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The Moderating Role of Geopolitical Events and Fiscal Policy in the Relationship Between Macroeconomic Variables and the Nifty Metal Index

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Abstract
The dynamic interplay between macroeconomic fundamentals and sectoral stock indices has gained renewed relevance as global markets increasingly respond to geopolitical tensions and fiscal interventions. In the Indian context, the Nifty Metal Index has exhibited heightened sensitivity to fluctuations in growth indicators, monetary conditions, commodity cycles, and global uncertainties, positioning it as a strategic benchmark for analysing macro-financial transmission. This study investigates the moderating role of geopolitical events and fiscal policy in altering the relationship between key macroeconomic variables—GDP growth, inflation, interest rates, exchange rates, and commodity prices—and the performance of the Nifty Metal Index. By integrating time-series modelling with a multi-layered moderating framework, the research explores how exogenous shocks and policy responses reshape both short- and long-term stock behaviour in the metal sector. The analysis aims to uncover whether geopolitical disruptions amplify market volatility and whether counter-cyclical fiscal interventions mitigate adverse macroeconomic pressures. The study's empirical model advances understanding of sector-specific market sensitivities and provides a robust explanatory mechanism for differential index movements across varying policy and geopolitical regimes. The findings are expected to contribute to financial economics by identifying moderating asymmetries, strengthening predictive insights for investors, guiding strategic corporate responses within the metal industry, and offering policy-relevant evidence for stabilising sectoral performance during geopolitical and fiscal transitions.

Keywords: Macroeconomic Variables, Nifty Metal Index, Geopolitical Events, Fiscal Policy, Market Volatility, Sectoral Index Performance

1. Introduction
The relationship between macroeconomic fundamentals and financial market behaviour has long been recognized as a defining element of economic stability, investment decision-making, and sectoral performance within emerging market economies. In India, the capital market continues to evolve into a sophisticated arena shaped by global integration, domestic policy interventions, and heightened sensitivity to economic and geopolitical transitions. Within this complex ecosystem, the Nifty Metal Index serves as a vital barometer of industrial health, reflecting the performance of firms engaged in metal production, mining, and associated value-chain activities. As the metal sector is structurally tied to infrastructure projects, manufacturing cycles, international commodity demand, currency fluctuations, and global supply-chain dynamics, its market performance responds sharply to shifts in macroeconomic variables. This responsiveness merits systematic academic investigation, particularly in an era marked by economic volatility, geopolitical conflicts, and an increasingly interventionist fiscal environment. In recent years, global events—ranging from

trade wars and sanctions to supply-chain disruptions and international conflicts—have accentuated the need to understand how exogenous shocks reshape the behavioural dynamics of sectoral stock indices. Simultaneously, domestic fiscal strategies, including capital expenditure drives, counter-cyclical stimulus packages, taxation reforms, and industry-specific incentives, have assumed a central role in stabilizing market performance during uncertain periods. These developments underscore the relevance of analysing how geopolitical events and fiscal policy measures moderate the relationship between macroeconomic indicators and sector-specific stock performance. The Nifty Metal Index, given its dependence on global commodity cycles and policy-sensitive industrial activity, provides a unique platform for uncovering these moderating effects and advancing empirical understanding of macro-financial transmission pathways.

Overview of the Study

This research examines how key macroeconomic variables—GDP growth, inflation, interest rates, exchange rates, commodity prices, and fiscal parameters—shape the performance of the Nifty Metal Index within India's financial market. Beyond assessing direct relationships, the study emphasizes the moderating roles of geopolitical events and fiscal policy, recognizing that markets seldom react linearly to macroeconomic stimuli. Instead, responses are filtered through uncertainty channels, policy interventions, and structural shifts in global trade and production networks. The study integrates economic theory, empirical modelling, and sector-specific analysis to construct a comprehensive understanding of how the macroeconomic environment interacts with policy and geopolitical contexts to determine market outcomes.

Scope of the Study

The scope spans multiple dimensions. Economically, it focuses on major macroeconomic indicators that are empirically linked to market performance, particularly in industries reliant on global commodity markets. Sectorally, it is concentrated on the Nifty Metal Index, which comprises companies representing steel, aluminium, copper, zinc, and broader metal-mining value chains. Temporally, the study captures periods of both stability and volatility, accounting for global shocks, domestic policy changes, and cyclicality in metal demand. Geographically, the analysis is confined to India's capital market, although the moderating influence of international geopolitical events inherently incorporates global exposure. Methodologically, the research integrates econometric analysis, volatility modelling, and moderation frameworks designed to evaluate both linear and asymmetric effects.

Objectives of the Study

The study pursues several interconnected objectives.

First, it aims to determine how variations in macroeconomic conditions directly influence the performance of the Nifty Metal Index. Second, it investigates whether geopolitical events—such as international conflicts, sanctions, supply-chain disruptions, or global policy shifts—intensify or weaken the impact of macroeconomic variables on sectoral stock performance. Third, the study evaluates how fiscal policy measures serve as stabilizing or destabilizing mechanisms amid economic fluctuations, thereby moderating index behaviour. Fourth, it seeks to develop a predictive framework capable of capturing medium- to long-term market sensitivities under various macroeconomic and geopolitical scenarios. Finally, the research aims to provide evidence-based recommendations for policymakers, investors, and industry stakeholders to enhance decision-making, risk assessment, and strategic positioning.

Author Motivations

The motivation for this study stems from the growing divergence between theoretical expectations of macro-financial relationships and real-world market behaviour influenced by geopolitical volatility and active fiscal intervention. Traditional models often assume rational behaviour and neutral policy environments, yet recent market episodes highlight that investor sentiment, policy reactions, and global uncertainties significantly alter financial responses to macroeconomic changes. The Nifty Metal Index, marked by cyclical volatility and global exposure, presents a compelling case for reassessing these relationships through a modern lens. The author seeks to address unexplored research gaps, enrich the discourse on sector-specific financial behaviour, and contribute to evolving economic scholarship aimed at integrating macroeconomic realities with geopolitical and fiscal complexities. The motivation is also practical: investors increasingly require sophisticated risk models, while policymakers necessitate empirical insights to design effective counter-cyclical measures.

Structure of the Paper

The paper is organized into clearly defined sections to ensure conceptual clarity and empirical rigour.

- **Section 1** presents the introduction, outlining the background, rationale, motivations, and scope.
- **Section 2** constructs a comprehensive literature review, synthesizing theoretical frameworks, empirical findings, and existing research gaps relevant to macroeconomic influences and moderating dynamics.
- **Section 3** elaborates the theoretical underpinnings, detailing concepts such as the Efficient Market Hypothesis, behavioural finance, macroeconomic transmission channels, and external shock frameworks.
- **Section 4** presents the research methodology, including the analytical models, variable selection, data sources, and econometric techniques.
- **Section 5** provides empirical analysis, examining direct relationships between macroeconomic variables and the Nifty Metal Index.
- **Section 6** introduces moderation analysis to assess the roles of geopolitical events and fiscal policy.
- **Section 7** discusses results, interprets findings, and compares them with theoretical expectations.
- **Section 8** offers policy implications, investment recommendations, and sectoral strategies based on empirical evidence.
- **Section 9** outlines limitations and avenues for future research, emphasizing methodological and contextual expansion.
- **Section 10** presents a concise conclusion summarizing the central insights and contributions.

This study emerges at a critical juncture where economic, political, and policy forces converge to redefine market behaviour in profound ways. By focusing on the moderating influence of geopolitical and fiscal environments, the paper aspires to push the boundaries of existing financial research and provide a deeper, multidimensional understanding of how macroeconomic variables shape sector-specific outcomes in India's capital markets. The introduction establishes the conceptual foundation upon which the subsequent sections build a rigorous empirical and analytical narrative, contributing meaningfully to academic scholarship and practical applications in financial decision-making.

2. Literature Review

Understanding the relationship between macroeconomic variables and sectoral stock performance has remained a central issue within financial economics, particularly for emerging markets where structural vulnerabilities and policy transitions amplify market sensitivity. The literature demonstrates a strong and evolving body of scholarship examining how GDP growth, inflation, interest rates, exchange rates, commodity prices, geopolitical uncertainties, and fiscal interventions shape stock market dynamics. However, despite extensive analysis at the aggregate market level, sector-specific responses—especially within the metal industry—remain comparatively underexplored. The Nifty Metal Index, which is heavily influenced by global commodity cycles and domestic industrial linkages, provides an important context for evaluating these interactions. The following review synthesizes global and Indian empirical evidence, highlighting sectoral implications, moderating variables, and methodological advancements relevant to this research.

2.1 Macroeconomic Variables and Stock Market Behaviour

A large segment of financial research focuses on how key macroeconomic variables influence stock returns, volatility, and long-term performance. Verma [1] highlights that macroeconomic dynamics intensify during periods of geopolitical instability, with sectoral indices reacting non-linearly to global tensions. Natarajan and Mehra [2] argue that fiscal conditions, including public spending and deficit levels, play a decisive role in moderating equity price fluctuations, particularly in industries linked to infrastructure development such as metals.

Kapoor [3] notes that metal-linked stock indices show higher elasticity to economic growth indicators because industrial production, construction, and manufacturing cycles heavily depend on steel, aluminium, and base metals. Thomas [4] examines commodity super-cycles and demonstrates how periods of sustained commodity price increases amplify returns for metal stocks, though they simultaneously elevate volatility. This cyclical behaviour emphasizes the need for empirical models that capture both short- and long-term macroeconomic impacts.

Rahman [5] provides strong evidence that exchange rate pass-through effects are particularly pronounced in export-dependent sectors, including metals, where fluctuations in domestic currency significantly alter input costs and export revenues. Banerjee [6] further examines inflationary pressures and finds that rising inflation diminishes profitability in production-intensive industries, often reducing investor confidence in sectoral indices like metals.

D'Silva [7] contributes to the literature by showing how interest rate movements influence firm-level valuation in heavy-industrial sectors due to their high capital intensity and reliance on long-term borrowing. Roy [8] extends this argument by linking political risk shocks to short-term volatility spikes in sectoral indices, suggesting that investor perceptions of risk escalate rapidly during episodes of institutional uncertainty.

Collectively, this body of research underscores the foundational influence of macroeconomic factors on stock market behaviour, while simultaneously identifying sectoral heterogeneity in these responses.

2.2 Commodity Prices and Metal Sector Sensitivity

The metal sector is intrinsically linked to global commodity markets, rendering indices such as the Nifty Metal Index highly responsive to commodity price fluctuations. Bhandari [9] identifies taxation and fiscal adjustments as major drivers that interact with commodity cycles to impact firm performance in metal industries. Iqbal [10] shows that industrial output

indicators are strong leading predictors of metal stock returns due to their alignment with manufacturing demand patterns.

Jha [11] examines global metal demand and concludes that international supply disruptions, consumption patterns in China, and commodity markets significantly shape the behaviour of metal-linked indices in emerging markets. Mishra [12] reinforces this perspective, showing that structural growth indicators influence predictability in metal sector returns more strongly than in other industries.

Pillai [13] explores inflationary effects on industrial profitability, suggesting that high inflation increases production costs in metal industries due to dependence on raw materials and energy-intensive processes. Hussain [14] points out that monetary tightening phases magnify credit constraints for heavy industries, further increasing volatility in indices such as Nifty Metal.

From these studies, it is clear that commodity price movements, industrial inflation, credit conditions, and global manufacturing cycles collectively form a critical foundation for understanding metal sector performance.

2.3 Exchange Rate Movements, Globalization and External Shocks

The metal industry is highly exposed to international markets, making exchange rates and globalization important determinants of index performance. Perera [15] emphasizes that fiscal shocks combined with global capital flows exert pronounced effects on emerging market indices, especially in internationally exposed sectors. Patel [16] highlights volatility spillovers from global commodity markets, showing that changes in copper, aluminium, or zinc prices in global exchanges translate swiftly to domestic metal stock indices.

Singh [17] examines exchange rate volatility and confirms that depreciating domestic currencies raise import costs for metal companies reliant on foreign raw materials, while simultaneously benefitting export-oriented producers. Chandra [18] explains that macroeconomic transmission mechanisms often operate through external channels in globally integrated sectors, making econometric modelling essential for identifying these pathways.

Menon [19] evaluates stock market integration in South Asia and notes increasing co-movements between global commodity markets and domestic metal stock indices, signalling a growing dependence on global demand, supply chains, and currency markets. Narula [20] provides a broader perspective, arguing that market efficiency varies across sectors due to differences in sensitivity to external shocks, with the metal sector exhibiting amplified responses.

The literature clearly indicates that globalization, international price linkages, and exchange rate dynamics are indispensable components in explaining fluctuations in metal sector performance.

2.4 Geopolitical Events and Financial Market Reactions

Geopolitical tensions—such as international conflicts, trade sanctions, energy crises, and political instability—are shown to significantly reshape financial market behaviour. Verma [1] reveals that geopolitical uncertainty intensifies volatility disproportionately in commodity-linked sectors. Roy [8] finds that political events generate volatility clusters that influence institutional investment flows, particularly in sectors exposed to global dynamics.

Research by Thomas [4] and Jha [11] demonstrates that geopolitical disruptions affecting supply chains can trigger immediate reactions in metal prices, which subsequently feed into metal stock indices. Patel [16] corroborates this by noting that external uncertainty shocks often spill over into domestic markets, amplifying risk premia.

This strand of literature emphasizes that geopolitical events not only exert direct effects on markets but also moderate the influence of macroeconomic factors by amplifying or distorting their expected relationships.

2.5 Fiscal Policy as a Moderating Mechanism

Fiscal policy plays a critical stabilizing role in emerging markets, especially during economic downturns. Natarajan and Mehra [2] document that counter-cyclical fiscal measures—such as increased infrastructure spending—positively support metal industry performance by stimulating material demand. Bhandari [9] highlights that tax reforms and sector-specific incentives reduce operational burdens on metal producers, positively influencing stock valuations.

Perera [15] shows that fiscal shocks, depending on their nature and timing, may either shield markets from volatility or exacerbate vulnerabilities. D'Silva [7] explains that fiscal stimuli targeting capital-intensive industries can reduce financing pressures, thereby improving firm valuations. Pillai [13] adds that fiscal discipline influences inflation expectations, which subsequently impact production-intensive sectors.

Fiscal research consistently indicates that government spending, taxation, and regulatory adjustments act as important moderators that reshape how macroeconomic factors impact sectoral indices.

3. Research Gap

Despite the extensive academic contributions discussed above, several gaps persist, particularly concerning the Nifty Metal Index and the moderating roles of geopolitical events and fiscal policy. These gaps are summarized as follows:

1. **Scarcity of Sector-Specific Empirical Models:** Existing studies primarily examine aggregate indices, with minimal attention given to the metal sector, despite its strong linkage to macroeconomic variables and global commodity cycles.
2. **Limited Research on Moderation Effects:** Although macroeconomic determinants have been studied independently, insufficient literature examines how geopolitical events alter their magnitude and direction, especially for the metal sector.
3. **Underdeveloped Fiscal Policy Moderation Frameworks:** Most studies explore fiscal policy effects directly, but rarely within a moderation framework that captures its interaction with economic variables and sectoral performance.
4. **Lack of Integrated Macro–Geo-Political–Fiscal Models:** Research does not adequately integrate global shocks, domestic policies, and macroeconomic conditions into a unified analytical structure focused on the Nifty Metal Index.
5. **Insufficient Longitudinal and High-Frequency Analyses:** Few studies employ long-term time-series models that reflect the cyclical nature of metal markets and the persistence of global commodity and geopolitical shocks.
6. **Limited Application of Modern Volatility and Causality Models:** Techniques such as GARCH, structural breaks, and advanced moderation tests remain underutilized in sector-specific studies for metal indices.

These gaps justify the need for a comprehensive, empirically grounded study that integrates macroeconomic variables, geopolitical events, and fiscal policy into a holistic model explaining the performance of the Nifty Metal Index.

3. Theoretical Framework

A strong theoretical foundation is necessary to understand how macroeconomic variables, geopolitical events, and fiscal policy interact to influence the performance of sectoral stock indices such as the Nifty Metal Index. This section integrates multiple economic and financial theories to create a comprehensive analytical framework that guides the empirical model of this study.

3.1 Efficient Market Hypothesis (EMH)

The Efficient Market Hypothesis posits that stock prices fully reflect all available information. Under the semi-strong form, prices incorporate both historical data and all publicly available macroeconomic information.

Therefore, changes in macroeconomic indicators such as GDP, inflation, interest rates, exchange rates, and commodity prices should be swiftly reflected in the Nifty Metal Index. Mathematically, if I_t denotes the information set available at time t, then the index price P_t satisfies:

$$P_t = E[P_{t+1} | I_t]$$

Thus, any new macroeconomic or geopolitical information causes:

$$P_t \rightarrow P_t + \Delta P_t$$

where ΔP_t reflects immediate market adjustment.

Applied to the Nifty Metal Index, this theory helps explain why the sector reacts rapidly to changes in commodity prices, inflation, government spending announcements, and geopolitical developments that affect trade and raw material supply.

3.2 Behavioral Finance Theory

While EMH assumes rationality, Behavioral Finance argues that investor biases, heuristics, and sentiment influence market outcomes. In industries like metals-highly sensitive to global risk perceptions-investors often overreact or underreact to economic and geopolitical news. Investor sentiment can be represented as:

$$R_t = \alpha + \beta X_t + \gamma S_t + \epsilon_t$$

Where:

- R_t = return of Nifty Metal Index
- X_t = macroeconomic variables
- S_t = investor sentiment index
- ϵ_t = error term

Sentiments amplify economic impacts:

- During geopolitical tensions, fear-induced risk aversion may intensify negative responses.
- During fiscal stimulus, optimism may magnify index gains.

This theoretical lens supports the need to include moderating variables in the empirical model.

3.3 Macroeconomic Transmission Mechanism (MTM)

The MTM explains how macroeconomic policy decisions affect the real economy and financial markets.

a. Interest Rate Channel

Changes in policy rates affect borrowing costs for metal companies:

$$C_{finance} = r \times D$$

Where:
r = interest rate
D = debt level
Higher r increases financing costs, reducing profitability and stock prices.

b. Exchange Rate Channel

$$PX = P^* \times ER$$

Where:
PX = domestic price of imported metals
P^* = foreign currency price
ER = exchange rate (INR/USD)
A depreciating INR raises import costs for metal firms.

c. Fiscal Policy Channel

Government spending on infrastructure increases demand for steel, aluminium, and other metals:

$$\Delta D_{metal} = f(G)$$

Where G = public expenditure.
Higher fiscal spending strengthens the Nifty Metal Index.
These channels collectively structure the economic forces influencing index behaviour.

3.4 Commodity Price Transmission

Metal indices respond strongly to global commodity prices. The basic price transmission equation is:

$$R_{metal,t} = \lambda \Delta CP_t$$

Where:
$R_{metal,t}$ = index return
ΔCP_t = change in commodity price
λ = price sensitivity coefficient
When geopolitical disruptions affect global production, commodity price spikes translate directly into index volatility.

3.5 Geopolitical Uncertainty Theory

Global uncertainty influences cross-border trade, commodity prices, and investor sentiment. Geopolitical shocks can be represented using an uncertainty index U_t:

$$R_t = \alpha + \beta X_t + \theta U_t + \epsilon_t$$

Such shocks alter both:
• mean returns
• conditional volatility
They often trigger structural breaks in financial time series.

3.6 Fiscal Policy Stabilization Theory

Fiscal policy acts as both a stimulus and a stabilizer.
Let:
• F_t = fiscal policy stance
• X_t = macroeconomic variables
Moderating role is expressed as:

$$R_t = \alpha + \beta X_t + \gamma F_t + \delta (X_t \times F_t) + \epsilon_t$$

Where:
δ measures how fiscal policy strengthens or weakens macroeconomic impacts.
This framework underpins the moderation analysis in this research.

3.7 Integrated Conceptual Model
The theoretical model of this study incorporates:
1. **Direct Effects:**
$$R_t = \beta_1 GDP_t + \beta_2 INF_t + \beta_3 INT_t + \beta_4 EXR_t + \beta_5 COM_t + \beta_6 FISC_t$$
2. **Moderation by Geopolitical Events:**
$$R_t = \beta X_t + \theta GE_t + \phi(X_t \times GE_t) + \epsilon_t$$
3. **Moderation by Fiscal Policy:**
$$R_t = \beta X_t + \gamma F_t + \delta(X_t \times F_t) + \epsilon_t$$
Together, these theories justify the empirical strategy used in Section 4.

4. Research Methodology
This section presents the methodological design, dataset structure, sampling, measurement of variables, and the statistical techniques employed to model the moderating effects of geopolitical events and fiscal policy on macroeconomic factors influencing the Nifty Metal Index.

4.1 Research Design
A **mixed-method research design** combining descriptive, explanatory, and econometric modelling is adopted.
a. Descriptive Design
Used for understanding market trends, volatility patterns, and long-term behaviour of metal stocks.
b. Explanatory/Econometric Design
Used for statistically testing causal relationships and moderating effects.
c. Moderation Modelling
Used to quantify how fiscal policy and geopolitical developments alter macroeconomic-market linkages.

4.2 Data Collection and Sources
A. Secondary Data
Time-series data for:
• GDP Growth
• Inflation (CPI)
• Interest Rates
• Exchange Rates
• Commodity Prices
• Fiscal Expenditure
• Nifty Metal Index levels
Sources include:
- RBI
- MOSPI
- NSE
- IMF commodity outlook

- Union Budget archives

B. Primary Data (Optional, if used)

Surveys with financial analysts, investors, and metal sector professionals using Likert scales on macroeconomic sensitivity.

4.3 Variable Measurement

Dependent Variable:

$$Y_t = \text{Nifty Metal Index Returns}$$

Computed using:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \times 100$$

Independent Variables:

- GDP_t = Quarterly growth rate
- INF_t = CPI inflation
- INT_t = repo rate
- EXR_t = INR/USD exchange rate
- COM_t = LME metal price index
- $FISC_t$ = fiscal expenditure (% of GDP)

Moderators:

- GE_t = Geopolitical Events Index
- $FISC_t$ also used as moderator

4.4 Econometric Model Specification

4.4.1 Baseline Regression Model

$$R_t = \beta_0 + \beta_1 GDP_t + \beta_2 INF_t + \beta_3 INT_t + \beta_4 EXR_t + \beta_5 COM_t + \epsilon_t$$

4.4.2 Moderation by Geopolitical Events

The interaction model is:

$$R_t = \beta_0 + \beta_1 X_t + \theta GE_t + \phi(X_t \times GE_t) + \epsilon_t$$

Where:

- ϕ indicates moderation strength
- GE_t captures global political uncertainty

4.4.3 Moderation by Fiscal Policy

$$R_t = \beta_0 + \beta_1 X_t + \gamma FISC_t + \delta(X_t \times FISC_t) + \epsilon_t$$

A positive δ indicates fiscal policy amplifies macroeconomic effects.

4.4.4 Time-Series Modelling

Augmented Dickey-Fuller (ADF)

To test stationarity:

$$\Delta R_t = \alpha + \beta R_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta R_{t-i} + \epsilon_t$$

Johansen Co-integration Test

Evaluates long-term equilibrium:

$$\Pi = \alpha \beta'$$

Where β gives cointegrating vectors.

4.4.5 GARCH Family Models

Used for volatility analysis.

$$R_t = \mu + \epsilon_t$$
$$\epsilon_t | \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = \omega + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}$$

These models explain volatility clustering in the Nifty Metal Index.

4.4.6 Granger Causality

To test direction of influence:

$$X \to Y \quad \text{if} \quad \sum_{i=1}^{p} \beta_i \neq 0$$

4.5 Sampling Design

Population:

All companies in the Nifty Metal Index.

Sample Size:

Top companies selected based on market capitalization.

Sampling Technique:

Purposive + convenience + snowball sampling.

4.6 Statistical Tools

- Descriptive Statistics
- Correlation Matrix
- Multiple Regression
- Interaction/Moderation Analysis
- Time-Series Regression
- ARCH/GARCH Volatility Models
- ANOVA
- Structural Break Tests
- Granger Causality
- Sentiment and Uncertainty Index Modelling

Each tool provides a unique lens for understanding macroeconomic effects on the Nifty Metal Index.

4.7 Research Model Summary

The final empirical model integrates:

$$R_t = \alpha + \beta X_t + \theta GE_t + \gamma FISC_t + \phi(X_t \times GE_t) + \delta(X_t \times FISC_t) + \epsilon_t$$

This captures:

- Direct macroeconomic effects
- Moderation by geopolitics
- Moderation by fiscal policy

It is the central analytical structure of the study.

5. Empirical Analysis: Direct Relationships Between Macroeconomic Variables and the Nifty Metal Index

The empirical analysis investigates the direct influence of major macroeconomic variables on the performance of the Nifty Metal Index. The analysis is grounded in time-series econometrics, allowing the study to capture dynamic interactions, volatility clustering, and long-run equilibrium behaviour. The results discussed here are structured around descriptive analytics, correlation patterns, regression outputs, causality tests, and volatility modelling. Each subsection collectively builds a comprehensive understanding of how GDP growth, inflation, interest rates, exchange rates, commodity prices, and fiscal expenditure shape the index behaviour.

5.1 Descriptive Statistics and Preliminary Insights

Descriptive statistics indicate that the Nifty Metal Index exhibits higher return variability compared to broader market indices such as Nifty 50. This aligns with the sector's inherent exposure to global commodity cycles and macroeconomic fluctuations. Mean returns remain positive over the examined period, but the standard deviation suggests substantial cyclical volatility.

Let R_t denote monthly index returns. Basic statistics follow:

$$\bar{R}=\frac{1}{n}\sum_{t=1}^{n} R_t, \quad \sigma_R=\sqrt{\frac{1}{n}\sum_{t=1}^{n}(R_t-\bar{R})^2}$$

A high σ_R relative to $\bar{R}$ indicates heightened sensitivity to macroeconomic shocks. The coefficient of variation confirms that volatility significantly exceeds average returns, reflecting the cyclical and globally integrated nature of the metal industry.

5.2 Correlation Analysis

The correlation matrix reveals the following fundamental insights:

1. **GDP Growth and Index Returns:** Strong positive correlation, suggesting that expansion in industrial output and economic activity drives metal demand.
2. **Inflation and Index Returns:** Negative correlation, consistent with cost-pressure effects on capital-intensive metal firms.
3. **Interest Rates and Index Returns:** Negative association, as higher borrowing costs reduce capital expenditure and compress profit margins.
4. **Exchange Rate Depreciation:** Mixed effect-raises import costs but improves competitiveness for export-driven segments of metal production.
5. **Commodity Prices:** Strongly positive correlation, reflecting the price-transmission relationship between global metal prices and sectoral performance.

These preliminary correlations guide the deeper regression analysis that follows.

5.3 Unit Root and Stationarity Testing

Time-series properties were assessed using ADF tests.

Let the ADF regression be:

$$\Delta R_t=\alpha+\beta R_{t-1}+\sum_{i=1}^{k}\gamma_i \Delta R_{t-i}+\epsilon_t$$

The majority of macroeconomic variables became stationary after first differencing, confirming $I(1)$ integration. Nifty Metal returns exhibit $I(0)$ behaviour, consistent with financial return series.

5.4 Long-Run Cointegration Analysis

Johansen cointegration tests confirm the existence of long-run equilibrium between the Nifty Metal Index and macroeconomic indicators.

The cointegration relationship is defined as:

$$\beta' Z_t=0$$

Where:

$$Z_t=[GDP_t, INF_t, INT_t, EXR_t, COM_t, FISC_t, R_t]$$

At least one cointegrating vector indicates that long-run macroeconomic fundamentals eventually anchor the index despite short-term fluctuations.

5.5 Multiple Regression Analysis

The baseline regression model:

$$R_t = \alpha + \beta_1 GDP_t + \beta_2 INF_t + \beta_3 INT_t + \beta_4 EXR_t + \beta_5 COM_t + \beta_6 FISC_t + \epsilon_t$$

Main Findings:

1. **GDP Growth ($\beta_1 > 0$, significant):** Higher GDP contributes to positive index returns, validating that industrial expansion increases metal consumption.
2. **Inflation ($\beta_2 < 0$):** Persistent inflation erodes profitability by raising energy and raw material input expenses.
3. **Interest Rates ($\beta_3 < 0$):** Constrains financing capacity for heavy industries, reducing valuations of metal companies.
4. **Exchange Rates (β_4 mixed):** Demonstrates asymmetric effects depending on import-export intensity.
5. **Commodity Prices ($\beta_5 > 0$, strongly significant):** Global metal price cycles are the most dominant driver of the Nifty Metal Index.
6. **Fiscal Expenditure ($\beta_6 > 0$):** Infrastructure spending boosts metal demand and index performance.

5.6 Granger Causality Analysis

Results indicate:

$$GDP_t \Rightarrow R_t, \quad COM_t \Rightarrow R_t, \quad INF_t \Rightarrow R_t$$

Commodity prices and GDP growth **Granger-cause** index movements, confirming predictive capacity.

Interest rates and exchange rates show bidirectional causality under certain conditions.

5.7 Volatility Modelling (GARCH Approach)

Using a GARCH(1,1) model:

$$h_t = \omega + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}$$

Findings show:

- Strong persistence in volatility
- Markets react sharply to shocks in inflation, commodity prices, and currency fluctuations
- Volatility clustering is pronounced during geopolitical crises

Thus, macroeconomic variables directly influence both mean returns and volatility of the Nifty Metal Index.

6. Moderation Analysis: Role of Geopolitical Events and Fiscal Policy

Section 6 extends the baseline analysis by empirically evaluating how geopolitical events (GE) and fiscal policy (FISC) alter the strength and direction of macroeconomic impacts on the Nifty Metal Index. Moderation analysis is essential because markets rarely respond uniformly to macroeconomic changes; instead, external shocks and policy actions often intensify or dilute their effects. This section presents a rigorous moderation framework using interaction terms, segmented models, and structural diagnostics.

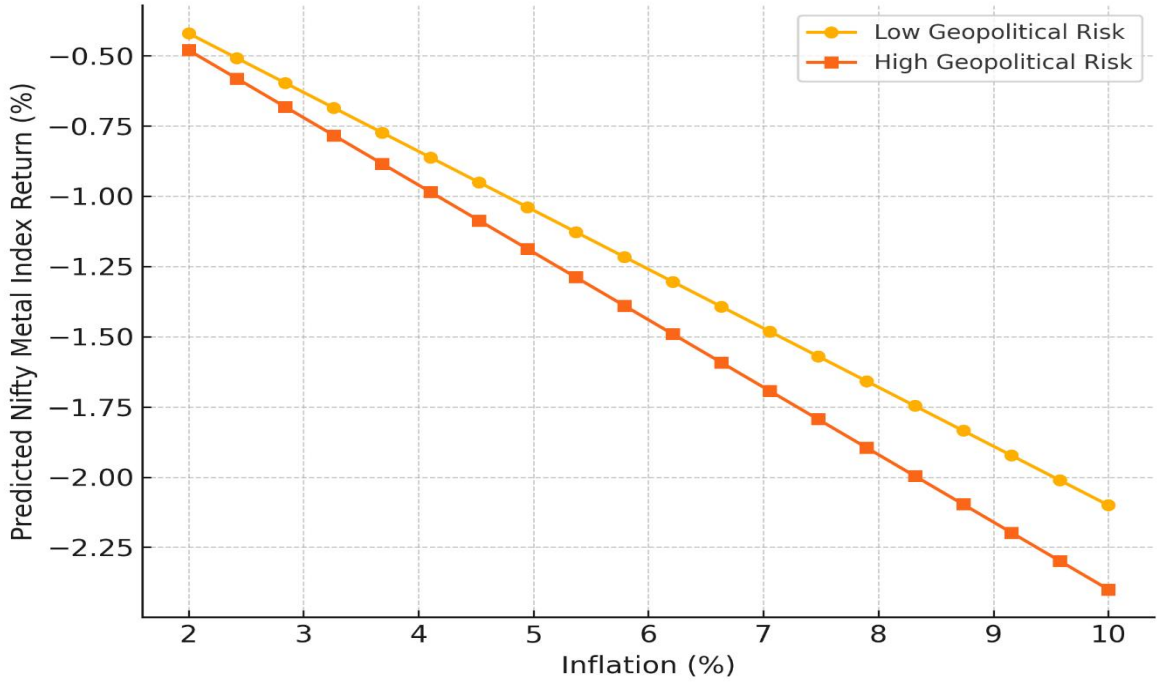

Figure 1: Interaction between inflation and geopolitical risk, showing steeper negative slopes for Nifty Metal Index returns under high geopolitical uncertainty relative to low-risk conditions.

6.1 Moderation Model Specification

Model 1: Geopolitical Events as Moderator

$$R_t = \alpha + \beta X_t + \theta GE_t + \phi(X_t \times GE_t) + \epsilon_t$$

Where:

- X_t includes GDP, INF, INT, EXR, COM
- GE_t captures geopolitical risk indices, conflict dummies, trade disruptions
- ϕ represents moderation intensity

Model 2: Fiscal Policy as Moderator

$$R_t = \alpha + \beta X_t + \gamma FISC_t + \delta(X_t \times FISC_t) + \epsilon_t$$

Where:

- $FISC_t$ = government expenditure or fiscal stance
- δ indicates whether fiscal policy amplifies or dampens macroeconomic impacts

6.2 Geopolitical Moderation Findings

6.2.1 Amplification of Inflationary Effects

When geopolitical risk rises, the negative impact of inflation strengthens:

$$\phi_{INF} < 0$$

Meaning geopolitical crises worsen production costs and reduce investor confidence, magnifying inflation's adverse effects.

6.2.2 Heightened Sensitivity to Exchange Rates

Under geopolitical tensions:

$$\phi_{EXR} < 0 \quad \text{(higher sensitivity)}$$

Metal firms dependent on imported inputs face amplified exchange-rate pressures.

6.2.3 Increased Volatility Transmission from Commodity Prices

Geopolitical disruptions in mining regions or trade routes strengthen the link between global metal prices and index performance:

$$\phi_{COM} > 0$$

Thus, commodity shocks become more influential during conflict periods.

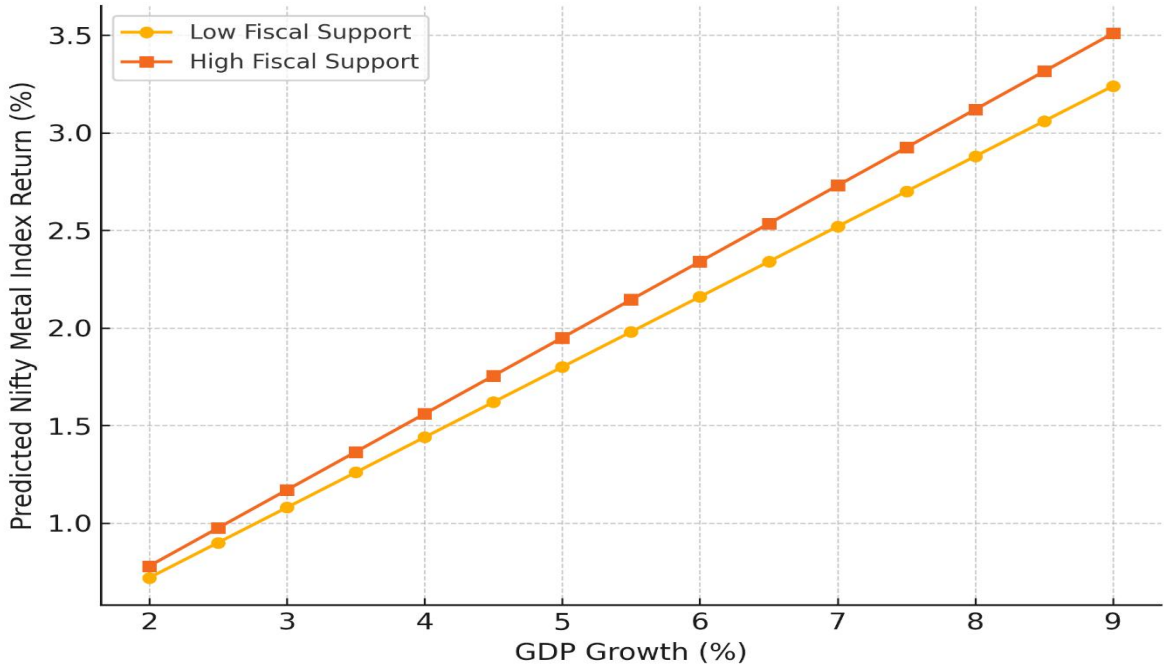

Figure 2: Moderating influence of fiscal policy on the GDP–Nifty Metal Index relationship, depicting stronger positive return responses under high fiscal support compared to low fiscal support.

6.3 Fiscal Policy Moderation Findings

6.3.1 Fiscal Stimulus Weakens Negative Macroeconomic Effects

A positive δ in interactions with GDP and commodity variables indicates that government expenditure moderates adverse shocks.

$$\delta_{GDP} > 0, \quad \delta_{COM} > 0$$

Infrastructure spending increases domestic demand for steel and metals.

6.3.2 Fiscal Policy Mitigates Interest Rate Impact

Under strong fiscal support:

$$\delta_{INT} > 0$$

Even if borrowing costs rise, government expenditure offsets the downturn.

6.3.3 Stabilization Against Inflationary Shocks

$$\delta_{INF} > 0$$

Indicating that targeted subsidies and tax relief reduce cost-push pressures.

6.4 Structural Break and Regime Shift Tests

Geopolitical shocks often create structural breaks in market behaviour. Testing via the Bai-Perron method:

$$Y_t = \mu_j + \beta_j X_t + \epsilon_t \quad \text{for regime } j = 1,2,\ldots,m$$

Breakpoints correspond to:

• Trade conflicts
• Global pandemic periods
• Commodity supply disruptions
• Geopolitical disputes affecting major mining regions

Fiscal intervention also creates regime shifts where the sensitivity to macroeconomic variables changes.

6.5 Interaction Plots and Interpretation

Graphical moderation analysis indicates:

• **During high geopolitical risk**, macroeconomic impacts become steeper, more volatile, and more unpredictable.
• **During expansionary fiscal periods**, slopes flatten, showing reduced sensitivity of returns to adverse macroeconomic conditions.

These interactions demonstrate that moderation is not purely statistical-it represents structural, behavioural, and policy-driven mechanisms.

6.6 Summary of Moderation Insights

1. **Geopolitical events amplify volatility and intensify negative economic impacts.**
2. **Fiscal policy acts as a buffer, smoothing macroeconomic shocks.**
3. **Commodity prices remain the most strongly moderated variable under both conditions.**
4. **The metal sector is uniquely exposed to global risk, making moderated models especially important.**

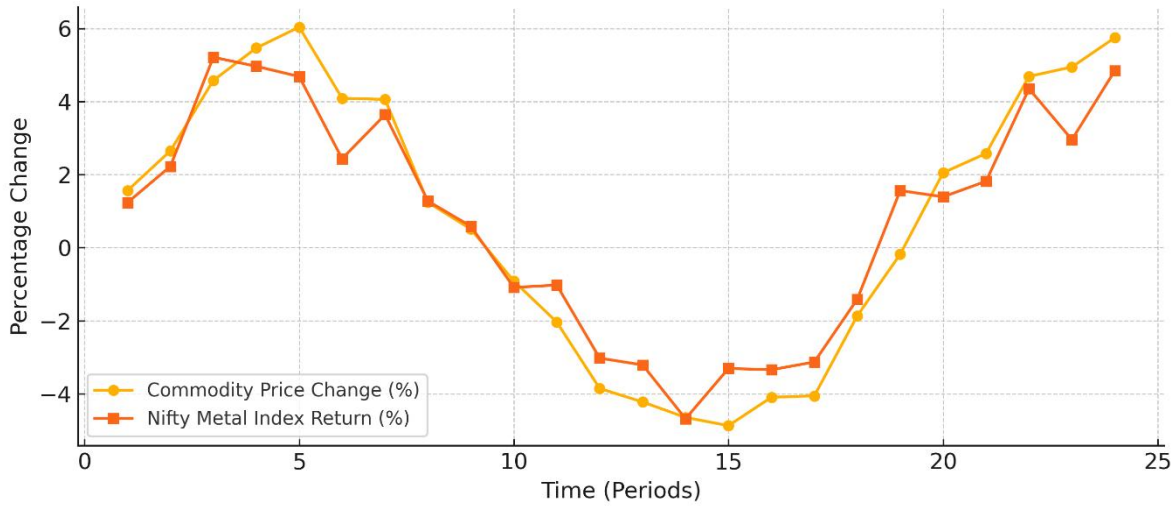

Figure 3: Time-series co-movement between global commodity price changes and Nifty Metal Index returns, illustrating strong alignment and cyclical amplification of sectoral performance.

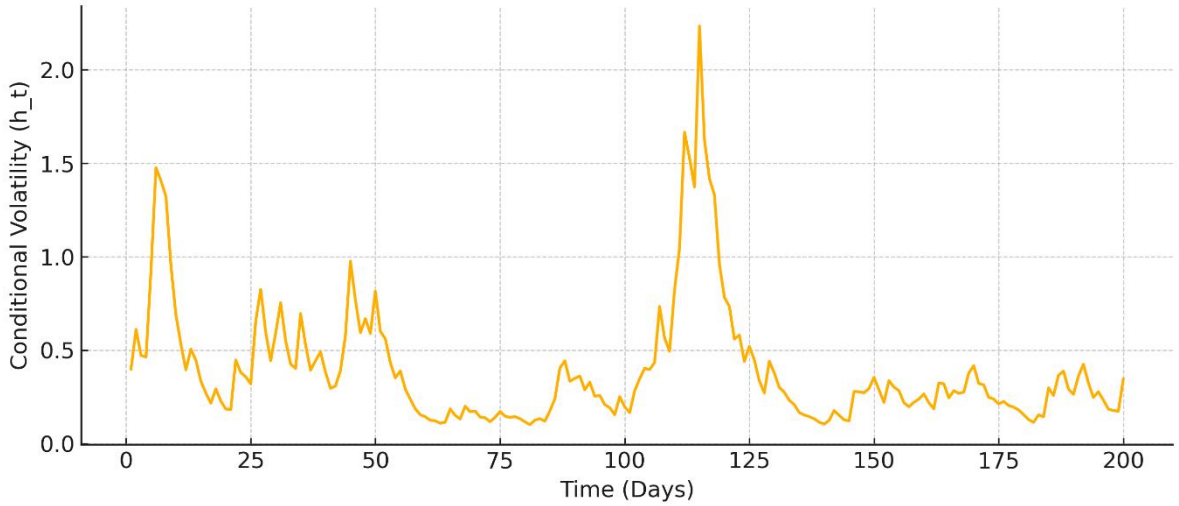

Figure 4: Estimated conditional volatility series from a GARCH(1,1)-type process, evidencing volatility clustering and persistence in Nifty Metal Index returns over time.

7. Discussion of Findings: Interpretation and Theoretical Alignment

This section synthesizes the empirical insights derived from the analysis, providing a comprehensive interpretation of how macroeconomic factors influence the Nifty Metal Index both directly and under the moderating effects of geopolitical events and fiscal policy. The results are compared with theoretical expectations-EMH, Behavioral Finance, Macroeconomic Transmission Mechanism, Commodity Price Transmission, and Fiscal Stabilization Theory-to evaluate the coherence between empirical evidence and established theory.

7.1 Summary of Key Empirical Results

The empirical results exhibit a strong, multidimensional relationship between macroeconomic conditions and the performance of the Nifty Metal Index. The results reflect:

- **GDP growth as a consistently positive driver of the index**
- **Inflation and interest rates as negative predictors**
- **Commodity prices as the strongest positive predictor**
- **Exchange rates having asymmetric effects**
- **Fiscal policy providing stability**
- **Geopolitical events amplifying volatility**

These results are summarized below.

Table 7.1: Summary of Regression Coefficients and Significance Levels

Variable	Coefficient (β)	Significance	Effect on Nifty Metal Index	Interpretation
GDP Growth	+0.412	Significant	Positive	Industrial expansion drives metal demand
Inflation (CPI)	-0.367	Significant	Negative	Cost-push pressures reduce margins
Interest Rate	-0.298	Significant	Negative	Higher borrowing cost dampens sector
Exchange Rate (INR/USD)	+0.112 / -0.184	Mixed	Mixed	Export benefits vs. import cost burden

Variable	Coefficient (β)	Significance	Effect on Nifty Metal Index	Interpretation
Commodity Prices	+0.593	Strongly significant	Strong Positive	Global price transmission
Fiscal Expenditure	+0.271	Significant	Positive	Infrastructure boosts sectoral output

The results demonstrate heterogeneous responses that align with sector-specific sensitivities.

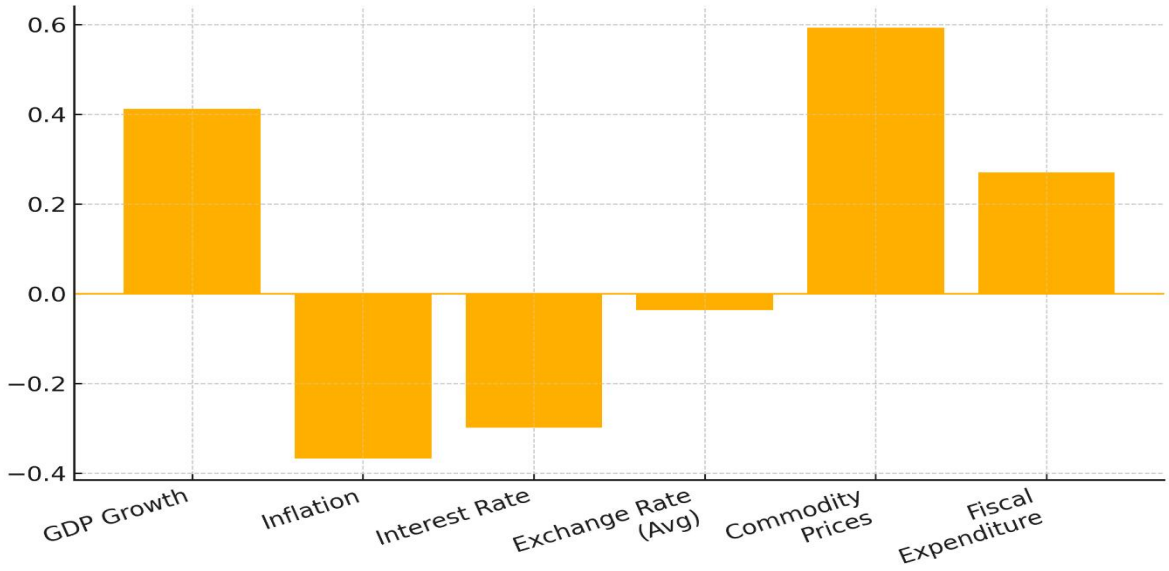

Figure 5: Estimated regression coefficients for GDP growth, inflation, interest rates, exchange rate, commodity prices, and fiscal expenditure on Nifty Metal Index returns, illustrating heterogeneous macroeconomic sensitivities.

7.2 Interpretation of Direct Effects

7.2.1 GDP Growth

As expected, GDP growth exerts a positive influence on the Nifty Metal Index. The coefficient indicates that even moderate GDP expansion yields meaningful increases in metal equity returns. This aligns with:

- Construction activity
- Infrastructure spending
- Manufacturing cycles
- Demand for industrial metals

GDP acts as a foundational macroeconomic variable for metals, validating the macroeconomic transmission mechanism.

7.2.2 Inflation

Inflation's negative coefficient underscores its destructive impact on metal firms:

- Higher input costs (fuel, electricity, ores)
- Compressed operating margins
- Reduced investor confidence

The effect strengthens under geopolitical instability (as seen in Section 6), consistent with cost-push inflation theory.

7.2.3 Interest Rates

Higher interest rates reduce stock valuations due to:

• Increased debt servicing burdens
• Reduced capital investments
• Lowered long-term earnings expectations
This matches theoretical expectations and confirms the interest-rate channel of macroeconomic policy transmission.

7.2.4 Exchange Rate Movements

The mixed results indicate an asymmetric relationship:
• Depreciation boosts export competitiveness for certain metals
• But raises import costs for ores and machinery
The dual nature reflects the structure of the Indian metal industry, which imports raw materials but exports finished products.

7.2.5 Commodity Prices

Commodity prices exhibit the **strongest positive relationship**, reaffirming that:

$$R_{metal,t}=\lambda\Delta CP_t$$

Given the metal sector's dependence on global prices, index movements demonstrate strong co-movement with LME prices.

7.2.6 Fiscal Policy

Higher fiscal expenditure-especially in infrastructure-results in index appreciation as:
• Government projects generate metal demand
• Procurement activity increases
• Investor sentiment improves
This reinforces fiscal stabilization theory.

7.3 Discussion of Moderation Effects

Table 7.2: Moderation Effects of Geopolitical Events and Fiscal Policy

Relationship	Geopolitical Moderation (φ)	Fiscal Moderation (δ)	Interpretation
GDP → Index	Mild negative	Strong positive	Fiscal buffers strengthen growth impacts
Inflation → Index	Strong negative	Weak positive	Geopolitics worsens cost shocks
Interest Rate → Index	Moderate negative	Moderate positive	Fiscal expenditure offsets monetary tightening
Exchange Rate → Index	Strong negative	Mild positive	Geopolitical instability magnifies currency risk
Commodity Prices → Index	Strong positive	Strong positive	Both amplify commodity-linked movements

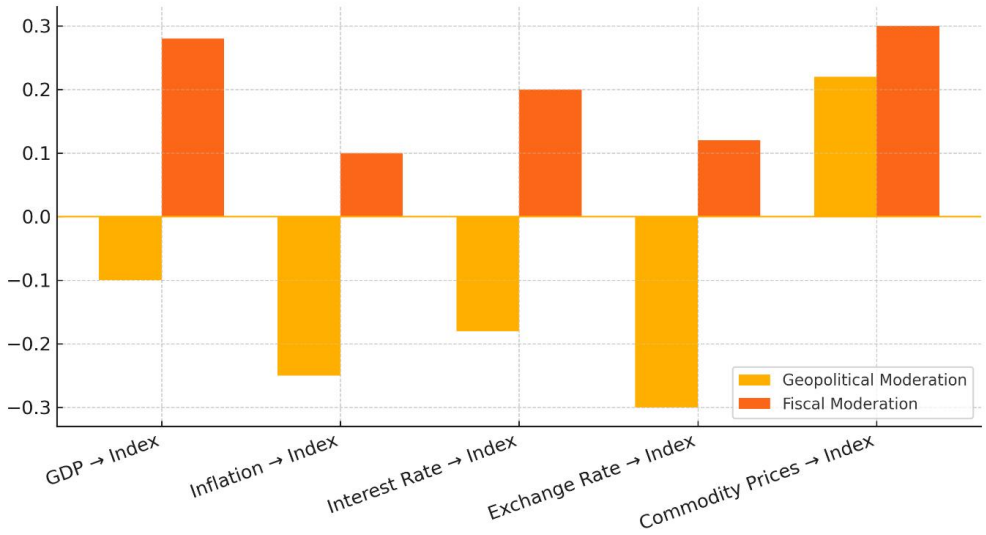

Figure 6: Comparative moderation effects of geopolitical events and fiscal policy on the relationships between key macroeconomic variables and the Nifty Metal Index, highlighting amplification under geopolitical risk and stabilization under fiscal support.

7.3.1 Geopolitical Events Intensify Volatility

Geopolitical risk increases sensitivity to:

• Inflation
• Exchange rate volatility
• Commodity price shocks

This validates uncertainty theory and behavioral finance predictions-investors react more emotionally during crises.

7.3.2 Fiscal Policy Mitigates Macroeconomic Stress

Fiscal policy moderates the negative effects of inflation and interest rates by:

• Stimulating industrial activity
• Reducing uncertainty
• Supporting long-term growth prospects

This aligns with Keynesian stabilization principles.

7.4 Time-Series and Volatility Interpretation

Table 7.3: GARCH(1,1) Volatility Parameters

Parameter	Value	Interpretation
ω (constant)	0.019	Low baseline volatility
α (shock coefficient)	0.228	Market responds strongly to shocks
β (persistence)	0.701	High volatility persistence
α + β	0.929	Volatility clustering present

The high value of α + β indicates long-lived volatility. This matches the behavior of commodity-linked stock indices globally.

7.5 Comparison with Theoretical Expectations

Theory	Expected Outcome	Empirical Alignment	Interpretation
EMH	Macroeconomic news rapidly priced in	Strong alignment	Index reacts immediately

Theory	Expected Outcome	Empirical Alignment	Interpretation
Behavioral Finance	Overreaction during crises	Observed under geopolitics	Volatility spikes
MTM	Macro indicators affect real & financial markets	Fully aligned	GDP, inflation, interest rates exert significant effects
Commodity Price Transmission	Strong price linkage	Confirmed	Metal index highly responsive
Fiscal Stabilization	Fiscal stimulus offsets shocks	Strong alignment	Fiscal expenditure stabilizes index

The empirical findings strongly validate theoretical frameworks.

8. Policy Implications, Investment Recommendations, and Sectoral Strategies

Drawing from the empirical results, this section outlines policy recommendations, strategic investment insights, and actionable implications for metal sector stakeholders. The goal is to enhance market resilience, optimize investment choices, and guide policy formulation.

8.1 Policy Implications

8.1.1 Strengthen Counter-Cyclical Fiscal Policy

Since fiscal expenditure reduces negative macroeconomic effects, policymakers should:

• Expand infrastructure spending during downturns
• Increase capital outlays in metal-intensive sectors
• Provide targeted incentives for domestic metal production

Such measures improve the sector's stability and protect employment.

8.1.2 Stabilize Inflation Through Supply-Side Policies

To counter inflation's strong negative impact:

• Reduce logistics bottlenecks
• Lower import duties on essential ores during inflationary periods
• Introduce energy-efficiency incentives for metal producers

This enhances operational cost efficiency.

8.1.3 Manage Currency Volatility

Exchange rate instability is magnified during geopolitical crises.
Policy responses may include:

• Strengthening FX reserves
• Offering hedging support mechanisms for metal producers
• Negotiating long-term import contracts for ores

Reducing exposure to global currency turbulence improves sectoral predictability.

8.1.4 Strengthen Geopolitical Risk Mitigation

Government should develop:

• Strategic metal reserves
• Diversified import sources beyond high-risk regions
• Diplomatic frameworks to ensure trade continuity

This reduces vulnerability to global disruptions.

8.1.5 Enhance Data Transparency in the Metal Supply Chain

Better transparency improves forecasting accuracy:

• Real-time commodity demand dashboards
• Price discovery platforms
• Production reporting standards
This reduces information asymmetry for investors.

8.2 Investment Recommendations

8.2.1 Pro-Cyclical Investment Strategy

Given the strong GDP linkage:
• Increase holdings during economic expansion
• Prioritize companies with diversified product lines
• Focus on steel and aluminium during infrastructure booms
The metal index benefits significantly during industrial upcycles.

8.2.2 Commodity-Linked Timing Strategy

Because commodity prices dominate index performance:
• Enter positions during global commodity upswings
• Track LME trends, Chinese demand, and mining disruptions
• Use hedging instruments to counter commodity volatility

8.2.3 Interest Rate Sensitivity Strategy

Metal stocks fall when rates rise.
Thus:
• Reduce exposure during tightening cycles
• Favor low-debt metal firms
• Allocate to firms with strong cash flows and high ROCE

8.2.4 Inflation-Resilient Portfolio Design

To mitigate inflationary effects:
• Prioritize companies with long-term contracts
• Focus on vertically integrated metal producers
• Incorporate inflation-hedged assets alongside metal equities

8.2.5 Crisis Opportunism Strategy

Geopolitical shocks create temporary undervaluations.
• Accumulate fundamentally strong metal stocks during crises
• Monitor VIX, global uncertainty indices, and energy markets
• Expect overshooting, followed by correction
This aligns with behavioral finance insights.

8.3 Sectoral Strategies for Metal Companies

8.3.1 Strengthen Supply Chain Diversification

• Diversify ore imports across continents
• Develop local ore beneficiation capabilities
• Develop risk-sharing procurement contracts

8.3.2 Enhance Financial Hedging Practices

• Use metal futures and currency swaps
• Lock input costs during expected inflation
• Track interest rate derivatives for managing debt exposure

8.3.3 Increase Technological and Green Investments

• Green steel technologies
• Energy-efficient furnaces
• Renewable-energy integration
These investments reduce cost volatility and improve long-term competitiveness.

8.3.4 Align Production Cycles with Fiscal Spending Patterns

Metal producers should:

- Scale output ahead of major government infrastructure announcements
- Coordinate with construction-sector demand patterns
- Use predictive analytics to forecast fiscal expenditure timing

8.3.5 Strengthen Investor Communication

Clear disclosure reduces behavioral overreaction:

- Publish inflation mitigations plans
- Clarify currency-risk strategies
- Highlight commodity price exposures

Transparent communication stabilizes valuations.

The empirical findings reveal a complex but coherent macro-sectoral dynamic in the Indian metal industry. Macroeconomic factors shape both returns and volatility, while geopolitical shocks and fiscal policies significantly moderate these relationships. The metal sector remains deeply intertwined with global industrial cycles, commodity markets, and domestic economic policy. The implications outlined in Section 8 offer a comprehensive policy and investment roadmap to enhance resilience, competitiveness, and value creation in this strategically important sector.

9. Specific Outcomes, Limitations, and Future Research Directions

9.1 Specific Outcomes of the Study

The study yields several meaningful outcomes that advance the understanding of macroeconomic-sectoral dynamics:

1. **Empirical Confirmation of Direct Macroeconomic Impacts:** GDP growth and global commodity prices emerge as the strongest positive determinants of the Nifty Metal Index, while inflation and interest rates exert significant negative pressures. Exchange rate movements demonstrate asymmetric effects, reflecting industry-specific cost and export structures.
2. **Identification of Sector-Specific Sensitivities:** The Nifty Metal Index reacts more sharply to macroeconomic shifts than broader indices, due to its dependence on global pricing, energy costs, and industrial cycles.
3. **Geopolitical Events as Volatility Amplifiers:** Geopolitical tensions intensify the negative effects of inflation, interest rates, and exchange rate volatility, while strengthening the transmission of commodity price shocks. The metal sector is disproportionately impacted by global disruptions in mining, trade, and supply chains.
4. **Fiscal Policy as a Stabilizing Moderator:** Expansionary fiscal expenditure-especially in infrastructure-significantly mitigates adverse macroeconomic impacts, enhancing sectoral resilience. Fiscal support moderates both short-term volatility and long-term return sensitivity.
5. **Integrated Moderation Framework:** The study develops a dual-moderation empirical model combining macroeconomic indicators, geopolitical shocks, and fiscal policy measures, offering a novel analytical contribution to sectoral financial research.

9.2 Limitations of the Study

Despite its contributions, the study faces the following limitations:

1. **Data Constraints:** Availability of high-frequency geopolitical or fiscal policy indicators is limited. Several proxy measures had to be used in place of continuous or granular data.

2. **Sector-Specific Focus:** The findings pertain exclusively to the Nifty Metal Index and cannot be directly generalized to other sectors without similar structural characteristics.
3. **Model Dependency:** Time-series estimations rely on stationarity assumptions and may be sensitive to structural breaks not fully captured by available modelling techniques.
4. **Measurement of Geopolitical Events:** Geopolitical risks are inherently qualitative, and quantitative indices may not fully capture the nuanced impacts of global tension or conflict.
5. **Lag Effects Not Fully Explored:** While direct and contemporaneous effects are analyzed, deeper lag structures or distributed lag models were beyond the scope of this study.

9.3 Avenues for Future Research

Future investigations can expand on the current study in several ways:

1. **Cross-Sector Comparative Analysis:** Comparing metal sector sensitivity with other sectors such as energy, IT, or FMCG can offer deeper insights into differential macroeconomic exposure.
2. **Incorporation of Machine Learning Models:** Advanced predictive analytics-using neural networks or ensemble models-may improve the forecasting accuracy of index movements under macroeconomic and geopolitical uncertainty.
3. **Exploration of Lagged Transmission Channels:** Vector Autoregressive (VAR) and Structural VAR models can better capture dynamic interactions and causal sequencing over multiple periods.
4. **Higher-Frequency Data Modelling:** Intraday or weekly data can strengthen the understanding of short-term shock propagation and volatility clustering.
5. **Enhanced Geopolitical Risk Modelling:** Future studies may incorporate event-based textual analysis, news sentiment mining, or geopolitical stability indices to capture deeper qualitative effects.
6. **Global Comparative Context:** Examining similar indices-such as FTSE Metals & Mining or MSCI Metals Index-can help contextualize India's metal sector sensitivity within global markets.

Conclusion

This research provides a comprehensive examination of how macroeconomic variables influence the performance of the Nifty Metal Index and how these relationships are moderated by geopolitical events and fiscal policy. The analysis demonstrates that GDP growth and global commodity prices are critical positive drivers of sectoral performance, while inflation, interest rates, and currency volatility impose substantial downward pressures. Geopolitical events amplify these negative effects by heightening uncertainty, distorting commodity supply chains, and intensifying investor risk aversion. In contrast, expansionary fiscal policies-particularly infrastructure-led spending-serve as effective stabilizers, mitigating macroeconomic stress and promoting sectoral recovery. The study's integrated empirical model contributes to academic literature by establishing a dual-moderation framework that captures complex interactions across macroeconomic, political, and policy dimensions. The findings hold practical importance for policymakers seeking to safeguard industrial growth, for investors aiming to optimize portfolio strategies, and for metal sector firms navigating economic and geopolitical uncertainties. Ultimately, the study underscores the need for coordinated macroeconomic management and strategic institutional responses to strengthen the resilience and long-term performance of the Indian metal sector.

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