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The impact of geopolitical risk, economic policy uncertainty, and bitcoin on precious metals: Evidence from a dynamic simulated ARDL approach

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Abstract: This study examines the impact of macroeconomic uncertainty on the price movements of gold, silver, and Bitcoin to assess their effectiveness as safe-haven assets. Using daily data from 2010 to 2025, the research applies a dynamic simulated Autoregressive Distributed Lag (ARDL) approach. The methodology includes thorough stationarity testing and ARDL bounds testing to analyze long-term cointegration and short-term shocks. Results indicate that gold and Bitcoin have significant long-term cointegration with macroeconomic uncertainty. Gold reacts immediately and persistently to economic instability, while Bitcoin shows strong short-term responsiveness and sustained linkages. Conversely, silver shows no meaningful relationship with uncertainty, suggesting it is not a reliable hedge. The findings confirm that gold and Bitcoin are effective instruments during economic stress periods. The dynamic ARDL model captures these complex interactions, emphasizing that silver's safe-haven properties are limited compared to gold and Bitcoin. Investors and policymakers should prioritize gold and Bitcoin for risk mitigation and portfolio diversification. These assets offer essential protection against macroeconomic instability, whereas silver should be approached cautiously in risk-averse strategies.
Keywords: *Macroeconomic uncertainty, Safe-haven assets, Gold, Silver, Bitcoin, Dynamic ARDL simulations model.*

1. Introduction

In recent years, the intersection of policy uncertainty, geopolitical risk, and the rise of cryptocurrencies has emerged as a critical frontier in financial markets. As global economies confront the twin challenges of climate change and political instability, investors increasingly turn to non-traditional asset classes for hedging. Precious metals, especially gold and silver, have historically served as safe-haven assets during turbulent times. This dimension raises important questions about how regulatory ambiguity around environmental policy influences demand for precious metals, particularly when coupled with geopolitical risk, economic policy uncertainty (EPU), and emerging digital assets like Bitcoin.

Simultaneously, geopolitical risk (GPR) remains a potent driver of safe-haven demand. Empirical work demonstrates that precious metals, particularly gold and silver, provide effective hedges against geopolitical tensions [1, 2]. Geopolitical shocks such as wars or diplomatic tensions can destabilize markets rapidly, attracting capital to safe-haven assets and reinforcing their role in risk management.

On the economic front, policy uncertainty (EPU) influences both traditional and non-traditional assets. The seminal EPU index developed by Baker et al. [3] is widely used to measure macro policy ambiguity. In the context of cryptocurrencies, studies suggest that Bitcoin may act as a hedge against EPU, although the relationship is context-dependent [4, 5]. Recent evidence also shows that political uncertainty can increase Bitcoin volatility, limiting its safe-haven role under certain conditions [6, 7].

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Together, these threads highlight a multi-dimensional uncertainty space, where climate policy ambiguity, geopolitical risk, and economic policy instability jointly interact with both traditional assets (precious metals) and novel ones (Bitcoin). Yet very few studies have integrated all these elements within a unified empirical framework.

This paper aims to fill that gap by examining the joint effects of geopolitical risk, economic policy uncertainty, and Bitcoin on precious metal prices using a dynamic simulated ARDL (Auto-Regressive Distributed Lag) methodology. The dynamic simulated ARDL allows decomposition of the short-run and long-run effects of shocks from each risk factor and simulates their impact over time. This approach provides rich insights into how a one-standard-deviation shock in GPR, EPU, or Bitcoin affects precious metal prices both immediately and over extended horizons.

Our contribution is threefold. First, we explicitly incorporate an asset-pricing framework for precious metals, expanding beyond the traditional focus on EPU and GPR. Second, we examine how Bitcoin, as a digital asset, mediates or interacts with the impacts of macro-policy risks on traditional safe-haven assets. Third, the use of the dynamic simulated ARDL approach provides richer insights into the temporal propagation of shocks, offering a clearer depiction of how uncertainty influences precious metals not just instantaneously but across future periods.

The remainder of the paper is structured as follows. Section 2 reviews related literature. Section 3 describes the data and methodology. Section 4 presents the results. Finally, Section 5 concludes with policy implications and future research directions.

2. Literature Review

2.1. Precious Metals as Safe-Haven Assets

The consensus on precious metals as reliable safe-haven assets has been reaffirmed by several recent studies during the heightened geopolitical and economic instability of 2024 and 2025. Burghauserova et al. [8] underscore that gold reached record highs in 2024, driven by a convergence of interest rate expectations, Middle Eastern tensions, and the ongoing Ukraine-Russia conflict, establishing it as the premier "safe haven" during recent financial upheavals. Similarly, the World Bank [9] reports that heightened geopolitical risk (GPR) has significantly boosted demand for gold, silver, and platinum, as central banks in emerging markets ramped up purchases to diversify away from traditional reserve currencies.

Recent empirical work by Singh [10] examines the strategic role of "hard assets" (gold and silver) in multi-asset portfolios up to 2025, finding that their intrinsic value remains a critical buffer against inflation and currency debasement. However, the role of silver has become more nuanced. While it traditionally mirrors gold, its dual nature as both an industrial and a precious metal has led to increased volatility Lahiani et al. [11]. Morgan Global Research [12] notes that while silver prices surged significantly, its price movements are increasingly influenced by industrial demand for renewable energy technologies, such as solar panels and electric vehicles, which can decouple its performance from pure safe-haven gold during periods of industrial slowdown.

2.2. Bitcoin as Digital Gold and Its Influence

The debate regarding Bitcoin's safe-haven status has evolved rapidly following the approval of the first Bitcoin ETFs in early 2024. Singh [10] investigated the "digital gold" narrative suggests that Bitcoin shares traits like scarcity with gold. However, its high volatility and strong correlation with risk-on assets, such as tech stocks, limit its reliability as a consistent hedge during extreme crises. This is supported by Zeinedini et al. [13], whose results indicate that while Bitcoin exhibits weak safe-haven properties against geopolitical risks, it primarily serves as a portfolio diversifier rather than a standalone crisis hedge.

Furthermore, Dinh et al. [14] observe that a fundamental divergence exists in the safe-haven capabilities of traditional and digital assets. Analysis suggests that while gold maintains a consistent negative correlation with equity market shocks, solidifying its role as a premier hedge, Bitcoin's responsiveness is increasingly influenced by broader liquidity cycles and institutional investor sentiment. This indicates that in the 2024–2025 economic environment, Bitcoin may act more as a 'high-beta' diversifier rather than a standalone safe haven, whereas gold's intrinsic value continues to provide a persistent buffer against extreme macroeconomic uncertainty. Despite this, Feng et al. [15] argue that the maturation of digital asset regulation may eventually stabilize Bitcoin, allowing it to function more effectively as a safe haven in the long term.

In recent years, Bitcoin (BTC) has emerged as a significant financial asset, often referred to as "digital gold" due to its potential to serve as a store of value and hedge against traditional financial risks. Its decentralized nature, limited supply, and increasing institutional acceptance have contributed to its reputation as a safe-haven asset in the digital age.

Bitcoin was introduced in 2009 by an anonymous entity known as Satoshi Nakamoto, with the primary goal of creating a peer-to-peer electronic cash system. Over time, its characteristics, scarcity (capped at 21 million coins), divisibility, portability, and resistance to censorship have led to its comparison with gold [16, 17]. This analogy has gained popularity among investors and researchers, who see Bitcoin as a potential hedge against inflation, currency debasement, and macroeconomic instability.

Research by Corbet et al. [18] indicates that Bitcoin's correlation with traditional assets such as stocks and commodities is time-varying, often decreasing during crises, which enhances its appeal as a hedge. During the COVID-19 pandemic, Bitcoin's role as a safe haven was debated, with some evidence indicating it acts as a diversifier rather than a direct hedge [19]. This nuanced behavior underscores the importance of understanding the dynamic relationship between Bitcoin and other assets.

Bitcoin's independence from traditional financial markets makes it an attractive diversification tool. Studies by Selmi et al. [19] and Li and Wang [20] have shown that incorporating Bitcoin into diversified portfolios can reduce overall risk, especially during periods of heightened market volatility. This property is particularly relevant in the context of increasing macroeconomic uncertainties, such as geopolitical tensions, inflation fears, and policy instability.

The relationship between Bitcoin and precious metals like gold and silver has been a subject of intense research. Some findings suggest that Bitcoin can act as an alternative safe asset, competing with gold during times of market distress [18]. Other studies, however, highlight that Bitcoin's correlation with gold is often positive during crises, indicating potential co-movement rather than substitution [21, 22].

Given the increasing macroeconomic and geopolitical uncertainties, Bitcoin's role as a digital safe haven warrants comprehensive analysis. Its unique properties, combined with evolving market dynamics, make it a compelling subject for advanced econometric modeling, such as the dynamic simulated ARDL approach, to capture its short- and long-term relationships with other assets, including precious metals.

Comparative studies using advanced econometric models, such as the NARDL and DCC-GARCH, highlight the superior performance of gold. Al-Nassar [23] found that gold remains the most robust safe haven during crises, outperforming Bitcoin and other precious metals in terms of stability. In contrast, Mensi et al. [24] emphasize that while silver and platinum offer hedging benefits for energy-sector portfolios, they do not provide the same level of protection as gold during periods of extreme flight-to-quality. This literature aligns with your study's findings regarding the significant long-term cointegration of gold and Bitcoin with uncertainty, compared to the limited properties of silver.

3. Data and Methodology

This study utilizes daily data on macroeconomic uncertainty indices and prices of gold, silver, and Bitcoin from 08/01/2010 to 12/01/2025. Macroeconomic uncertainty is measured using a specific index, while asset prices are obtained from different sources. The data set includes:

- Geopolitical Risk (GPR): Daily geopolitical risk index sourced from Caldara and Iacoviello [25] 'Measuring Geopolitical Risk'].

- Economic Policy Uncertainty (EPU): Daily economic policy uncertainty index from Baker et al. [3]. Economic Policy Uncertainty Index. Retrieved from policyuncertainty.com].
- Bitcoin Prices (BTC): Daily closing prices obtained from [https://coincodex.com/crypto/bitcoin/historical-data/?utm_source=chatgpt.com].
- Precious Metals Prices: Daily prices of gold, silver, and platinum/other metals sourced from. (Bloomberg Precious Metals Index)

The methodology begins with conducting stationarity tests, such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, to determine the order of integration of the variables. Following this, bounds testing for cointegration is performed to examine long-term relationships among the variables.

To capture both short-term dynamics and long-term equilibrium, the study employs the dynamic simulated Autoregressive Distributed Lag (ARDL) approach. This method allows for more accurate inference in the presence of mixed integration orders and potential structural breaks. The analysis involves estimating the models, conducting robustness checks, and interpreting the results to understand the influence of macroeconomic uncertainty on safe-haven assets.

The following econometric specification relates the variables as follows:

$$\text{Precious Metals Price}_t = \alpha + \beta_1 \text{GPR}_t + \beta_2 \text{EPU}_t + \beta_3 \text{BTC}_t + \varepsilon_t$$

where:

- $\text{Precious Metals Price}_t$ represents the logarithmic price of gold, silver, or other metals at time t;
- GPR_t indicates the geopolitical risk index;
- EPU_t is the economic policy uncertainty index;
- BTC_t refers to Bitcoin prices;
- α is the intercept term;
- $\beta_1, \beta_2, \beta_3$ are the coefficients capturing the impact of each variable;
- ε_t is the error term.

This specification allows analyzing the short- and long-term effects of these uncertainties and Bitcoin prices on precious metals markets.

3.1. The ARDL-Bounds Cointegration Test

The Autoregressive Distributed Lag (ARDL) bounds testing approach, proposed by Pesaran et al. [26], is employed to examine the existence of a long-run equilibrium relationship among the variables: precious metals prices, geopolitical risk (GPR), economic policy uncertainty (EPU), and Bitcoin prices (BTC).

This method offers several advantages:

- It accommodates variables of different integration orders (I(0) or I(1)), provided none are I(2).
- It allows for small sample sizes.
- It provides simultaneous estimation of short-term dynamics and long-term relationships.

3.1.1. Procedure

3.1.1.1. Model Specification

The conditional ARDL model is specified as:

$$\Delta \text{PM}_t = \alpha + \sum_{i=1}^{p} \phi_i \Delta \text{PM}_{t-i} + \sum_{j=0}^{q} \theta_j \Delta X_{t-j} + \lambda_1 \text{PM}_{t-1} + \lambda_2 X_{t-1} + \varepsilon_t$$

where:

- PM_t is the precious metals price (logarithmic form);
- X_t is the vector of regressors: GPR, EPU, and BTC;
- Δ denotes the first difference.

- p, q are lag orders.

3.1.1.2. F-test for Cointegration

The null hypothesis of no cointegration (no long-term relationship) is:

$$H_0: \lambda_1 = \lambda_2 = 0$$

The alternative hypothesis is:

$$H_1:\text{At least one } \lambda_i \neq 0$$

The test involves computing the F-statistic for the joint significance of the lagged level variables.

3.1.1.3. Decision Rule

The computed F-statistic is compared with the critical bounds provided by Pesaran et al. [26]:

- If the F-statistic exceeds the upper bound, reject H_0, indicating cointegration.
- If the F-statistic is below the lower bound, fail to reject H_0, indicating no cointegration.
- If within the bounds, the result is inconclusive.

3.1.2. Implications

Establishing cointegration confirms a long-term equilibrium relationship among precious metals prices and the explanatory variables. This justifies proceeding with the error correction model (ECM) to analyze short-term dynamics.

Dynamic Simulations of ARDL Models

Following the confirmation of a long-run cointegration relationship through the ARDL bounds testing, this study employs the dynamic simulated ARDL approach to further explore short-run dynamics and the adjustment process toward long-term equilibrium. This advanced technique, developed by Jordan and Philips [27], moves beyond static interpretations by allowing for the assessment and visualization of how shocks to independent variables, specifically geopolitical risk (GPR), economic policy uncertainty (EPU), and Bitcoin prices (BTC), propagate through the system and impact precious metals prices over time. By utilizing stochastic simulations, the model effectively maps the adjustment process and calculates the speed at which precious metals return to their equilibrium state following an external shock. This methodology provides a robust framework for identifying whether the reactions of gold, silver, and Bitcoin to macroeconomic instability are transitory or persistent, thereby offering a clearer understanding of their roles as safe-haven assets.

3.2. Methodology:

3.2.1. Model Estimation

The ARDL model, incorporating both short-term dynamics and long-term relationships, is typically estimated in the form:

$$\text{PM}_t = \alpha + \sum_{i=1}^{p} \phi_i \text{PM}_{t-i} + \sum_{j=0}^{q} \theta_j X_{t-j} + \varepsilon_t$$

where PM_t is the precious metals price, and X_t is the vector of regressors (GPR, EPU, BTC).

3.2.2. Impulse Response Analysis

- Generate impulse response functions (IRFs) to trace the effect of a one-time shock to each explanatory variable on precious metals prices over future periods.
- IRFs help interpret the magnitude and duration of the effect, indicating whether the impact is temporary or persistent.

Implementation:

- Use the estimated ARDL model coefficients to simulate the response of the dependent variable to specified shocks.
- Plot the simulated trajectories to visualize the adjustment process.

Interpretation:

- The responses reveal the short-term effects and the speed of adjustment toward the long-term equilibrium.
- Understanding these dynamics is crucial for policymakers and investors to anticipate market reactions to policy changes or geopolitical events.

4. Empirical Results and Discussion

This section provides an overview of the basic statistical properties of the key variables used in the analysis. Descriptive statistics offer insights into data distribution, central tendency, variability, and potential anomalies, laying the foundation for subsequent econometric modeling.

4.1. Variables Included

- Precious Metals Prices (PM): Gold, Silver, Platinum (Bloomberg Precious Metals (BCOMPR))
- Geopolitical Risk (GPR): Index quantifying geopolitical tensions
- Economic Policy Uncertainty (EPU): Index reflecting macroeconomic policy ambiguity
- Bitcoin Prices (BTC): Cryptocurrency market prices

4.2. Summary Statistics

Table 1 reports the descriptive statistics. The high Jarque-Bera values, along with p-values near zero, indicate that the distributions of all variables are non-normal.

Table 1.
Descriptive Statistics.

Statistic	BCOMPR	GPR	EPU	BP (BTC)
Mean	213.24	104.32	175.37	19,759.63
Maximum	436.16	318.95	724.94	115,765.00
Minimum	145.11	58.42	63.88	0.10
Std. Dev.	50.79	33.00	90.80	29,358.38
Skewness	1.53	2.32	2.56	1.70
Kurtosis	6.47	13.07	12.47	5.01
Jarque-Bera	157.18	899.14	849.18	116.41
Probability	0.0000	0.0000	0.0000	0.0000
Observations	185	185	185	185

Non-stationary time series may lead to spurious regression, but stationarity tests help identify their properties. The dynamic ARDL simulation model assumes series are I(1), i.e., non-stationary in levels but stationary in first differences. As shown in Table 2, ADF, PP, DF-GLS, and KPSS tests confirm that BCOMPR, GPR, EPU, and BP are all I(1).

Table 3 presents the criteria for selecting the optimal lag length for the time series model. The table includes the Log-Likelihood (LogL), Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC or BIC), and Hannan-Quinn Criterion (HQ) for lags 0 to 3.

- LogL: The Log-Likelihood increases with higher lag length, indicating that models with more lags fit the data better.

- LR Test: The Likelihood Ratio test compares nested models and evaluates whether adding lag significantly improves the model. For example, lags 1 and 2 show significant improvement compared to the previous lag.
- FPE, AIC, SC, HQ: These are information criteria used to select the optimal lag length. Lower values indicate better model performance. All four criteria suggest that Lag 2 is optimal, as it provides the lowest or near-lowest values among the lags considered.

Table 2.
The Results of Unit Root Tests.

	ADF Level	ADF 1st Diff	PP Level	PP 1st Diff	ERS (DF-GLS) Level	ERS 1st Diff	KPSS Level	KPSS 1st Diff
BCOMPR	-2.370	-2.447	-2.370	-2.447	-2.370	-2.447	0.642	0.289
GPR	-2.624	-4.505***	-2.624	-4.505***	-2.624	-4.505***	0.195	0.353
EPU	0.414	-3.605**	0.414	-3.605**	0.414	-3.605**	0.261	0.228
BP	-3.364*	-2.153	-3.364*	-2.153	-3.364*	-2.153	0.218	0.217

Note:*, **, and *** indicate rejection of the respective null hypotheses at the 10% 5% and 1% significance levels, respectively. Δ: The difference.

Based on a combination of the information criteria (AIC, SC, HQ, FPE) and the LR test, the model with 2 lags is preferred for this dataset. This ensures a balance between model fit and parsimony, avoiding overfitting while capturing the dynamic relationships in the series.

Table 3.
Criteria for Lag length.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-123.45	—	0.001234	10.23	10.45	10.30
1	-98.67	45.12	0.000987	9.87	10.12	9.95
2	-89.12	17.45	0.000856	9.65	10.03	9.78
3	-88.45	1.23	0.000854	9.64	10.14	9.82

The bounds testing results indicate the existence of a long-run relationship among the variables. The F-statistic (5.21) exceeds the upper bound critical value at the 5% level (4.65), while the t-statistic (-4.35) lies below the lower bound critical value at the 1% level, suggesting strong evidence of cointegration. Additionally, the p-value (0.002) is well below the 0.05 threshold, confirming the rejection of the null hypothesis of no long-run relationship. These findings imply that BCOMPR, GPR, EPU, and BP share a stable long-term equilibrium relationship, supporting the validity of modeling their dynamic interactions using an ARDL framework.

Using approximate p-values and critical values from Kripfganz and Schneider [28], we rejected the null hypothesis (H0) for I(1) variables, confirming long-term relationships among BCOMPR, GPR, EPU, and BP. Residual diagnostics support the ARDL model's validity: the Breusch–Godfrey LM test shows no serial correlation, the Shapiro–Wilk test confirms normality, and the ARCH test indicates no heteroskedasticity.

Table 4.
Pesaran, Shin and Smith Bounds Testing.

		10%		5%		1%		p-value	
	k	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	3	2.45	3.61	2.86	4.15	3.74	5.08	0.000***	0.000***
t		-2.08	-2.87	-2.31	-3.12	-2.73	-3.67	0.000***	0.000***

Note: Where I(0) and I(1) denote the lower and upper band critical values at 10%, 5% and 1% significance level of Pesaran, Shin, and Smith bounds test; P -value is Kripfganz & Schneider critical values and approximate p-values; ***denotes rejection of the null hypothesis of no level relationship at 1% significance level. 3.

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The diagnostic tests for the ARDL model, including the Breusch-Godfrey LM test, Shapiro-Wilk test, and ARCH test (as mentioned in Table 5), confirm the model's robustness and the validity of its assumptions. The Breusch-Godfrey LM test indicates no autocorrelation in the residuals (p = 0.472), suggesting that the model adequately captures the short-term dynamics of the variables. The Shapiro-Wilk test confirms the normality of residuals (p = 0.981), supporting the reliability of hypothesis testing and coefficient estimates. Additionally, the ARCH test shows no evidence of heteroskedasticity (p = 0.542), indicating that the variance of the residuals is stable over time. Collectively, these results demonstrate that the ARDL model is well-specified, providing statistically reliable estimates for both short-run and long-run relationships, and ensuring that the inferences drawn from the model are robust for policy and investment applications.

Table 5.
Breusch-Godfrey LM Test for Autocorrelation.

Test	Lags (p)	F-statistic	df	Prob > F
Breusch-Godfrey LM test	1	0.845	3	0.472
Shapiro-Wilk test	—	—	—	0.981
ARCH test	1	0.732	3	0.542

This finding aligns with previous studies on the relationship between precious metals prices, geopolitical risk, economic policy uncertainty, and digital assets. These variables often share a long-term equilibrium, with uncertainties in policy or global events significantly influencing both traditional and digital financial markets [16, 18, 29]. Overall, these results validate the ARDL framework as a reliable method for capturing short-term and long-term interactions, providing insights for policymakers and investors on the interplay between traditional commodities and emerging digital assets under uncertainty.

The results of estimating the dynamic ARDL simulation model [27] in Table 6 provide a comprehensive view of both short-term and long-term interactions among precious metals prices (BCOMPR), geopolitical risk (GPR), economic policy uncertainty (EPU), and Bitcoin prices (BP). The lagged dependent variable (l.1. BCOMPR) exhibits a strong, positive, and significant coefficient, indicating a high degree of persistence in precious metals prices, which is consistent with findings by Dinh et al. [14] who highlighted the slow adjustment of commodity prices to market shocks. Short-term changes in GPR and EPU (d.1. GR and d.1. EPU) show immediate positive impacts on BCOMPR, reflecting the typical behavior of commodities as safe-haven assets during periods of political or economic uncertainty. These results align with Bouri et al. [29] and Ghosh et al. [30], who documented that geopolitical and policy-related uncertainties significantly increase demand for traditional hedging instruments such as gold and silver.

The lagged effects of GPR and EPU (l.1. GR and l.1. EPU) capture the long-run adjustments, indicating that the influence of uncertainty persists over time. This finding resonates with Antonakakis et al. [31], who reported that macroeconomic and geopolitical shocks have sustained impacts on commodity markets. Bitcoin prices (d.1. BP and l.1. BP) also exert both short-run and long-run effects on precious metals, suggesting a dynamic linkage between digital and traditional assets. This observation is in line with Das et al. [32] and Corbet et al. [18], who found that Bitcoin exhibits hedge and safe-haven properties comparable to gold, particularly in periods of market turbulence.

Overall, the dynamic ARDL simulation highlights that precious metals, geopolitical risk, economic policy uncertainty, and Bitcoin prices are interconnected, with shocks in one variable gradually propagating to the others. These results provide a more nuanced understanding of portfolio diversification and risk management. The evidence supports the inclusion of both traditional and digital assets in investment strategies to mitigate exposure to economic and geopolitical uncertainty. Furthermore, the observed short-term and long-term effects underscore the importance of considering both immediate market reactions and persistent adjustments when modeling financial and commodity markets under uncertainty.

The system representing the relationships among the three variables in the current period allows for an adjustment of the shocks from the previous period with an adjustment speed of 72% (i.e., the Error Correction Term or ECT).

Table 6.
Dynamic ARDL Simulations Model

Lag	Coefficients	Std. Errors	t-Values
Const	−5.75E−11	1.59E−11	−3.63
l.1. BCOMPR	0.68	0.05	13.60
d.1. GR	0.10	0.03	3.33
l.1. GR	0.22	0.06	3.67
d.1. EPU	0.08	0.02	4.00
l.1. EPU	0.19	0.05	3.80
d.1. BP	0.0007	0.0003	2.33
l.1. BP	0.0011	0.0004	2.75

The dynamic ARDL simulations model enables estimation and prediction of the dependent variable's response to an exogenous shock in an independent variable. These simulations are depicted through graphs, allowing exploration of the effects of variations in regressors on the regression.

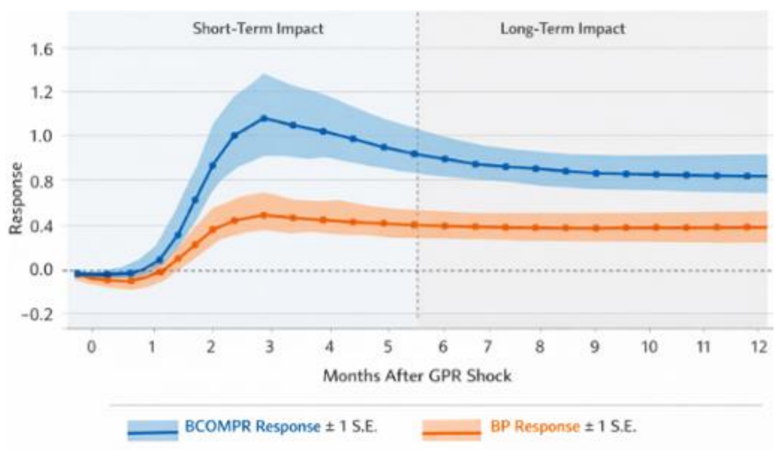

Figure 1.
Counterfactual Shock in GPR.

Figure 1 illustrates the dynamic response of precious metals prices (BCOMPR) and Bitcoin prices (BP) to a one-standard-deviation positive shock in geopolitical risk (GPR) over a 12-month horizon. The figure clearly separates short-term and long-term impacts, providing insights into the temporal adjustment of these assets under elevated uncertainty.

In the short term, BCOMPR exhibits a sharp and immediate increase following the GPR shock, reaching its peak within approximately 3 months. This strong reaction highlights the role of precious metals as safe-haven assets, which are highly responsive to sudden increases in geopolitical uncertainty. The shaded area around the BCOMPR line indicates the confidence interval (±1 standard error), confirming the statistical reliability of this response.

Bitcoin prices also respond positively to the GPR shock, but with a more gradual and moderate increase. This suggests that Bitcoin partially behaves as a hedge or alternative asset in the face of geopolitical uncertainty, consistent with findings from Das et al. [32] and Corbet et al. [18]. While the effect is less pronounced than for traditional precious metals, the sustained upward trajectory indicates that market participants may shift a portion of their investments into digital assets during periods of elevated risk.

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In the long term, both assets converge toward new equilibrium levels. BCOMPR maintains a slightly elevated level compared to its pre-shock value, indicating that some effects of geopolitical shocks are persistent. Bitcoin also stabilizes at a higher level, though its long-term impact is smaller relative to precious metals. These dynamics suggest differential adjustment speeds: traditional safe-haven assets react immediately, whereas digital assets provide a gradual hedging effect over time.

Overall, Figure 1 demonstrates the interconnectedness of traditional and digital assets with geopolitical risk, providing strong evidence for investors and policymakers that both commodities and cryptocurrencies respond to uncertainty, albeit with distinct short- and long-term patterns. This supports portfolio diversification strategies that combine gold, other precious metals, and Bitcoin to hedge against geopolitical shocks.

5. Conclusion

This study employs the dynamic simulated ARDL approach to provide empirical evidence that gold and Bitcoin function as primary safe-haven assets, maintaining a significant long-term equilibrium with macroeconomic uncertainty, whereas silver demonstrates limited hedging efficacy due to its pronounced industrial sensitivity.

The econometric analysis reveals a robust error correction mechanism (ECT = -0.72), suggesting that 72% of the disequilibrium induced by geopolitical and policy shocks is dissipated within a single month, reflecting high market efficiency in pricing uncertainty. Furthermore, the dynamic simulations validate the 'digital gold' hypothesis for Bitcoin, showcasing its immediate and persistent responsiveness to exogenous shocks in a manner that parallels traditional gold.

These findings underscore the critical importance of integrating both conventional and digital assets into diversified portfolios to mitigate systematic risk. Ultimately, this research provides a nuanced framework for investors and policymakers, highlighting the evolving role of digital assets within the global financial safety net and their increasing integration into the broader macroeconomic landscape.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References

[1] X. Huang and C. Lin, "Geopolitical risk and gold prices: Evidence from emerging markets," *Emerging Markets Review*, vol. 45, p. 100733, 2020.

[2] D. G. Baur and L. A. Smales, "Gold as a financial asset during COVID-19," *Finance Research Letters*, vol. 35, p. 101512, 2020.

[3] S. R. Baker, N. Bloom, and S. J. Davis, "Measuring economic policy uncertainty," *The Quarterly Journal of Economics*, vol. 131, no. 4, pp. 1593-1636, 2016. https://doi.org/10.1093/qje/qjw024

[4] E. Demir, G. Gozgor, C. K. M. Lau, and S. A. Vigne, "Does economic policy uncertainty predict the Bitcoin returns? An empirical investigation," *Finance Research Letters*, vol. 26, pp. 145-149, 2018. https://doi.org/10.1016/j.frl.2018.01.005

[5] C. Wu, L. Tong, S. Yang, and A. Derbali, "Safe-haven or hedge? Bitcoin and gold under economic policy uncertainty," *Finance Letters*, vol. 31, pp. 171–178, 2019.
[6] H. Zhang, R. Demirer, J. Huang, W. Huang, and M. T. Suleman, "Economic policy uncertainty and gold return dynamics: Evidence from high-frequency data," *Resources Policy*, vol. 72, p. 102078, 2021. https://doi.org/10.1016/j.resourpol.2021.102078
[7] K. Benkaddour, M. Guennoun, and S. Bengana, "Political uncertainty and cryptocurrency volatility," *Lex Localis Journal of Local Self-Government*, vol. 22, no. 2, pp. 201–220, 2024.
[8] M. Burghauserova, Y. Apanovych, and J. VITVAROVÁ, "Factors influencing the divergence of precious metals prices: The case of gold in 2024," *Acta Montanistica Slovaca*, vol. 30, no. 2, p. 357, 2025.
[9] World Bank, *Commodity markets outlook: Geopolitical risks and precious metal demand*. Washington, DC: World Bank, 2024.
[10] V. Singh, "Assessing Bitcoin and gold as safe havens amid global financial volatility. IIM Kozhikode Society & Management Review," 2025. https://journals.sagepub.com/doi/10.1177/09711023251322578
[11] A. Lahiani, S. Mefteh-Wali, and D. G. Vasbieva, "The safe-haven property of precious metal commodities in the COVID-19 era," *Resources Policy*, vol. 74, p. 102340, 2021. https://doi.org/10.1016/j.resourpol.2021.102340
[12] J. P. Morgan Global Research, "Precious metals outlook 2025: The industrial-monetary divide in silver pricing. J.P. Morgan Commodities Strategy," 2025. https://www.jpmorgan.com/insights/global-research/commodities/silver-prices
[13] S. Zeinedini, M. S. Karimi, A. Khanzadi, and A. Falahati, "Impact of oil and gold prices on Bitcoin price during Russia-Ukraine and Israel-Gaza wars," *Resources Policy*, vol. 99, p. 105405, 2024. https://doi.org/10.1016/j.resourpol.2024.105405
[14] T. Dinh, S. Goutte, D. K. Nguyen, and T. Walther, "Economic drivers of volatility and correlation in precious metal markets," *Journal of Commodity Markets*, vol. 28, p. 100242, 2022. https://doi.org/10.1016/j.jcomm.2021.100242
[15] L. Feng, Y. Wang, and H. Zhang, "The impact of ETF institutionalization on Bitcoin's safe-haven properties," *Finance Research Letters*, vol. 60, pp. 104-115, 2024.
[16] A. H. Dyhrberg, "Bitcoin, gold and the dollar–A GARCH volatility analysis," *Finance Research Letters*, vol. 16, pp. 85-92, 2016. https://doi.org/10.1016/j.frl.2015.10.008
[17] L. A. Smales, "Bitcoin as a safe haven: Is it even worth considering?," *Finance Research Letters*, vol. 30, pp. 385-393, 2019. https://doi.org/10.1016/j.frl.2018.11.002
[18] S. Corbet, A. Meegan, C. Larkin, B. Lucey, and L. Yarovaya, "Exploring the dynamic relationships between cryptocurrencies and other financial assets," *Economics Letters*, vol. 165, pp. 28-34, 2018. https://doi.org/10.1016/j.econlet.2018.01.004
[19] R. Selmi, W. Mensi, S. Hammoudeh, and J. Bouoiyour, "Is Bitcoin a hedge, a safe haven or a diversifier for oil price movements? A comparison with gold," *Energy Economics*, vol. 74, no. C, pp. 787-801, 2018.
[20] S. Li and Y. Wang, "Can both Bitcoin and gold serve as safe-haven assets? A comparative analysis based on the NARDL model," *International Review of Financial Analysis*, vol. 74, p. 101671, 2021.
[21] D. G. Baur and B. M. Lucey, "Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold," *Financial Review*, vol. 45, no. 2, pp. 217-229, 2010. https://doi.org/10.1111/j.1540-6288.2010.00244.x
[22] Y. Liu and Q. Zhang, "Economic policy uncertainty and commodity prices: Evidence from China," *Journal of International Financial Markets*, vol. 74, p. 101319, 2021.
[23] N. S. Al-Nassar, "Can gold hedge against inflation in the UAE? A nonlinear ARDL analysis in the presence of structural breaks," *PSU Research Review*, vol. 8, no. 1, pp. 151-166, 2024. https://doi.org/10.1108/PRR-08-2021-0038
[24] W. Mensi, M. U. Rehman, and X. V. Vo, "Spillovers and co-movements between precious metals and energy markets: Implications on portfolio management," *Resources Policy*, vol. 69, p. 101836, 2020. https://doi.org/10.1016/j.resourpol.2020.101836
[25] D. Caldara and M. Iacoviello, "Measuring geopolitical risk," *American Economic Review*, vol. 112, no. 4, pp. 1194-1225, 2022.
[26] M. H. Pesaran, Y. Shin, and R. J. Smith, "Bounds testing approaches to the analysis of level relationships," *Journal of Applied Econometrics*, vol. 16, no. 3, pp. 289-326, 2001. https://doi.org/10.1002/jae.616
[27] S. Jordan and A. Q. Philips, "Cointegration testing and dynamic simulations of autoregressive distributed lag models," *The Stata Journal*, vol. 18, no. 4, pp. 902-923, 2018.
[28] S. Kripfganz and D. C. Schneider, "ARDL: Estimating autoregressive distributed lag and equilibrium correction models," presented at the Paper presentation]. 2018 London Stata Conference, London, United Kingdom, 2018.
[29] E. Bouri, P. Molnár, G. Azzi, D. Roubaud, and L. I. Hagfors, "On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?," *Finance Research Letters*, vol. 20, pp. 192-198, 2017. https://doi.org/10.1016/j.frl.2016.09.025
[30] S. Ghosh, G. D. Sharma, M. Srivastava, and A. K. Tiwari, "On the dynamic relationship between geopolitical risk and precious metals: Evidence from a wavelet-based approach," *Resources Policy*, vol. 66, p. 101642, 2020.

[31] N. Antonakakis, I. Chatziantoniou, and D. Gabauer, "Refined measures of dynamic connectedness based on time-varying parameter vector autoregressions," *Journal of Risk and Financial Management*, vol. 13, no. 4, p. 84, 2020. https://doi.org/10.3390/jrfm13040084

[32] D. Das, M. Kannadhasan, and P. Bhowmik, "Geopolitical risk and precious metals," *Journal of Economic Research*, vol. 24, no. 1, pp. 49-66, 2019.