The Impact of Geopolitical Conflicts on Stock Market Volatility: Evidence from the Colombo Stock Exchange

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ABSTRACT

Geopolitical conflicts are an important source of financial uncertainty. This study examines the statistical association between the global Geopolitical Risk (GPR) Index and conditional stock-market volatility in Sri Lanka. Using daily secondary data from January 2010 to June 2026, the analysis applies ARMA (2,2)-GARCH (1,1) models to the All Share Price Index (ASPI) and two purposively selected sector indices, Energy and Transportation. The dataset contains 3,876 ASPI price observations and 2,337 observations for each sector; the ASPI model reports 3,874 usable observations. The GPR and exchange-rate return are included as variance regressors. The estimated GPR coefficient is positive and statistically significant for ASPI (0.0138, $p < .001$), while estimated sector coefficients are negative. ASPI volatility persistence is approximately 0.999, and the test does not reject unity ($p = .8305$). The sector findings are exploratory, with the Transportation result limited by residual serial dependence and a data-verification concern. The results indicate conditional associations rather than causal effects. The study contributes evidence on the relationship between a global geopolitical-risk measure and daily CSE index volatility, subject to missing observations, exchange-rate mean filling, and model-diagnostic limitations.

Keywords: *Geopolitical Risk, Stock Market Volatility, ARMA-GARCH, Colombo Stock Exchange, Conditional Heteroskedasticity*

1. INTRODUCTION

Geopolitical developments can influence financial markets through uncertainty, expectations, trade disruptions, capital flows, commodity prices and perceived risk. Wars, terrorist attacks, sanctions and diplomatic tensions may affect financial assets even when a conflict occurs outside the market's home country. This is particularly relevant to frontier and emerging markets that are exposed to international trade and financial conditions. The CSE provides a meaningful setting because Sri Lanka has experienced several overlapping domestic and international shocks, including the Easter Sunday attacks in 2019, the COVID-19 period, the 2022 economic crisis and sovereign-debt default, the Russia-Ukraine conflict and renewed Middle East tensions. The domestic episodes matter because they may affect market volatility independently of the global GPR series.

Caldara and Iacoviello (2022) developed the Geopolitical Risk Index as a news-based measure of adverse geopolitical events and associated risks. The index provides a systematic alternative to examining individual conflicts. International evidence generally indicates that higher geopolitical risk is associated with greater financial-market uncertainty and stock-market volatility. (Salisu *et al.*, 2022) found significant geopolitical-risk effects on emerging-market stock-return volatility using GARCH-MIDAS, while (Bouras *et al.*, 2019) reported stronger associations with conditional volatility than average returns. (Panazan, Gheorghe and Calefariu, 2024) provide related evidence for the SAARC region.

The research problem is whether changes in geopolitical risk are statistically associated with changes in stock-market volatility in Sri Lanka after accounting for the market's own volatility dynamics and exchange-rate movements. The study's main objective is to investigate the impact of geopolitical risk on stock-market volatility in the Colombo Stock Exchange. The ASPI provides the principal overall-market analysis, while Energy and Transportation provide supplementary sectoral evidence.

Although previous studies have examined the relationship between geopolitical risk and financial market volatility, the evidence remains limited in the context of Sri Lanka and its emerging stock market. The Colombo Stock Exchange operates within an economy exposed to both global geopolitical developments and domestic political and economic disruptions. Therefore, examining the relationship between geopolitical conflicts and stock market volatility in Sri Lanka provides an opportunity to extend the existing literature. This study contributes by investigating the relationship between geopolitical risk and stock market volatility using daily market data from the Colombo Stock Exchange.

2. OBJECTIVES

The objective is to examine the association between geopolitical risk and conditional variance in ASPI returns. Energy and Transportation are supplementary, purposively selected sector-index cases. The main directional hypothesis is H1: higher geopolitical risk is positively associated with ASPI conditional variance. H0: the GPR coefficient in the ASPI conditional-variance equation is zero. Sector estimates are exploratory; the study does not formulate a causal hypothesis that geopolitical risk reduces sector volatility.

3. THEORY

The theoretical foundation combines the Efficient Market Hypothesis (EMH) and Behavioral Finance Theory. EMH, associated with (Fama, 1970), argues that publicly available information is incorporated into market prices. Geopolitical events can alter expectations about trade, growth, capital flows and risk, producing changes in returns and volatility.

Behavioral Finance Theory provides a complementary explanation by recognizing that investors do not always respond to information fully rationally. (Shiller, 2003) highlights the role of psychological factors in financial markets, while investor-sentiment research shows that uncertainty and emotion can influence pricing behavior. During geopolitical crises, fear, loss aversion, herding and uncertainty may intensify trading responses and contribute to larger price fluctuations. Thus, EMH provides an information-based explanation of how geopolitical information may be incorporated into prices, while Behavioral Finance provides a behavioral mechanism through which investor reactions may amplify and prolong volatility. The study also draws on the GARCH framework of (Bollerslev, 1986) which models time-varying conditional variance and volatility persistence.

The present study therefore treats GARCH-based conditional volatility as the principal outcome and the GPR index as the main explanatory variables.

4. METHODS

4.1 Research Design and Data

The research adopts a positivist philosophy, deductive approach and quantitative time-series design using secondary daily market data. The population consists of 289 companies listed on the CSE across 20 Global Industry Classification Standard (GICS) industries. The analytical sample uses ASPI as the overall-market index and purposively selected Energy and Transportation sector indices. The unit of analysis is the daily market observation. ASPI and GPR data cover January 2010 to June 2026, producing 3,876 ASPI observations, while each sector provides 2,337 observations from August 2016 to June 2026.

ASPI and sector-index data were obtained from CSE-related market-data sources, the GPR Index from the Caldara and Iacoviello database, and exchange-rate data from the Central Bank of Sri Lanka. ASPI daily returns were calculated as logarithmic price changes, $r_t = 100 \times [\ln(P_t) - \ln(P_{t-1})]$, where P_t is the index closing value; this is a percentage-scaled log return. The daily Geopolitical Risk Index (GPR) was obtained from the geopolitical risk database developed by Caldara and Iacoviello (2022). The GPR observations were aligned with the Colombo Stock Exchange trading dates by calendar date. The analysis uses the downloaded daily index series in its original scale. The ASPI price series contains 51 missing dates in January - February 2012. These were not replaced with unverified prices; consequently, return construction across the gap and estimation may lose observations. The raw exchange-rate sheet contains 532 missing observations corresponding to ASPI trading dates. These missing values were filled using the mean of the available daily exchange-rate returns. Mean imputation may reduce variation in the exchange-rate return series and potentially affect the estimated coefficients. An available-observation or alternative-imputation sensitivity analysis has not been completed; therefore, the results should be interpreted as conditional on the preprocessing applied.

This study focuses on geopolitical conflicts and their association with stock market volatility in Sri Lanka. Geopolitical risk is operationalized using the daily Geopolitical Risk (GPR) Index developed by Caldara and Iacoviello (2022). The index provides a systematic, news-based measure of geopolitical risks arising from adverse geopolitical events and associated threats. Therefore, the GPR Index is used as an empirical proxy to examine the volatility implications of geopolitical conflicts and related geopolitical uncertainty.

4.2 ARMA-GARCH-X Framework

The reported specification uses an ARMA (2,2) mean equation and a GARCH (1,1) conditional-variance equation. The ARMA terms capture serial dependence in returns, while the GARCH terms capture volatility clustering and persistence. The general multiplicative GARCH-X form can be expressed as $h_t = (\omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}) \times \exp(\gamma GPR_t + \delta FX_t)$, where h_t is conditional variance, ε^2_{t-1} is the lagged squared innovation, and GPR_t and FX_t denotes the included exogenous variance regressors. The estimated GPR coefficient is therefore a parameter in the conditional-variance multiplier, not a direct percentage change in volatility. Its numerical interpretation depends on the exact transformation and scale used in estimation; accordingly, the coefficient is interpreted directionally and conditionally rather than converted into a percentage effect. AR (1) =1.144 and MA(1)=−0.898 have opposite signs and relatively similar magnitudes, which may indicate near-cancellation and motivates checking alternative ARMA orders. The ARMA (2,2) specification is retained as the originally estimated model; model-order optimality is not claimed because alternative-order AIC/BIC comparisons were not available.

Standard errors and confidence intervals are not reported in the available estimation summary, so inference is confined to the coefficient significance information supplied.

5. RESULTS

5.1 Overall Market Results

Table 1. ARMA-GARCH-X Results for ASPI Returns

Parameter	Coefficient
Constant (mean)	0.0001
AR(1)	1.144***
AR(2)	-0.223*
MA(1)	-0.898***
MA(2)	0.052
ARCH(1)	0.194***
GARCH(1)	0.805***
Exchange Rate Return	-4.213***
GPR	0.0138***
Persistence (ARCH+GARCH)	0.999
Log-likelihood	13,627.78
AIC	-27,235.57
BIC	-27,172.95
N	3,874

Source: Author's calculations based on Stata output.
Note: *** p<0.01, ** p<0.05, * p<0.10.

The reported GPR coefficient is positive and statistically significant (0.0138, p<0.001), indicating a positive conditional association with ASPI variance in the estimated specification. Exchange-rate return is negative and significant (−4.213, p<0.001). ARCH and GARCH estimates are significant; their sum is approximately 0.999. The test of persistence equal to unity gives χ^2 (1)=0.05, p=0.8305, so the null is not rejected. This is consistent with near-integrated volatility and warrants a cautious discussion of stability and slow shock decay. The dataset contains 3,876 ASPI price observations, while the model table reports N=3,874 usable estimation observations; the difference arises during return construction and model estimation and should be disclosed rather than treated as contradictory. AIC, BIC and log-likelihood refer to the complete controlled specification and do not demonstrate that GPR alone improves predictive performance. Crisis dummies and an exclusion of 2022 were not estimated, so domestic crisis confounding remains a limitation.

5.2 Sectoral Results

The Energy model reports a negative and significant GPR coefficient (-0.0029, p = 0.013), with persistence of 0.981. Residual diagnostics do not indicate significant remaining serial correlation. The Transportation model also produces a negative and

significant coefficient (-0.0147, $p < 0.001$), with persistence of 0.949. However, the standardized-residual Portmanteau test remains significant ($Q(20) = 52.65$, $p = 0.0001$), while the squared-residual test is not significant ($Q(20) = 17.73$, $p = 0.6050$). Therefore, the Transportation coefficient should be treated cautiously rather than as evidence that geopolitical risk reduces Transportation volatility. The underlying Transportation index also requires independent verification.

Table 2. ARMA GARCH-X Results for Selected Sectors

Sector	GPR coefficient	p-value	Persistence	Diagnostic observation
Energy	-0.0029	0.013	0.981	Residual diagnostics satisfactory
Transportation	-0.0147	<0.001	0.949	Standardized residual dependence remains

Source: Author's calculations based on Stata output.

5.3 Hypothesis Testing

The positive and statistically significant GPR coefficient in the ASPI conditional-variance equation provides evidence against the null hypothesis. Therefore, the alternative hypothesis, which proposes a positive association between geopolitical risk and ASPI conditional variance, is supported by the reported baseline results. The sectoral estimates are exploratory and are not used to test separate directional hypotheses.

6. DISCUSSION

The principal finding is that geopolitical risk is positively and significantly associated with overall CSE conditional volatility. This is consistent with (Salisu *et al.*, 2022), who identified significant geopolitical-risk effects on emerging-market stock volatility, and (Bouras *et al.*, 2019),who found stronger associations with conditional volatility than average returns. It is also consistent with Sri Lankan evidence from (Riyath *et al.*, 2024) and (Samarawickrama and Pallegedara, 2023), which document volatility clustering and persistence in CSE returns.

The positive ASPI coefficient indicates that geopolitical risk contains information relevant to CSE volatility after controlling for exchange-rate movements and underlying volatility dynamics. This is compatible with EMH because geopolitical information can be incorporated into prices as investors revise expectations. At the same time, the very high persistence of volatility is consistent with the possibility that investor sentiment and behavioral responses may prolong uncertainty.

The estimated ARCH-GARCH persistence of 0.999 is a central result. The formal test does not reject a sum equal to unity ($p=0.8305$), so the estimate is compatible

with near integrated volatility. The result suggests potentially slow volatility decay but also raises a stability concern; it should not be presented as definitive proof of a stable long-memory process.
The sectoral findings demonstrate that estimated geopolitical-risk associations are not uniform across market segments. The negative Energy and Transportation coefficients differ from the positive overall-market coefficient. However, the sectoral estimates should not be interpreted as evidence that geopolitical risk mechanically lowers sector volatility. In the Transportation case, significant residual serial dependence indicates that some return dynamics remain unexplained. The unresolved index-data concern further limits interpretation. The sector results are therefore supplementary evidence that motivates additional sector-specific research.

7. IMPLICATIONS, LIMITATIONS AND CONCLUSION

The findings may be considered by investors, portfolio managers and regulators as one input to market-risk monitoring. The study does not test out-of-sample forecasting improvement or establish causal effects; claims of predictive superiority are therefore avoided. The persistence estimate and its non-rejection of unity warrant caution when using the fitted model for risk decisions.

The sector findings should be used cautiously. The Energy coefficient is a conditional association, and its negative sign does not establish lower vulnerability. The Transportation result remains provisional because of residual serial dependence and the index-data concern. Practitioners should combine these estimates with independent market and sector risk assessments.

The study has several limitations. The 51 missing ASPI dates in early 2012 were not replaced by verified observations. The 532-missing exchange-rate observations corresponding to ASPI trading dates were filled using the mean of the available daily exchange-rate returns. This mean imputation may smooth variation and affect the estimates; sensitivity analysis is outstanding. The reported sample of 3,874 differs from the 3,876 index observations because returns and model estimation require usable data. The analysis uses daily index observations rather than individual firms, and only two purposively selected sector indices are examined. The Transportation index requires source verification, and its standardized residuals retain serial dependence. The model does not include explicit event dummies for the Easter 2019 attacks, COVID-19 or the 2022 economic crisis, nor does it report a model excluding 2022. Consequently, GPR may capture or be confounded by concurrent domestic shocks. Finally, global GPR does not isolate Sri Lanka-specific risk, and the study establishes conditional association rather than causality.

The study finds a positive and statistically significant association between geopolitical risk and ASPI conditional variance in the reported baseline model. Volatility persistence is estimated at 0.999 and is statistically consistent with unity

under the reported test. Selected sector estimates are negative, but they are exploratory and particularly provisional for Transportation. The contribution is a CSE daily-index analysis using a global GPR measure within an ARMA-GARCH conditional-variance framework; the conclusions remain bounded by data-preparation and model-diagnostic limitations.

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