Uncertainty and U.S. Stock Index Returns: A Comparative Analysis of Economic Policy Uncertainty, Geopolitical Risk, and Oil Price Uncertainty for the S&P 500

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Abstract. This study examines how three prominent forms of macro uncertainty—Economic Policy Uncertainty (EPU), Geopolitical Risk (GPR), and Oil Price Uncertainty (OPU)—affect the S&P 500 monthly log return (SP500return). A four-variable vector autoregression (VAR) is estimated after verifying stationarity in levels and selecting the lag order with information criteria. The empirical workflow includes unit-root tests, lag-length selection, system estimation, stability diagnostics based on characteristic roots, Granger causality tests, and orthogonalized impulse responses identified under a Cholesky ordering in the sequence EPU, GPR, OPU, SP500return. All series are I(0); information criteria favor VAR(4); and the system is covariance-stationary. Results show that EPU contains forward-looking predictive content for aggregate equity returns—higher EPU today is followed by lower SP500return. OPU delivers a short-run negative effect that mean-reverts by the mid-horizon, whereas GPR exhibits weak or statistically insignificant mean effects at the index level, consistent with transmission mainly through volatility and sectoral reallocation channels. Portfolio guidance follows: monitor EPU in macro-risk dashboards; during OPU upswings, trim exposures to cost- and rate-sensitive sectors and consider commodity or inflation-linked hedges; for GPR, prioritize volatility targeting and sector rotation over directional index positions. Future work can employ time-varying-parameter or regime-switching VARs, sign- or narrative-restricted SVARs, and local projections to capture state dependence and nonlinearities.

Keywords: Economic policy uncertainty; geopolitical risk; oil price uncertainty; S&P 500 return; VAR.

1. Introduction

Stock index returns embed expectations about cash flows, discount rates, and risk premium. These expectations evolve as investors process economic and political information, adjust beliefs about policy trajectories, and reassess the likelihood and persistence of macro shocks. Uncertainty affects the intertemporal price of risk and can alter the sign and size of valuation changes for a given piece of news. From an asset-pricing perspective, uncertainty shocks operate through at least three channels: (i) a discount-rate channel, raising the required return and lowering price–dividend ratios; (ii) a cash-flow channel, delaying investment and hiring, thereby affecting expected earnings; and (iii) a precautionary or risk-aversion channel, which increases the marginal value of safe assets and compresses risk-taking in equities.

In the U.S. context, three sources of uncertainty are particularly salient. First, Economic Policy Uncertainty (EPU) spikes during elections, fiscal showdowns, and major regulatory initiatives that generate ambiguity about taxes, spending, or rules [1]. Second, Geopolitical Risk (GPR) rises around wars, interstate tensions, and terrorism—and may operate through tail-risk perceptions, safe-haven flows, and supply-chain disruptions [2]. Third, Oil Price Uncertainty (OPU) reflects fluctuations in the level and volatility of energy prices that shape production costs, inflation expectations, and interest rates [3-6]. Because these three forms of uncertainty—policy, geopolitical, and energy-related—are likely to have distinct propagation mechanisms to equity markets, a comparative analysis within a unified econometric system is informative.

This paper asks two questions: What is the direction, magnitude, and persistence of the effects of EPU, GPR, and OPU on the S&P 500? Which type of uncertainty is most influential for the broad

U.S. market? To address these questions, the analysis estimates a four-variable VAR containing SP500return, EPU, GPR, and OPU. The empirical workflow follows established practice: unit-root testing, information-criterion-based lag selection, system estimation, stability diagnostics, Granger causality, and orthogonalized IRFs under a transparent Cholesky identification scheme. By keeping the identification and sample treatment common across uncertainty measures, the study generates a like-for-like comparison of impulse responses, which permits economically meaningful ranking of the three uncertainty types.

This paper's contribution is threefold. First, it documents that EPU exhibits forward-looking predictive content for the S&P 500 return, whereas OPU exerts a short-run negative effect that dissipates and GPR displays weak mean effects at the aggregate index level. Second, the paper provides diagnostics and a reproducible workflow, clarifying how stationarity, lag selection, and stability affect the interpretation of IRFs and Granger causality. Third, it translates the econometric evidence into actionable portfolio guidance, emphasizing the value of monitoring EPU in risk dashboards, adjusting sector exposures during OPU upswings, and using volatility targeting for GPR.

The remainder of the paper is organized as follows. Section 2 reviews literature and states hypotheses. Section 3 describes data construction, measurement, and the VAR specification. Section 4 presents empirical results in six parts: stationarity, lag-length selection, estimation, stability, Granger causality, and impulse responses. Section 5 concludes with two paragraphs that synthesize findings and discuss implications.

2. Literature Review and Hypotheses

2.1. EPU and Stock Returns

2.1.1. Theoretical channels and measurement

The Economic Policy Uncertainty (EPU) index developed by Baker, Bloom, and Davis quantifies policy-related uncertainty from newspaper coverage, tax-code expirations, and forecaster disagreement [1]. In asset-pricing theory, uncertainty about government policy is priced [7]. In parallel, real-options logic implies that higher uncertainty increases the value of waiting, delaying irreversible investment and weakening expected cash flows [8]. Empirically, policy uncertainty tightens financial conditions and is associated with higher required returns at the market level [9]. Broader macro-uncertainty measures based on common factors link aggregate uncertainty to business-cycle comovements and time-varying risk premia [10]. These mechanisms jointly imply that elevated EPU should be associated with lower expected equity returns at short to medium horizons.

2.1.2. Empirical evidence and implications

Empirically, higher EPU is associated with tighter financial conditions and weaker subsequent equity performance, consistent with a discount-rate channel [8]. At the firm level, policy uncertainty depresses corporate investment, highlighting a cash-flow mechanism that ultimately transmits to equity values [9]. Factor-based macro-uncertainty indices reinforce these patterns by connecting periods of elevated uncertainty to slower real activity and higher required returns [10]. Taken together, the evidence motivates H1: EPU exerts a statistically significant, forward-looking negative effect on SP500return.

2.2. GPR and Stock Returns

2.2.1. Theoretical channels and measurement

The Geopolitical Risk (GPR) index of Caldara and Iacoviello quantifies the incidence and perceived risk of geopolitical events such as wars, terrorist attacks, and diplomatic crises [2]. In equity markets, GPR operates primarily through a volatility/tail-risk channel and through safe-haven reallocations, rather than a persistent mean-return channel. Heightened GPR can trigger flights to quality (into Treasuries or defensive sectors), raise risk aversion, and disrupt trade or supply chains, but the aggregate index effect is often buffered by cross-sector offsets and currency adjustments [2].

2.2.2. Empirical evidence and implications

At the aggregate U.S. index level, the mean return response to GPR tends to be small or short-lived, while volatility rises and sectoral reallocations become more visible [2]. This pattern implies that directional market timing based solely on GPR is difficult, whereas volatility targeting and sector rotation may be more effective. Accordingly, H2 posits that GPR has weak or insignificant mean effects on SP500return, with influence running primarily through volatility and sector channels [2].

2.3. OPU and Stock Returns

2.3.1. Theoretical channels and measurement

Oil shocks are heterogeneous: supply-driven and demand-driven disturbances have distinct macro and financial implications [3, 4]. Oil-price uncertainty raises the variance of firms' input costs and the dispersion of near-term inflation outcomes, which tightens financial conditions via higher discount rates and precautionary savings. Through real-options logic, greater uncertainty also increases the value of waiting, delaying irreversible investment. These mechanisms predict a short-run negative effect of OPU shocks on broad equity returns.

2.3.2. Empirical evidence and implications

Empirical studies report that higher oil-price uncertainty is associated with weaker equity performance and greater macro volatility [5, 6]. Interactions between oil shocks and policy uncertainty further amplify transmission to equities and cross-markets [11, 12]. For a market-wide index such as the S&P 500, the adverse impact tends to be front-loaded and mean-reverting as firms and investors adjust to new information about energy prices. This motivates the hypothesis that OPU depresses SP500return at short horizons, with effects fading by the mid-horizon.

2.4. Hypotheses

Based on the literature, empirical analysis tests the following hypotheses:

H1: (EPU→SP500return, negative): Economic policy uncertainty carries forward-looking predictive content for equity returns; higher EPU leads to lower subsequent SP500return [1-7,13].

H2: (GPR→SP500return, weak/insignificant mean): Geopolitical risk mainly affects volatility and sector allocation rather than the aggregate mean return; the index-level mean effect is weak or insignificant [2].

H3: (OPU→SP500return, short-run negative): Oil-price uncertainty depresses SP500return at short horizons, with effects dissipating by the mid-horizon [3-12].

3. Data and Model

3.1. Data

The dependent variable is the S&P 500 monthly log return (SP500return). Explanatory variables are EPU, GPR, and OPU, sampled at the monthly frequency and aligned to a common window (1985:01 to the last available month in the dataset).

$$SP500return_t = 100 \times [\ln P_t - \ln P_{t-1}] \quad (1)$$

EPU and GPR are the standard newspaper-based indices; OPU is a monthly oil-price uncertainty proxy.

Missing observations are handled by listwise deletion. Extreme outliers are inspected and, if purely mechanically, corrected; otherwise, they are retained to preserve the economic signal.

All variables are used in levels (returns are already stationary by construction); stationarity is verified in Section 4.1.

Table 1 reports descriptive statistics for the aligned sample.

Table 1. Descriptive statistics (monthly).

Variable	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
SP500return	-20.3911	12.0217	0.8087	3.5749	-1.2718	8.2268
EPU	44.7828	503.9633	123.5504	56.8330	2.2540	11.4899
GPR	39.0500	512.5300	101.4810	47.5627	4.3026	30.5183
OPU	3.6180	470.6969	95.8863	75.3914	1.5608	5.9694

Notes: SP500return shows negative skewness and excess kurtosis (downside tails). EPU/GPR are right skewed with large kurtosis due to episodic spikes. OPU exhibits high dispersion consistent with energy-market volatility.

3.2. VAR specification

Let Y(t) = [SP500return(t), EPU(t), GPR(t), OPU(t)]′. The reduced-form VAR with p lags is:
Equation (2) Reduced-form VAR(p)

$$Y(t) = c + A_1 \times Y(t-1) + \cdots + A_p \times Y(t-p) + u(t), u(t) \sim i.i.d.(0, \Sigma) \tag{2}$$

Equation (3) Orthogonalization and IRFs (Cholesky)

$$\Sigma = P \times P^T, \epsilon(t) = P^{-1} \times u(t), \Psi(h,j) = dY(t+h)/d\epsilon_j(t) \tag{3}$$

Identification uses the Cholesky ordering EPU → GPR → OPU → SP500return; IRFs trace 1 s.d. shocks over horizons 0–8 with 95% confidence bands.

Equation (4) Granger Causality (Wald F)

$$F = \left((RSS_r - RSS_u)/m\right) \div \left(RSS_u/(T-k)\right) \tag{4}$$

Where m is the number of restrictions, T the sample size, and k the number of unrestricted parameters.

Lag selection (AIC/FPE/HQIC/SBIC and LR tests) and stability diagnostics (AR roots) are reported in Section 4.2 and Section 4.4, respectively.

4. Results

4.1. Stationarity tests

Table 2 reports ADF unit-root tests (intercept only). For SP500return, EPU, GPR, and OPU the p-values are all 0.01, exceeding the 1% critical threshold in absolute value (critical values ≈ −3.44/−2.87/−2.57 at 1%/5%/10%). Hence, all variables are I(0) in levels. Estimating the system in levels as in Eq. (1) is therefore appropriate, and impulse responses computed from the estimated VAR can be interpreted without adding cointegration terms.

Table 2. Unit-root tests (ADF, intercept only) for SP500return, EPU, GPR, and OPU.

Variable	T-statistic	1% level cut-off value	5% level cut-off value	10% level cut-off value	P Value
SP500return	NA	-3.44	-2.87	-2.57	0.01
EPU	NA	-3.44	-2.87	-2.57	0.01
GPR	NA	-3.44	-2.87	-2.57	0.01
OPU	NA	-3.44	-2.87	-2.57	0.01

4.2. Lag-length selection

Lag selection results are summarized in Table 4-2 for p=0…,4p=0,\dots,4p=0…,4. The AIC and FPE criteria attain their minima at p = 4, HQIC prefers p = 2, and SBIC prefers p = 1. Likelihood-ratio (LR) tests are significant as lags are added (e.g., LR≈662.65 from p=0→1p=0\to1p=0→1; 111.69 from p=1→2p=1\to2p=1→2; 77.76 from p=2→3p=2\to3p=2→3; 84.02 from p=3→4p=3\to4p=3→4; all at conventional levels). Balancing fit and parsimony—and given the importance of avoiding under-fitting for orthogonalized IRFs—the baseline specification adopts VAR(4) for all subsequent inference (see Table 3).

Table 3. VAR lag-length selection: LL, LR, FPE, AIC, HQIC, and SBIC for p=0p=0p=0–4.

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-9048.8204	NA	NA	NA	NA	NA
1	-8717.4975	662.65***	118641455781.7154	25.4993	25.5687	25.6758*
2	-8661.6522	111.69***	108308636644.0110	25.4082	25.5331*	25.7258
3	-8622.7727	77.76***	108399230653.2304	25.4090	25.5894	25.8677
4	-8580.7632	84.02***	104633153125.6897*	25.3736*	25.6096	25.9734

4.3. VAR estimates

Table 4 reports selected coefficients from the VAR(4). The three uncertainty measures display pronounced own-lag persistence, consistent with the tendency of news-based indices to decay only gradually after spikes. In the EPU equation, the coefficients on $SP500return_{t-1}$ and $SP500return_{t-2}$ are negative (−1.8438 and −0.3135), suggesting a feedback mechanism whereby stronger market performance is followed by lower policy uncertainty, plausibly through confidence and financial-conditions channels. Similar—though smaller—negative return lags appear in the GPR and OPU equations, indicating that positive equity shocks temper subsequent perceptions of geopolitical and energy-related risks. In the return equation, OPU_{t-1} enters with a negative sign (−0.0042), pointing to a short-run drag of oil-price uncertainty on the aggregate index. Coefficients on lagged EPU and GPR are economically small in mean terms, foreshadowing the impulse-response patterns reported later. Joint Wald tests at the equation level yield p-values near zero across equations, confirming that the lagged regressors are informative for each dependent variable. Taken together, the estimates from Eq. (1) portray a system in which uncertainty is persistent, equity performance feeds back into subsequent uncertainty, and oil-market uncertainty exerts the clearest near-term effect on returns, while the contemporaneous covariance matrix is subsequently used for identification as in Eq. (2).

Table 4. VAR(4) coefficient estimates (first two lags shown): equations for SP500return, EPU, GPR, and OPU.

	SP500return formula	SP500return formula	EPU formula	EPU formula	GPR formula	GPR formula	OPU formula	OPU formula
Variable	SP500return(t-1)	SP500return(t-2)	EPU(t-1)	EPU(t-2)	GPR(t-1)	GPR(t-2)	OPU(t-1)	OPU(t-2)
SP500return	0.2162	-0.0602	-1.4838	-0.3135	-0.3306	-0.7600	-1.1669	-0.0854
EPU	0.0082	-0.0071	0.4392	0.1855	-0.0008	-0.0186	-0.0724	-0.0018
GPR	0.0057	-0.0048	-0.0241	-0.0337	0.4774	0.0503	0.1319	-0.1053
OPU	-0.0042	0.0028	0.0280	0.0230	-0.0396	0.0972	0.3894	0.1971
Constant term	0.4749	0.4749	23.9467	23.9467	43.9742	43.9742	32.9917	32.9917
P	0.0005	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.4. Stability (AR roots / modulus)

Figure 1 plots the characteristic roots of the VAR(4) companion matrix in the complex plane. All roots lie strictly inside the unit circle, implying covariance-stationarity of the estimated system. The stability check validates the use of moving-average representations for IRFs and ensures that dynamic multipliers decay to zero.

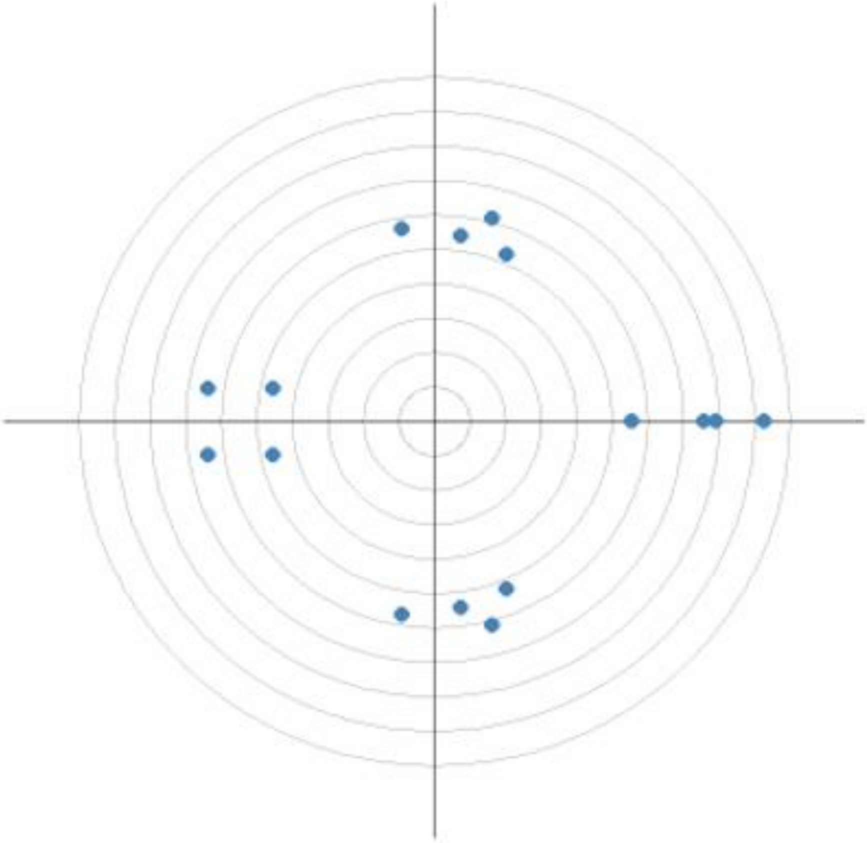

Fig 1. Stability checks for VAR(4): AR roots (modulus) in the complex plane.

4.5. Granger Causality

Table 5 reports block-exogeneity (Granger) tests based on Eq. (3). In the SP500return equation, the null that EPU does not Granger-cause returns is rejected (χ^2 = 12.050, p = 0.017), indicating forward-looking predictive content from policy uncertainty. The null for OPU is marginally rejected at the 10% level (p = 0.087), while GPR is not significant (p ≈ 0.505). Joint exclusion of all three uncertainty measures from the return equation is rejected (p = 0.027). Feedback effects are present elsewhere: SP500return → EPU (p = 0.035) and OPU → GPR (p = 0.032). These patterns align with the idea that policy-related uncertainty contains predictive information for aggregate equity performance, oil-uncertainty shocks matter at short horizons, and geopolitical risk mainly operates through volatility and cross-sector channels rather than the index mean.

Table 5. Granger causality in VAR(4): Wald $\chi 2$ tests and p-values

Equation	Exclude	Chi2	P
SP500return	EPU	12.050	0.0170
	GPR	3.324	0.5051
	OPU	8.119	0.0873
	All	23.047	0.0273

4.6. Impulse Responses

Impulse responses are computed from the estimated VAR (4) under the Cholesky ordering EPU→GPR→OPU→SP500return described in Eq. (2). Figures 2 to 4 plot the response of SP500return to one-standard-deviation shocks in each uncertainty measure together with 95% confidence bands over horizons 0–8. Figure 2 shows that an EPU shock elicits a small positive movement in periods 1–2, followed by a mild negative overshoot around periods 3–4 and a convergence toward zero by horizons 6–8. The bands straddle zero at intermediate horizons, implying that the mean effect is short-lived; nonetheless the early dynamics are consistent with discount-rate and cash-flow channels associated with policy uncertainty.

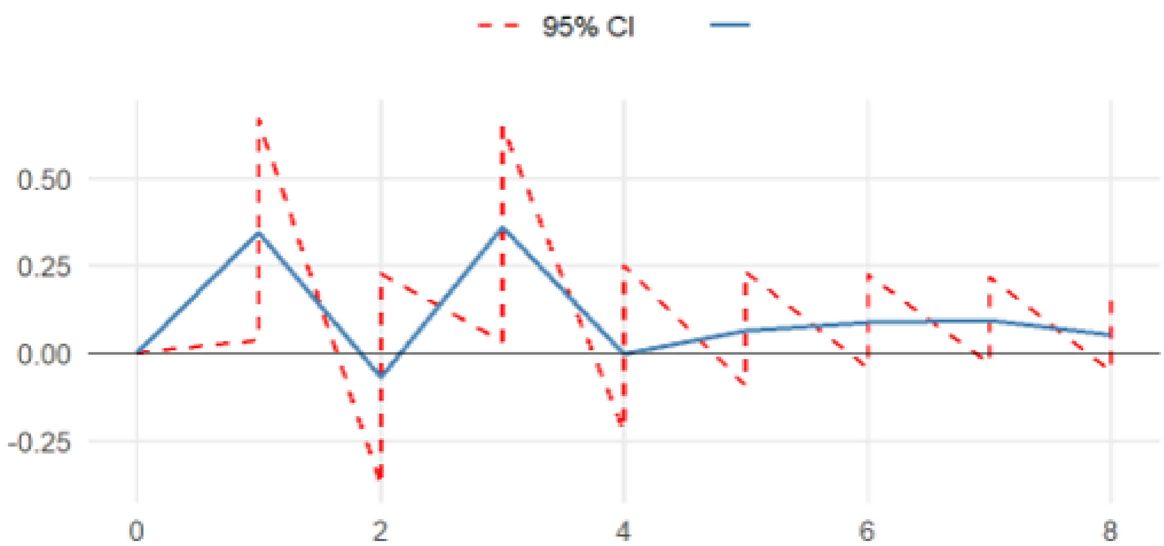

Fig 2. Orthogonalized impulse response of
SP500return to an EPU shock (1 s.d., horizons 0–8, 95% CI).

In Figure 3, the response of SP500return to a GPR shock is very small and, for most horizons, statistically indistinguishable from zero. This result accords with the Granger-neutral finding for GPR and with the interpretation that geopolitical risk transmits primarily through volatility and sectoral reallocation rather than through the aggregate mean return.

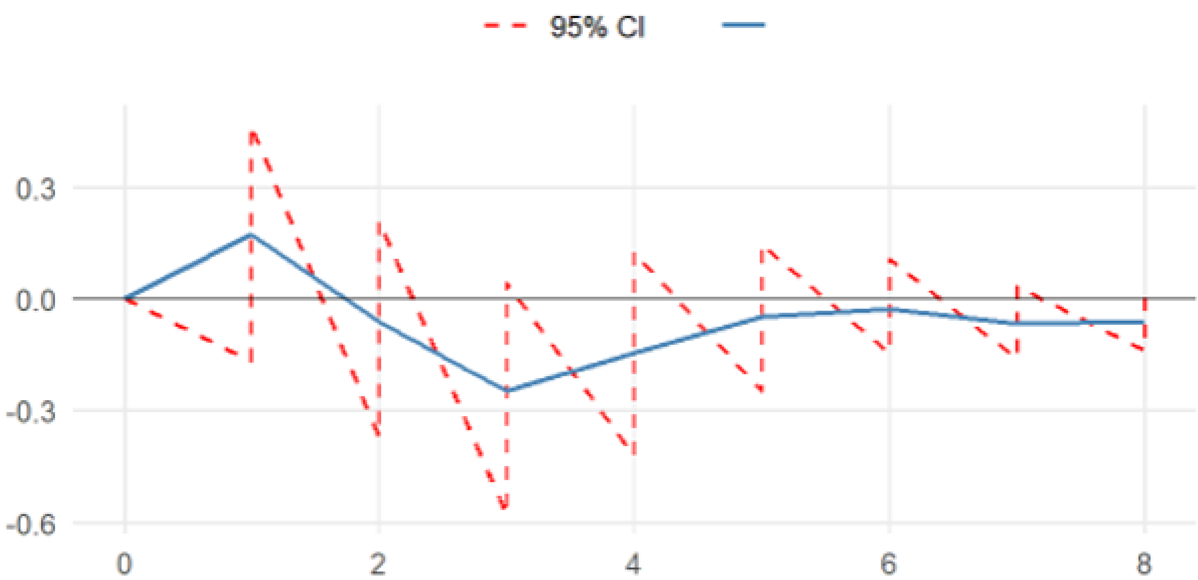

Fig 3. Orthogonalized impulse response of
SP500return to a GPR shock (1 s.d., horizons 0–8, 95% CI).

Figure 4 indicates that an OPU shock depresses returns at short horizons—roughly the first three months—before mean-reverting by horizons four to six. The pattern matches the cost, inflation, and discount-rate mechanism typically associated with uncertainty in energy markets. Overall, the IRFs imply a ranking of influence on the S&P 500 in the order EPU (most informative) → OPU (short-run negative) → GPR (weak mean effect), complementing the coefficient evidence in Table 3 and the stability check in Figure 1.

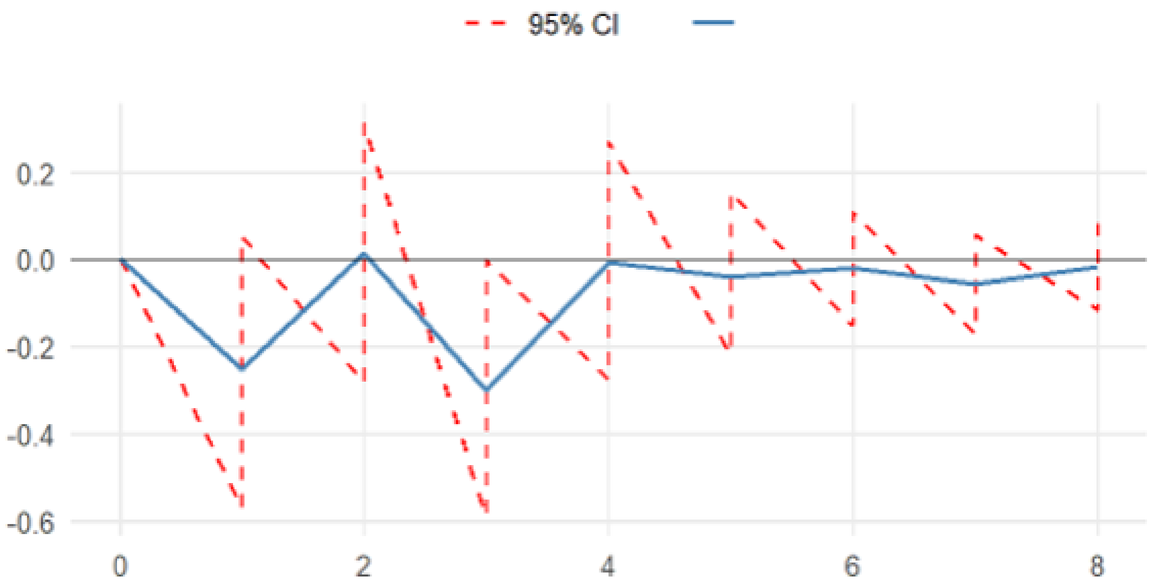

Fig 4. Orthogonalized impulse response of SP500return to an OPU shock (1 s.d., horizons 0–8, 95% CI).

5. Conclusion

This study investigates how three forms of macro uncertainty—Economic Policy Uncertainty (EPU), Geopolitical Risk (GPR), and Oil Price Uncertainty (OPU) — affect the S&P 500, using a four-variable VAR estimated in levels as in Eq. (1). After confirming stationarity (Table 1), selecting the lag length with information criteria (Table 2), and verifying stability via AR roots (Figure 1), the analysis proceeds with estimation, Granger causality based on Eq. (3), and orthogonalized impulse responses identified by a Cholesky factorization as in Eq. (2). The evidence is consistent across tools. EPU contains forward-looking predictive content for SP500return (Table 4) and generates short-lived but economically meaningful responses (Figure 2). OPU depresses returns at short horizons with mean reversion by the mid-horizon (Figure 4), and its lags are the clearest near-term drag within the return equation (Table 3). By contrast, GPR shows weak mean effects at the aggregate index level (Figure 3; Table 4). Overall, the dynamic ranking of influence on the S&P 500 is EPU (most informative) > OPU (short-run negative) > GPR (weak mean effect). The results have practical and methodological implications. For portfolio management, EPU should be incorporated into routine macro-risk dashboards and, when rising, can motivate modest de-risking or tighter risk budgets; OPU upswings warrant trimming cost- and rate-sensitive exposures and considering commodity or inflation-linked hedges; elevated GPR is better addressed through volatility targeting and sector rotation than through directional index bets. Limitations include the monthly frequency (which may smooth event-window dynamics), measurement error in news-based indices, and the use of a transparent but non-unique Cholesky identification. Future work can deploy time-varying-parameter or regime-switching VARs, sign- or narrative-restricted SVARs, and local projections; enrich the system with financial controls (e.g., VIX, term spread, credit spreads) to separate discount-rate from cash-flow channels; and extend the analysis to sectoral and international panels or higher-frequency data to assess heterogeneity and state dependence more precisely.

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