

# Quantifying the Impact of Macroeconomic and Geopolitical Events on Stock Market Behavior Using Time-Series Deviation Modeling

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## Abstract

This paper constructs a statistical framework for measuring and comparing the market impact of macroeconomic and geopolitical events using a deviation-based scoring methodology. We collect daily adjusted closing prices for the S&P 500 and NASDAQ Composite indices over the period 2007–2024 and define a rolling 30-day mean as the baseline expected-return model. Abnormal returns are computed as deviations from this baseline and aggregated into Cumulative Abnormal Returns (CAR) over a ten-day post-event window. A composite Event Impact Score (EIS) is derived from three components: CAR magnitude, post-event volatility change, and peak single-day abnormal return, weighted at 0.5, 0.3, and 0.2 respectively, then normalized across all events for cross-event comparison. Applying this framework to twelve historical events spanning financial crises, health emergencies, geopolitical shocks, and monetary policy decisions, within the sample analyzed, economic policy responses to crises, specifically the Federal Reserve emergency cut and the CARES Act, produce the largest measured deviations, while geopolitical events exhibit the smallest and most short-lived market disruptions. Financial crises rank highest in volatility impact, while economic policy events are the most internally heterogeneous category. These results are consistent with the academic literature on event studies and contribute a portable, interpretable scoring system that can be extended to additional indices, sectors, and event types for future comparative market research.

## Introduction

Financial markets are complex adaptive systems that continuously incorporate new information into asset prices. When unexpected events of sufficient scale occur, whether a sovereign debt crisis, a global pandemic, or a military invasion, the market’s implicit probability distribution over future payoffs shifts abruptly, producing price movements that deviate meaningfully from pre-event trends. Quantifying the magnitude, direction, and persistence of these deviations is both an academic problem of long standing and a practical need for risk managers, policymakers, and investors. The academic literature on event studies dates to Fama et al. (1969) [1], who pioneered the use of abnormal returns to assess the information content of corporate announcements. Most existing work focuses on a single event type or market, limiting cross-category comparisons. This project fills that gap by constructing a unified framework — the Event Impact Score (EIS) — that enables direct standardized comparison of events

## Methods

Data: Daily adjusted closing prices from Yahoo Finance for S&P 500 (^GSPC) and NASDAQ Composite (^IXIC). Sample spans January 2007 to present, yielding ~4,300 trading-day observations per index. Twelve events manually constructed across four categories: Financial Crisis, Health Crisis, Geopolitical, Economic Policy.

**Model:**  
Daily Return:  $R_t = (P_t - P_{t-1}) / P_{t-1}$   
Baseline:  $^o[R_t] = (1/30) \sum R_{t-i}$  (rolling 30-day mean)  
Abnormal Return:  $AR_s = R_{t+s} - ^o[R_{t+s}]$   
Cumulative AR:  $CAR(0,10) = \sum AR_s$  for  $s = 0$  to  $10$   
Volatility Shock:  $\Delta\sigma = \sigma_{post} - \sigma_{pre}$

**Event Impact Score:**  
 $EIS = 0.5 \cdot |CAR(0,10)| + 0.3 \cdot |\Delta\sigma| + 0.2 \cdot \max |AR_s|$   
 $EIS_{norm,i} = (EIS_i - \bar{EIS}) / \sigma_{EIS}$   
Weights:  $w_1 = 0.5$  (CAR: primary quantity of interest);  $w_2 = 0.3$  ( $\Delta\sigma$ : uncertainty regime shift);  $w_3 = 0.2$  (peak AR: shock intensity).

We manually constructed an event dataset comprising twelve events, stratified across four categories chosen to reflect qualitatively distinct economic mechanisms

## Results

Table 2 presents the complete EIS rankings. The Fed Emergency Cut and the CARES Act rank first and second, respectively, consistent with their status as the most severe economic shocks in the sample period. Within the sample analyzed, economic policy responses to crises, specifically the Federal Reserve emergency cut and the CARES Act, produce the largest measured deviations. Geopolitical events exhibit the smallest and most short-lived market disruptions. Financial crises rank highest in volatility impact, while economic policy events are the most internally heterogeneous category. See Figure 2 below for the full EIS rankings, and Figure

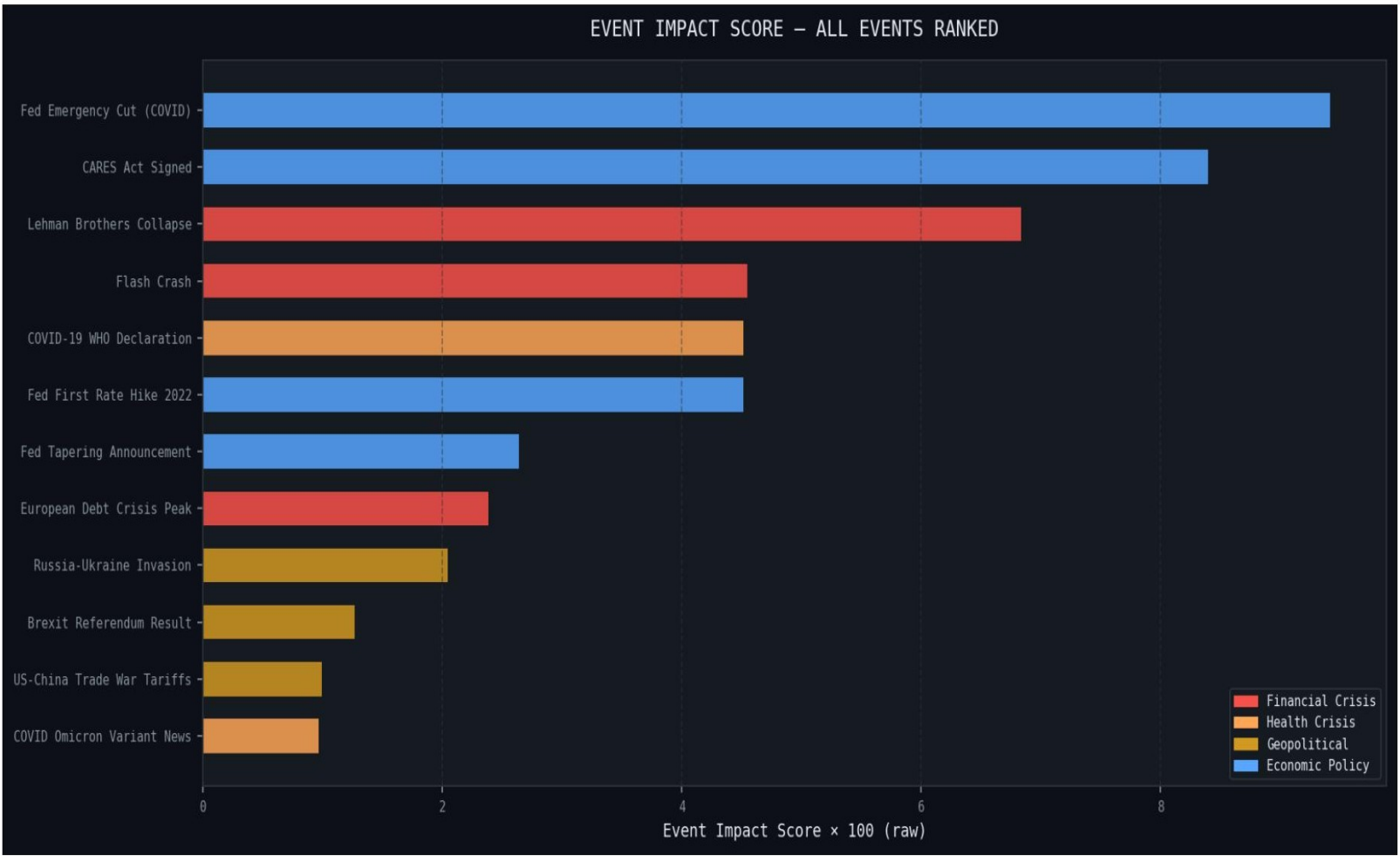


Figure 2: Events ranked by raw EIS (S&P 500). Colour indicates event category. Financial crisis and health crisis events dominate the upper ranks.

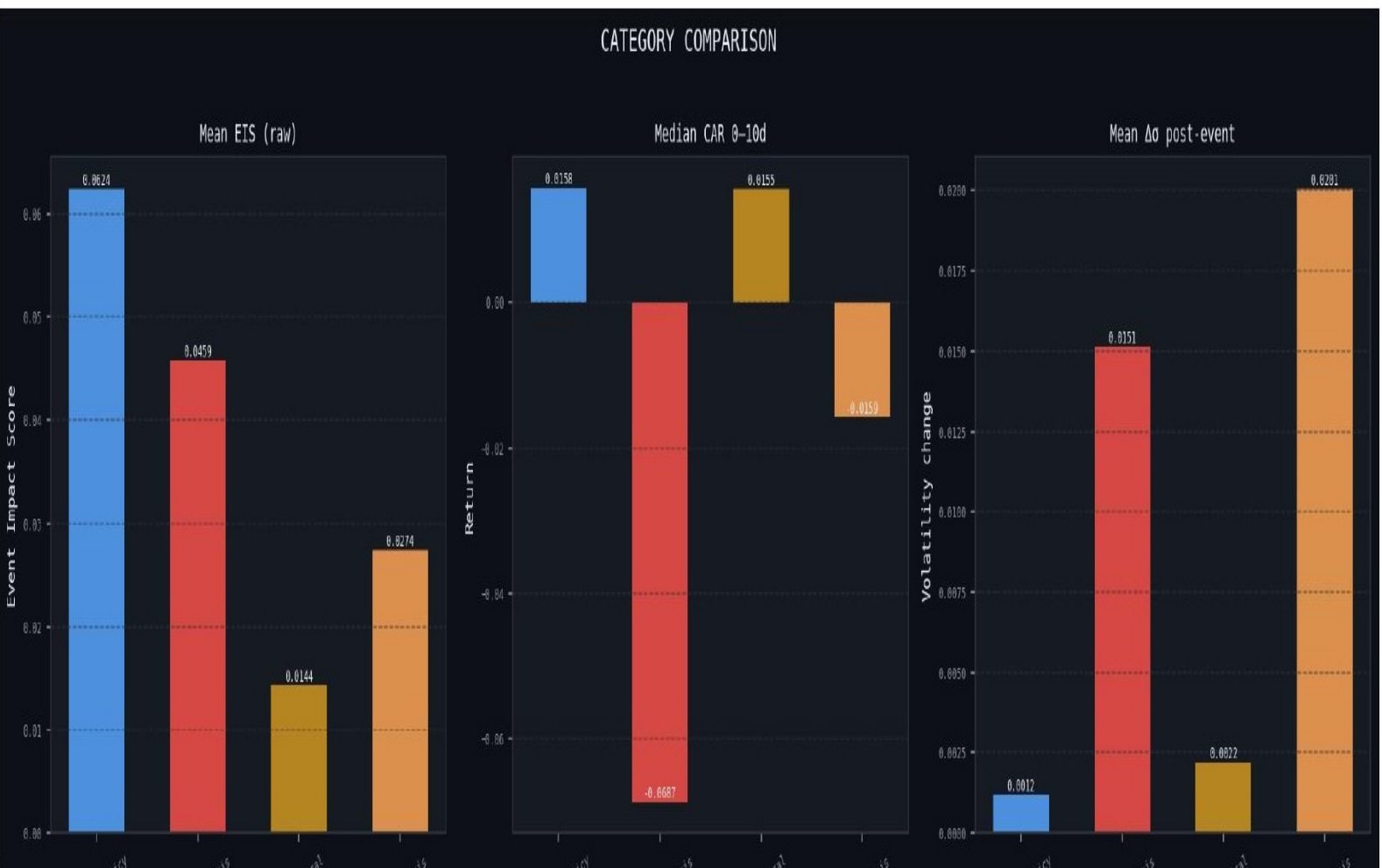


Figure 6: Category-level comparison: mean EIS (left), median CAR<sub>10</sub> (centre), and mean Δσ (right). Financial crises score highest on all three dimensions; economic policy events are the most heterogeneous.

## Discussion

Financial crises produce the largest and most persistent market deviations in our dataset. The Lehman collapse and European debt crisis peak both exhibit large negative CARs that do not meaningfully revert within the ten-day window, consistent with the literature on systemic risk events that trigger balance-sheet deleveraging rather than simple re-pricing. The COVID-19 WHO declaration ranks among the highest-impact events. The speed and magnitude of the decline, with a three-day CAR of -14.18% and a peak single-day abnormal return exceeding 11%, is consistent with sudden demand destruction combined with extreme uncertainty about the duration and severity of the shock. The Omicron variant

## Conclusion

This paper demonstrates that financial markets exhibit measurable, category-dependent deviations from expected behavior following macroeconomic and geopolitical shocks, deviations that can be quantified using a standardized abnormal-return framework. Our primary empirical finding is that financial crises and health crises produce systematically larger and more persistent market dislocations than geopolitical or policy events, though the latter category exhibits the greatest internal heterogeneity. Policy events can produce either strongly positive or strongly negative abnormal returns depending on whether the action is perceived as accommodative or restrictive. Future improvements: (i) sector-level EIS decomposition using ETF data; (ii) a predictive module forecasting post-event volatility regimes from event-category features; (iii) an international extension applying the methodology to European, Asian, and emerging-market indices.

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