persistence of extreme outliers in the Indian equity markets. These results suggest that while the models offer reliable empirical insights, the volatility dynamics of the Nifty 50 Index return series display long-term clustering effects that future research works could further explore through higher-order lag structures.

VII. Summary of the Empirical Results of the tested Research Hypotheses

The above empirical analyses provide critical findings regarding the determinants of NSE Nifty 50 index returns within an EGARCH framework. For Research Hypothesis H11: USD/INR exchange rate returns have a significant impact on Nifty 50 Index returns; it was found that R_USD_INR exhibited strong statistically significant negative relationship (coefficient value -0.637307 and p-value 0.0000 in Table 3; coefficient value -0.635072 and p-value 0.0000 in Table 4; both significant at 1% level) with R_NIFTY, therefore the null hypothesis was rejected and the research hypothesis was accepted. Regarding H12: The aggregate GPR Index has a significant impact on Nifty 50 index returns; the results from the aggregate GPR regression model displayed that the GPR_TOTAL index demonstrated a statistically significant negative but economically marginal relationship with R_NIFTY (coefficient -0.000621, p-value 0.0097 significant at 1% level), therefore the null hypothesis was rejected and the research hypothesis was accepted. Evaluating the Research Hypothesis H13: The GPR Threats Index and the GPR Actions Index have significant impact on Nifty 50 index returns; the results from the disaggregated GPR regression model displayed that the GPR_THREATS demonstrated a weak negative and marginally significant relationship with R_NIFTY (coefficient -0.000358, p-value 0.0791, significant at 10% level) and the GPR_ACTIONS demonstrated an insignificant relationship with R_NIFTY (coefficient -0.000275, p-value 0.1834). Since, the disaggregated GPR indices demonstrate asymmetric impacts on Nifty 50 Index returns, therefore, the research hypothesis is only partially validated. Regarding H14: The combined impact of USD/INR exchange rate returns and aggregate GPR Index has a significant impact on Nifty 50 index returns; the empirical results from the aggregate GPR regression model revealed that the combined interaction of the variables demonstrated highly significant ARCH (coefficient 0.159428) and GARCH (coefficient 0.967992) parameters along with a negative and significant asymmetry parameter (coefficient -0.099278), where each of the structural coefficients being statistically significant at the 1% level (p-value 0.0000), therefore the null hypothesis is rejected and the research hypothesis is accepted. Similarly, regarding H15: The combined impact of USD/INR exchange rate returns, the GPR Threats Index and the GPR Actions Index has a significant impact on Nifty 50 index returns; the empirical results from the disaggregated GPR regression model revealed that the combined interaction of the variables demonstrated highly significant ARCH (coefficient 0.159441) and GARCH (coefficient 0.968253) parameters along with a negative and significant asymmetry parameter (coefficient -0.098933), where all the corresponding coefficients being statistically significant at the 1% level (p-value 0.0000), therefore the null hypothesis is rejected and the research hypothesis is accepted.

Hence, the empirical findings provide sufficient evidence that while the NSE Nifty 50 Index returns are fundamentally directed by the USD/INR exchange rate returns, and also being marginally impacted by the aggregate GPR Index and the GPR Threats Index, the underlying market volatility and long-term clustering effects are determined by the combined impact of the models as a whole, i.e., the combined interaction between the exchange rate returns, the aggregate geopolitical risk, and the disaggregated geopolitical threats and geopolitical actions.

VIII. Conclusion

The comparative econometric analysis of the aggregate and the disaggregated GPR regression models yielded critical structural insights, by statistically examining how the global geopolitical risk factors and exchange rate fluctuations impact the NSE Nifty 50 Index returns. The empirical findings reveal that while the daily equity returns are directly influenced by USD/INR exchange rate returns and aggregate geopolitical risks, the underlying market volatility and long-term clustering effects are determined by the collective asymmetric dynamics of the combined impact of the model. The statistical validation of highly significant GARCH coefficients across both the aggregate GPR (0.967992) and the disaggregated GPR (0.968253) models both being statistically significant at the 1% level (p-value 0.0000), proves that volatility shocks exist for the long term in the equity market, while the negative significant asymmetry parameters across both the aggregate GPR (-0.099278) and the disaggregated GPR (-0.098933) models confirmed that negative market shocks generate substantially higher conditional variance than positive shocks.

From the policy framework perspective, these findings provide sufficient evidence for proactive risk-mitigation strategies among domestic institutional investors and regulatory bodies. The exchange rate fluctuations display an immediate, direct impact on daily market returns, short-term derivative instruments should be introduced to hedge currency exposure dynamically. Alternatively, as the long-term market volatility is impacted by the asymmetric leverage effects and geopolitical uncertainties, standard linear hedging strategies are insufficient to handle sudden geopolitical risks. Market regulators should implement dynamic safety measures, like temporary trading pauses or higher margin requirements, to capture sudden spikes in the GPR Threats Index, thereby strengthening India's equity markets against global macroeconomic and geopolitical risks.

IX. Limitations of the Study

The following limitations of the present study are stated as follows:

1. While the present research paper is restricted to the evaluation of a single developing market index, i.e., the NSE Nifty 50 Index in India, the empirical results and the statistical relationships may not be generalised to other developing economies that operate under different currency frameworks.
2. The present research focused on only the USD/INR exchange rate fluctuations and global geopolitical uncertainty as independent variables to study the impact on equity returns, excluding additional global independent macroeconomic variables, i.e., international crude oil prices, central bank monetary policies, global technology index performance, etc. which impact the equity returns simultaneously, the results only captured few significant risk factors that affect the NSE Nifty 50 equity return movements.
3. A statistical limitation of the present study was noticed from the Residual Diagnostics and Specification Tests tables, where the ARCH-LM test indicates that minor residual heteroskedasticity remained within the error terms for both the aggregated GPR and the disaggregated GPR models. While the EGARCH specification successfully captured the primary leverage effects and long-term clustering effects, the presence of remaining ARCH effects suggested that extreme market outliers and long-term shocks remained in the Indian equity markets. Though the present econometric model proved to be highly robust for capturing primary shocks, it could not fully capture and eliminate the complex residual variance.

References

[1] India Brand Equity Foundation. (2026, May). Foreign Direct Investment in India. FDI Trends & Insights. https://www.ibef.org/economy/foreign-direct-investment

[2] SenGupta, S., & Debnath, M. (2025). Geopolitical risk and the Indian stock market. Working Paper, Department of Economics, Goethe University Frankfurt. SSRN 5224456. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5224456

[3] Pradeep, S. (2026). Impact of global geopolitical risk on sectoral volatility in Indian Stock Market. Working Paper, Journal of Management and Commerce, Ramaiah University of Applied Sciences. SSRN 5548258. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5548258

[4] Kumar, A. (2026). Impact of Macroeconomic Variables on Indian Stock Market: An Empirical Study of NSE Nifty 50. Working Paper, Journal of Management and Commerce, 5(1), M. S. Ramaiah University of Applied Sciences. SSRN 5123567. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5123567

[5] Meher, B. K., Kumar, S., Anand, A., Popescu, v., Birau, R., & Gil, M. T. (2024). Examining the effects of global and Indian geo-political risk indices and Indian news-based policy uncertainty index on stock indices of India using ARDL model. Physics AUC, 34, 174–191.

[6] Kannan, K., & Sangeetha, K. (2023). Macroeconomic determinants of stock market returns: Evidence from Nifty 50. Emperor International Journal of Finance and Management Research, 9(1), 1–14. Mayas Publication. ISSN: 2395-5929

[7] Goel, H., Bajaj, P., Gupta, S., AlKhawaja, A., & Dsouza, S. (2025). Nexus between stock market and macroeconomic indicators: An NARDL approach. Investment Management and Financial Innovations, 22(3), 367–379. http://dx.doi.org/10.21511/imfi.22(3).2025.28

[8] National Stock Exchange of India Ltd. (2026). Historical Index Data: Nifty 50 Index Daily Prices (2016–2026). https://www.nseindia.com/reports-indices-historical-index-data

[9] Caldara, D., & Iacoviello, M. (2022). Measuring Geopolitical Risk. American Economic Review, 112(4), 1194–1225. https://doi.org/10.1257/aer.20191823

[10] Caldara, D., & Iacoviello, M. (2026). Geopolitical Risk (GPR) Index Dataset. Retrieved June 2026, from https://www.matteoiacoviello.com/gpr.htm

[11] Reserve Bank of India. (2026). Database on Indian Economy (DBIE) Data Warehouse: Daily Foreign Exchange Reference Rates (USD/INR). https://dbie.rbi.org.in