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Shocks, Stocks, and Rocks: Precious Metals as Safe Haven in Crises for Equity Market in South-East Asian Tri-nation

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ABSTRACT

Purpose: Southeast Asian equity markets face recurring crises in which cross-asset correlations rise and diversification weakens. Evidence on the joint defensive roles of gold, silver, platinum, and palladium for the equity markets of Indonesia, Singapore, and Malaysia remains fragmented.

Research Design and Methodology: This study evaluates the hedge and safe-haven properties of gold (XAU), silver (XAG), platinum (XPT), and palladium (XPD) for the Jakarta Composite Index (JKSE), the Straits Times Index (STI), and the Kuala Lumpur Composite Index (KLCI) using daily data from July 1st, 2005 to June 30th, 2025, divided into two sub-periods. Metals are priced in domestic currency, trading days are synchronized, and returns are computed as log differences. GARCH(1,1) models estimated under Gaussian, generalized error distribution, and Student-t innovations are combined with quantile regression ($\tau = 0.10$–0.50) to capture tail dependence.

Findings and Discussion: Results indicate that XAU is the only metal consistently hedging the three indices, evidenced by negative average coefficients, while its safe-haven role is state-dependent, strengthening during specific distress episodes. XAG, XPT, and XPD exhibit positive co-movement even at low quantiles, consistent with diversification or pro-cyclicality.

Implications: The findings reinforce safe-haven status as regime- and tail-dependent and support gold as an adaptive crisis overlay in ASEAN equity risk management.

Introduction

Market resilience was challenged by the 2008-2009 Global Financial Crisis (GFC), the Eurozone sovereign debt crisis, the 2020 pandemic collapse, and the 2022-2024 inflationary and geopolitical disruptions. Under uncertainty, investors shifted toward quality and liquidity (Caballero & Krishnamurthy, 2008), reallocating into safer assets; in March 2020, the global "flight to quality" cut the 10-year Treasury rate by over 100 basis points within 30 days (Hartmann et al., 2004), while a "flight to liquidity" pushed investors out of risky assets and into Treasuries, lowering the 10-year yield from 1.1% to 0.5% within days (Beber et al., 2009). Emerging-market outflows of about $100 billion during the initial shock further depressed risk appetite (Beirne et al., 2021), indicating regime-dependent shifts in correlations and premia and heterogeneous defensive roles for gold (Baur & Lucey, 2010; Baur & McDermott, 2010). In ASEAN, transmission differed: Indonesia slowed, Singapore contracted, and Malaysia fell into recession (Chandra Athukorala & Chongvilaivan, 2010) Eurozone stress amplified currency volatility (Aizenman et al., 2016; Febrian & Wahed, 2025; Shahrier, 2022), COVID-19 drove a synchronized downturn with persistent unemployment (Akhtaruzzaman et al., 2021; Baker et al., 2020), and 2022-2024 supply and energy shocks lifted inflation and tightened policy (Diaz et al., 2024), making 2008-2025 a useful setting to assess defensive assets.

In crises, Indonesia posted Gross Domestic Product (GDP) growth of +4.5 (2009), -2.07 (2020), and +5.31 (2022); inflation was +10.2 in 2008 and unemployment 7.1 in 2020 (Badan Pusat Statistik Indonesia, 2009, 2020, 2022). Singapore posted 0.1 (2009), -3.8 (2020), and +9.8 (2021); inflation was +6.6 in 2008 and +6.1 in 2022, but muted in 2020; unemployment was 5.9 (2009) and 4.1 (2020) (World Bank, 2024f, 2024d, 2024b). Malaysia recorded -1.5 (2009), -5.5 (2020), and +8.9 (2022); inflation shifted from +5.4 (2008) to -1.1 (2020). (World Bank, 2024e) reports unemployment of 4.5% in 2020 and 4.6% in 2021 (World Bank, 2024c, 2024e, 2024a). Under stress, investors seek safe havens: U.S. Treasuries drive yields lower (Baele et al., 2020; Beber et al., 2009), the yen and Swiss franc appreciate (Habib & Stracca, 2012; Ranaldo & Söderlind, 2010), gold hedges uncertainty but is regime-dependent (Baur & Lucey, 2010; Baur & McDermott, 2010; Cheema et al., 2022), while silver, platinum, and palladium are pro-cyclical via industrial demand (Lucey & Li, 2015). Even among financially interconnected systems, regional market structures and integration can affect safe-haven relationships, but global patterns are important benchmarks for assessing protective assets in emerging markets.

ASEAN equity markets are prone to contagion; global shocks intensify co-movement and volatility in crises. In the Global Financial Crisis, indices fell as investors moved to safer assets, raising correlations with global benchmarks and weakening diversification (Baur & Lucey, 2010; Celık, 2012). High-frequency evidence shows correlations surge in acute stress, eroding diversification gains (Celık, 2012). The COVID-19 shock was abrupt: Malaysia's KLCI dropped to 1,219.71 in March 2020 before rebounding after regulatory adjustments; Indonesia's JKSE and Singapore's STI also fell sharply and recovered (Kurniasari et al., 2023; Lee et al., 2020). High-frequency data indicate volatility clustering, bidirectional causality, and positive co-movement among ASEAN indices during crises (Lim et al., 2023). Volatility stayed elevated in 2022-2023, with co-movement and structural disturbances in the JKSE (Permana et al., 2023). Accordingly, exposure to JKSE, STI, and KLCI entails downside risk when diversification is most needed, supporting the case for "agents of protection" that preserve value or decorrelate under stress (Baur & McDermott, 2010), consistent with rising correlations in systemic episodes (Bekaert et al., 2014; Forbes & Rigobon, 2002).

Evidence indicates that Indonesian corporate bonds are the only domestic instruments that exhibit negative co-movement with the index after market crashes, consistent with safe-haven behaviour. By contrast, government bonds and all sukuk neither hedge nor protect the JKSE (Robiyanto, 2018b). In Malaysia, Malaysian Government Securities (MGS) yields moved with declining equity prices during the COVID-19 pandemic, supporting the conclusion that Malaysian government and corporate bonds "could not act as safe-haven assets" for the KLCI (Izadin et al., 2024). Conversely, global safe assets remain effective: U.S. Treasuries have historically appreciated in episodes of market turmoil, implying safe-haven properties for the JKSE, STI, and KLCI (Beber et al., 2009; Ranaldo & Söderlind, 2010). Reserve currencies such as USD, JPY, and CHF commonly strengthen in risk-off conditions, enabling tail-risk diversification, with JPY and CHF particularly salient in crises (Sato et al., 2024). Overall, Indonesian corporate bonds and core safe-haven currencies are the only instruments showing negative tail correlation with JKSE/STI/KLCI, while other assets provide limited hedging evidence (Robiyanto, 2018b; Sato et al., 2024). This context motivates testing gold, silver, platinum, and palladium as hedges and safe havens for JKSE, STI, and KLCI.

Evidence from the JKSE suggests that gold is protective under heightened volatility but less effective in tranquil periods, while silver, platinum, and palladium provide weak or inconsistent protection (Robiyanto, 2017; Wang et al., 2022; Yousaf et al., 2021). Although gold serves as a robust safe-haven against the equity markets of Indonesia (Yousaf et al., 2021), findings also indicate that gold often operates mainly as a diversification asset in normal conditions (Robiyanto, 2017). In Singapore, gold is generally a reliable hedge and safe haven, whereas silver and platinum are more crisis-contingent; this aligns with the claim that gold functions as a strong safe-haven in Singapore (Dung et al., 2023; Robiyanto, 2017; Yousaf et al., 2021). For Malaysia (KLCI), gold is consistently a crisis safe haven, silver and palladium deliver occasional gains, and platinum primarily diversifies

(Robiyanto, 2017; Yousaf et al., 2021). Cross-country evidence shows heterogeneity: precious-metal futures, especially gold, reduce equity portfolio variance in Indonesia and Malaysia, with stronger risk-adjusted gains in Malaysia (Robiyanto et al., 2017); however, quantile results (June 2008-September 2016) show limited protection for Indonesia in extreme downturns. Regime effects matter: gold may weaken under liquidity stress but recover as conditions normalize (Cheema et al., 2022), while non-gold metals rarely deliver safe-haven benefits and may be pro-cyclical (Lucey & Li, 2015).

Indonesia, Singapore, and Malaysia are assessed using Robiyanto's ASEAN findings. He finds considerable co-movement and integration among Indonesia, Malaysia, Singapore, Thailand, and the Philippines using an OGARCH framework for ASEAN-5 (2001–2016), implying that equity diversification within ASEAN offers minimal long-term gains (Robiyanto, 2017) In addition, his 2017 cross-market analysis of commodities as safe havens shows that gold is reliable for Singapore and Malaysia but not Indonesia, while West Texas Intermediate (WTI) crude is reliable for most ASEAN markets. These findings support a tri-country approach that (i) preserves regional integration forces and (ii) explores cross-market variances in precious-metal protection, where ASEAN data reveals the greatest disparity.

Despite repeated global shocks that have tightened co-movements across ASEAN equity markets and concentrated flight-to-safety into a narrow set of assets, there remains no integrated account of how gold, silver, platinum, and palladium jointly function as hedges and safe havens for Indonesia, Singapore, and Malaysia across crisis and non-crisis regimes. Existing findings are fragmented by sample period, market, and metal, and they often yield mixed inferences about whether these metals preserve value when correlations surge and diversification deteriorate, or instead behave pro-cyclically with regional risk sentiment. This gap is consequential given the region's exposure to heterogeneous macro-financial conditions from 2008 to 2025, including credit contractions, pandemic-driven downturns, and inflationary upswings, each with distinct implications for tail risk and dependence structures. Accordingly, this study systematically assesses gold, silver, platinum, and palladium as hedging instruments and safe havens for the JKSE, STI, and KLCI under alternative market states, identifying when, where, and to what extent precious metals can provide stability for South East Asian equity investors during severe turbulence.

This study contributes to the literature in four linked ways. First, it provides a unified tri-national view of how gold, silver, platinum, and palladium interact with the equity markets of Indonesia (JKSE), Singapore (STI), and Malaysia (KLCI) over a long horizon spanning the 2008-2009 Global Financial Crisis, the COVID-19 collapse, and recent inflationary and geopolitical shocks. Second, it distinguishes hedging from safe-haven roles by conditioning metal equity relations on market states and tail outcomes, clarifying whether and when metals decouple as correlations surge and diversification weakens. Third, it embeds these assets in a contagion-prone setting with volatility clustering and regime shifts, linking global flight-to-quality dynamics to the vulnerabilities of highly open ASEAN economies. Finally, it delivers an integrated cross-metal, cross-market framework to support portfolio construction and crisis risk management against extreme downside episodes in ASEAN equities.

Literature Review

Modern Portfolio Theory by Markowitz (1952) posits that combining assets with imperfect correlations reduces portfolio variance for a given expected return. Later work by Tobin (1958) and Sharpe (1964) strengthened risk return optimization in modern finance (Elbannan, 2014). Yet crises constrain mean variance diversification because correlations rise precisely when protection is most needed, violating the assumption of stable dependence. Evidence reports average correlations of 0.72 to 0.83 over 2020-2024, with crisis spikes that weakened portfolio insurance (Akhtaruzzaman et al., 2021; Longin & Solnik, 2001). Static correlation models therefore understate risk in turmoil, as the 2008 Global Financial Crisis and the 2020 COVID-19 pandemic showed correlations converging toward unity and diversified portfolios moving together. This motivates defensive assets with zero or negative dependence in downturns (Baur & Lucey, 2010) classify protective roles as hedges, diversifiers, and safe havens, while Baur & McDermott (2010) separate strong and weak safe havens. Quantile regression is commonly used to detect protection in extreme tails. Flight-to-quality and flight-to-liquidity explain these dynamics via shifting liquidity preferences and credit quality concerns (Vayanos, 2004).

Tail and regime dependence capture how asset linkages change across market states. Using multivariate regression quantile models, White et al. (2015) directly examine tail interdependence and document significant dependence across return quantiles, which standard correlation measures may miss when extreme downside protection is the object of interest. The quantile correlation coefficient of Choi & Shin (2022) further refines inference on conditional quantile sensitivity, improving identification of tail-dependent co-movement. The JKSE aggregates all firms listed on the Indonesia Stock Exchange; the STI tracks the 30 largest firms by market capitalization on the Singapore Exchange; and the KLCI measures the 30 largest firms by market capitalization on Bursa Malaysia. Precious metals serve economic roles beyond investment: jewellery and investment constitute about 60% of gold demand, and gold is held in central bank reserves due to negligible counterparty risk (Baur & Lucey, 2010; Baur & McDermott, 2010). Silver combines financial demand with industrial uses, while platinum and palladium are mainly tied to catalytic and related industrial applications. Government bonds and reserve assets are common safe havens, including Singapore Government Securities (SGS), MGS, and Surat Utang Negara (SUN), alongside U.S. Treasuries (Beber et al., 2009) and reserve currencies such as JPY and CHF (Ranaldo & Söderlind, 2010).

Empirical evidence on the protective roles of precious metals for Indonesian equities remains mixed and appears sensitive to both metal type and market state. Robiyanto (2017) reports limited safe-haven effectiveness of gold for the JKSE during severe downturns, casting doubt on its broader regional protection. In contrast, Yousaf et al. (2021) find that gold acts as a strong safe haven for Indonesian equities, with protection most evident in episodes of pronounced turmoil rather than routine fluctuations. Wang et al. (2022) further shows that gold performs best under volatility and weakest in stable regimes. Non-gold metals provide less consistent protection: silver, platinum, and palladium mitigate JKSE risk only conditionally, depending on local conditions. Robiyanto et al. (2017) document that precious-metal futures, particularly gold, reduce equity portfolio variance in Indonesia and Malaysia, with larger gains in Malaysia. Domestic bonds yield atypical results: quantile regression indicates that only Indonesian corporate bonds exhibit negative co-movement in crises, whereas SUN and all sukuk do not hedge or provide a safe haven for the JKSE (Robiyanto, 2018a). For Singapore, gold more consistently hedges and serves as a safe haven for the STI, while silver and platinum are mainly crisis-contingent (Yousaf et al., 2021); variance-reduction evidence supports portfolio gains when precious metals are included (Robiyanto et al., 2017), underscoring their relevance where domestic safe havens are limited.

Relative to Malaysia, the other two markets exhibit weaker safe-haven linkages with precious metals. Prior evidence indicates that the KLCI relies most on gold as a crisis safe haven. Robiyanto et al. (2017) document material improvements in Malaysian equity portfolios when gold is included, especially in risk-adjusted terms. Cross-country comparisons further suggest that gold protects Malaysian equities in severe downturns but does not consistently shield Indonesian equities during large drawdowns (Robiyanto, 2018a). For Malaysia, silver and palladium provide only limited benefits, while platinum tends to act mainly as a diversification asset rather than a secure refuge. Conventional domestic instruments also underperform as safe havens. Izadin et al. (2024) show that MGS, local sukuk, and corporate debt did not serve as safe havens during COVID-19, as MGS yields were positively correlated with falling stock prices rather than moving inversely. Overall, Robiyanto's cross-national evidence indicates that safe-haven effectiveness is country-contingent even within integrated markets (Robiyanto, 2018a; Robiyanto et al., 2017). Market-specific features such as financial development, currency regimes, institutional quality, and investor composition shape these relationships, and the stronger performance of precious metals in Malaysia and Singapore relative to Indonesia plausibly reflects differences in depth, liquidity, and global integration.

The synthesized literature suggests the following testable hypotheses. In severe equity market downturns, when diversification fails and losses concentrate, safe-haven assets provide portfolio insurance by appreciating or declining little. The dynamics of flight-to-quality and flight-to-liquidity underpin the theory. In times of uncertainty, investors liquidate riskier assets and move to safe havens with little counterparty risk (Caballero & Krishnamurthy, 2008; Vayanos, 2004). Gold's historical significance as a monetary metal and a central bank reserve asset establishes it as the primary safe-haven option. The analytical windows (GFC, COVID, and overall) examine the regime-dependent

nature of safe-haven attributes, demonstrating their operational status under synchronized global shocks (COVID) while being absent in regionally sequenced crises (GFC). Gold is anticipated to serve as a strong safe haven for the KLCI and STI, consistent with previous studies, however it is regarded as a conditional and weak safe haven for the JKSE, corroborated by contradictory historical data. Silver, platinum, and palladium are anticipated to fail to satisfy safe-haven criteria due to their industrial cyclicality. Based on these features, it is suggested that:
H1: Gold and other precious metal assets can act as safe havens in the trination stock markets.

Through zero or negative correlation throughout the study period, hedges provide protection in all market scenarios, not just crises. Hedge funds limit stock risk regardless of volatility, unlike tail-conditional safe havens. Gold can be an effective hedge due to its dual status as a monetary and investment asset and its responsiveness to real interest rates, inflation forecasts, and risk emotion (Baur & Lucey, 2010). Gold is expected to hedge the KLCI, which has the deepest gold market integration, and the STI and JKSE, depending on regime activations. Silver, platinum, and palladium are expected to have a positive beta, showing their potential as diversifiers or pro-cyclical assets without hedging. Based on these considerations, the second hypothesis is:
H2: Gold and other precious metal assets can act as a hedge in the trination stock markets.

Research Design and Methodology

As reported in Table I, daily series were obtained from Stooq, a public data repository, on 24 October 2025. Stooq symbols include ^JCI, ^STI, ^KLCI, XAUIDR, XAGIDR, XPTIDR, XPDIDR, XAUSGD, XAGSGD, XPTSGD, XPDSGD, XAUMYR, XAGMYR, XPTMYR, and XPDMYR. The three locked samples are: the GFC window (1 July 2005 to 30 June 2015), the COVID-19 window (1 July 2015 to 30 June 2025), and the overall period (1 July 2005 to 30 June 2025); trading calendars are intersected across the three markets.

This study prices precious metals in each market's domestic currency: gold, silver, platinum, and palladium are expressed in Indonesian Rupiah (IDR) alongside the JKSE, in Singapore Dollar (SGD) alongside the STI, and in Malaysian Ringgit (MYR) alongside the KLCI. This currency-matching design serves two objectives. First, it isolates equity–metal co-movement from exchange-rate effects, preventing spurious correlations driven by currency volatility rather than protective properties. Second, it mirrors the investment setting of domestic retail and institutional investors whose mandates commonly restrict unhedged foreign-exchange exposure (Sato et al., 2024). Returns are measured as log differences because log returns are time-additive, scale-invariant, and tend to stabilise variance (Cont, 2001). To reduce look-ahead bias and missing-data distortions, the return series are constructed using the intersection of trading days across Indonesia, Singapore, and Malaysia. Non-overlapping dates are removed so that each equity index is fully synchronised with its corresponding precious-metal series. Daily log returns are defined in Equation (1):

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

where, R_t = daily log return of class asset on day t; P_t = closing price of class asset on day t; P_{t-1} = closing price of class asset j on the previous day (t-1); $\ln$ = natural logarithm transformation.

Initial diagnostics inform the subsequent modelling framework. The Augmented Dickey–Fuller (ADF) test assesses unit roots; rejection indicates stationarity, enabling regression analysis without differencing. The Jarque-Bera (JB) test evaluates distributional normality; significant results signify heavy tails and skewness typical of financial returns. The Glejser (1969) heteroskedasticity test, an auxiliary regression of absolute residuals $|\hat{\varepsilon_t}|$ on index returns, reveals pervasive conditional heteroskedasticity across all index–metal pairs. Together, these diagnostics motivate three modelling choices: (i) GARCH(1,1) to address volatility clustering; (ii) alternative error distributions (Gaussian, GED, Student-t) for robustness against heavy tails; and (iii) quantile regression to identify tail-specific dependence not observable in conditional-mean models (Bollerslev, 1986; Koenker & Bassett, 1978).

The mean equation regresses metal returns on contemporaneous equity-index returns and is estimated jointly with the GARCH(1,1) variance equation, as presented in Equation (2):

$$R_t^{metal} = \alpha + \beta\, R_t^{index} + \varepsilon_t \quad (2)$$

where, R_t^{metal} = return of the metal asset; R_t^{index} = log return of the corresponding equity index; α = constant; β = coefficient measuring average co-movement (hedge indicator; $\beta < 0$= hedge); ε_t = residual term.

The slope parameter β serves as the hedge indicator on average: β < 0 implies negative co-movement, signalling hedge properties across all market conditions (Baur & Lucey, 2010). Conversely, β > 0 indicates positive co-movement, consistent with diversifier or pro-cyclical behaviour. Because the mean equation alone does not capture regime-specific dynamics, it is embedded within a GARCH(1,1) framework (Bollerslev, 1986) to accommodate volatility clustering and time-varying risk. The conditional variance evolves as presented in Equation (3):

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \quad (3)$$

where, h_t = conditional variance of returns at time t; ω = constant (long-run average variance); α = ARCH term capturing the impact of last-period shocks (ε_{t-1}^2); β = GARCH term capturing volatility persistence (h_{t-1}); ε_t = residual term

The sum $\alpha + \beta$ measures volatility persistence; values near unity, common in daily financial data, imply that shocks decay slowly, sustaining elevated risk during crisis episodes. The mean equation is estimated jointly with GARCH(1,1) under three distributional assumptions for ε_t: Gaussian, Generalised Error Distribution (GED), and Student-t. These distributions provide robustness against heavy-tailed errors while facilitating tractable maximum-likelihood estimation. The primary inference employs the Student-t specification, whereas Gaussian and GED outcomes serve as sensitivity checks. The mean-equation slope β from this GARCH framework offers a conditional-mean hedge test that accounts for heteroskedasticity while still averaging across the return distribution, hence justifying the inclusion of quantile regression as a complementary tool.

Quantile regression (Koenker & Bassett, 1978) estimates conditional quantile functions, enabling direct measurement of tail-specific co-movement that mean regressions obscure. For each quantile $\tau \in \{0.10, 0.20, 0.30, \ldots, 0.90\}$, the model is specified as Equation (4):

$$R_t^{metal} = \alpha(\tau) + \beta(\tau)\, R_t^{index} + \varepsilon_t(\tau)$$

where, $\alpha(\tau)$ = intercept estimated at quantile τ; $\beta(\tau)$ = slope coefficient at quantile τ (safe-haven indicator; negative values in lower τ imply safe-haven behavior); $\varepsilon_t(\tau)$ = residual term at quantile τ; τ = quantile levels used to capture tail-specific relationships.

The slope $\beta(\tau)$ measures metal-equity co-movement conditional on the equity-return distribution. A negative $\beta(\tau)$ at low quantiles (τ = 0.10, 0.20) signals safe-haven behaviour, meaning the metal appreciates, or declines less, when equity returns lie in the left tail, thereby providing downside protection. We treat τ = 0.50 as a robust central-tendency benchmark that is less sensitive to outliers than the conditional mean. Mapping $\beta(\tau)$ across quantiles indicates whether protection is tail-specific (safe haven) or broadly present (hedge), a distinction central to portfolio risk management (Baur & McDermott, 2010; White et al., 2015). Following Baur & Lucey (2010), a hedge satisfies β < 0 in the whole-sample mean equation (GARCH mean); a safe haven satisfies $\beta(\tau)$ < 0 at low quantiles; and a diversifier satisfies 0 < β < 1 on average. We compare β (average) and $\beta(\tau)$ across three windows (GFC, COVID-19, Overall) to assess regime dependence. All analyses were conducted using RStudio (version 2025.05.1+513 "Mariposa Orchid").

Findings and Discussion

Findings

Table II reports descriptive statistics for the overall period and both sub-samples, documenting a pronounced split in daily risk-return profiles between the equity indices (JKSE, STI, KLCI) and the four precious metals (XAU, XAG, XPT, XPD) priced in domestic currency. In the First Window (GFC), JKSE posts the highest equity mean (0.063%) and the greatest volatility (1.442%), while KLCI is the least volatile (0.763%) with a mean of 0.029%, and STI is intermediate (0.015% mean; 1.166%

volatility). Over the same window, gold (XAU) yields positive means in all markets (XAUIDR 0.057%, XAUMYR 0.041%, XAUSGD 0.029%) with moderate volatility (approximately 1.2%–1.4%), generally below silver (XAG) and palladium (XPD), with silver the most volatile (XAGIDR 2.230%, XAGMYR 2.171%, XAGSGD 2.175%). In the Second Window (COVID-19), equity volatility eases (JKSE 0.998%, STI 0.860%, KLCI 0.714%) and mean returns are 0.024% (JKSE), 0.007% (STI), and −0.004% (KLCI); gold remains positive with lower volatility (XAUIDR 0.867%, XAUMYR 0.859%, XAUSGD 0.815%), whereas palladium remains the highest-risk metal (approximately 2.15%–2.18%). In the overall sample, JKSE again combines the highest mean (0.044%) and risk (1.241%), KLCI stays the most defensive (0.739%), and gold remains the least volatile metal (approximately 1.0%–1.2%) relative to XAG and XPD (approximately 1.9%–2.1%). Augmented Dickey–Fuller tests reject the unit-root null at 1% across all series and periods, confirming stationarity and suitability for time-series analysis.

Further diagnostic checks are reported in Tables III and IV. Table III presents the Jarque–Bera normality test applied to residuals from a preliminary mean regression of metal returns on equity-index returns for each period and asset pair. The results indicate non-normal error distributions in every specification and window. Consistent with Robiyanto et al. (2025), this outcome is expected given the highly volatile nature of daily return data. Table IV reports the Glejser heteroskedasticity test and shows that all specifications across asset pairs and sub-periods violate the homoskedasticity assumption. Taken together, these twin assumption breaches motivate the use of GARCH(1,1) specifications with Student-t and GED innovations, in line with Robiyanto et al. (2025). Following Robiyanto et al. (2025), because all series are stationary across sub-periods, differencing is not required and q equals 1. Moreover, autocorrelation is significant at lag 1, implying p equals 1.

Table V summarises the GARCH estimates and shows a stable sign structure across windows and error distributions. In the First Window, the Gaussian specification indicates significant negative linkages for JKSE with XAUIDR (−0.034; 10%) and for KLCI with XAUMYR (−0.056; 10%), whereas JKSE is positively and significantly associated with XAGIDR (0.120; 1%), XPTIDR (0.071; 1%), and XPDIDR (0.168; 1%), and KLCI is positively and significantly associated with XAGMYR (0.228; 1%), XPTMYR (0.138; 1%), and XPDMYR (0.252; 1%). For Singapore, STI is positively and significantly related to XAGSGD (0.245; 1%), XPTSGD (0.162; 1%), and XPDSGD (0.308; 1%), while the STI–XAUSGD coefficient is negative but not significant (−0.010). GED and Student-t specifications preserve these directions, with JKSE–XAUIDR and KLCI–XAUMYR remaining significantly negative and STI–XAUSGD remaining negative yet insignificant. In the Second Window, JKSE–XAUIDR stays significantly negative under the Gaussian specification (−0.056; 1%) alongside positive, significant associations with XAGIDR, XPTIDR, and XPDIDR; KLCI–XAUMYR is negative but not significant under Gaussian (−0.035), although it turns significantly negative under GED and Student-t; and STI–XAUSGD becomes significantly negative. Over the overall period, across Gaussian, GED, and Student-t specifications, JKSE–XAUIDR, KLCI–XAUMYR, and STI–XAUSGD are consistently negative and significant, while all linkages of the three indices with XAG, XPT, and XPD remain positive and significant.

Based on the GARCH model estimates, the following findings emerge for the hedge-property analysis. In the First Window, consistency across distributional specifications indicates a clear cross-metal differentiation. For Indonesia, XAUIDR is negative and statistically significant against JKSE across Gaussian, GED, and Student-t distributions, classifying gold (XAU) as a hedge. In contrast, XAGIDR, XPTIDR, and XPDIDR are uniformly positive and significant vis-à-vis JKSE across all GARCH specifications, implying that they cannot serve as hedges owing to equity co-movement. For Malaysia, XAUMYR is likewise negative and significant against KLCI, positioning XAU as a hedge, while XAGMYR, XPTMYR, and XPDMYR remain positive and significant, hence not hedges. For Singapore, XAUSGD is stably negative but not significant against STI across distributions, supporting a hedging role in a weak (statistically unconfirmed) sense, whereas XAGSGD, XPTSGD, and XPDSGD are consistently positive and significant.

In the Second Window, the same structure largely persists, with a clearer signal for Singapore and a distribution-sensitive result for Malaysia. In Indonesia, XAUIDR remains a statistically significant hedge against JKSE across all distributional specifications, while XAGIDR, XPTIDR, and XPDIDR continue to exhibit significant positive co-movement. In Malaysia, XAUMYR stays negative and is most consistently confirmed under GED and Student-t (while Gaussian is weaker), sustaining the hedge classification. In Singapore, XAUSGD turns negative and significant, strengthening the hedge inference. Over the overall period, XAU is consistently negative and significant against JKSE, KLCI, and STI across all three distributional assumptions, while XAG, XPT, and XPD remain positive and significant and therefore cannot function as hedges.

Evidence from the GARCH framework, consistent across Gaussian, GED, and Student-t specifications, confirms that gold (XAU) is the only precious metal that operates as a hedge against the tri-nation equity indices, although the strength of protection varies across windows and markets. This pattern accords with flight-to-quality and flight-to-liquidity dynamics: investors shift from risky equities toward assets with higher perceived quality and lower counterparty risk, making XAU more likely to retain a weak or inverse association with equities than more cyclical commodities (Baur & Lucey, 2010; Caballero & Krishnamurthy, 2008). The persistence of XAU's hedging role in an ASEAN environment prone to contagion and correlation spikes during stress reinforces that regional equity diversification can fail precisely when protection is most needed, thereby elevating the relevance of assets with zero or negative dependence for portfolio risk control (Akhtaruzzaman et al., 2021; Celık, 2012; Longin & Solnik, 2001). In contrast, silver (XAG), platinum (XPT), and palladium (XPD) exhibit systematic equity co-movement across the JKSE, KLCI, and STI, implying that they do not function as hedges in this setting. This is consistent with the view that non-gold metals are relatively pro-cyclical because industrial-demand linkages tie them more closely to risk sentiment and real activity that are simultaneously embedded in equity pricing (Lucey & Li, 2015).

To further assess safe-haven functionality, quantile regression (QREG) is employed. Table VI reports the First Window estimates. For Indonesia, XAUIDR does not qualify as a safe haven under extreme distress because its association with JKSE at the 0.10 quantile is positive and statistically insignificant, but it behaves as a safe haven at the 0.20 quantile. Under more typical market conditions, XAUIDR acts as a hedge, given its negative linkage with JKSE at the 0.50 and 0.40 quantiles. By contrast, XAGIDR, XPTIDR, and XPDIDR display persistent and statistically significant positive co-movement with JKSE across all quantiles. For Malaysia, XAUMYR exhibits safe-haven features at the 0.10–0.20 quantiles through an insignificantly negative relation with KLCI, while providing hedging benefits at the 0.40–0.50 quantiles via a negative association. Conversely, XAGMYR, XPTMYR, and XPDMYR show strong co-movement with KLCI throughout. For Singapore, the XAUSGD-STI relation is positive and insignificant at the 0.10–0.20 quantiles, so the safe-haven role is not confirmed and XAUSGD functions only as a diversifier under distress; nevertheless, XAUSGD serves as a hedge at the central quantiles for the Singapore equity market.

Table VII reports the QREG estimates for the Second Window. For Indonesia (JKSE), the quantile results indicate that XAUIDR functions as a safe haven under extreme distress and remains a confirmed safe haven under moderate distress; under more normal market conditions, XAUIDR also serves as a hedge through its negative linkage with JKSE. In contrast, XAGIDR, XPTIDR, and XPDIDR consistently exhibit co-movement with JKSE across all quantiles, implying that they cannot be classified as safe havens and likewise do not operate as hedges. For Malaysia (KLCI), XAUMYR displays safe-haven characteristics in both extreme and moderate distress because the relationship is negative yet statistically unconfirmed; however, at the 0.40–0.50 quantiles, XAUMYR acts as a hedge against KLCI as the negative association becomes statistically supported. Meanwhile, XAGMYR, XPTMYR, and XPDMYR show strong and persistent co-movement with KLCI throughout the quantile spectrum, so they cannot be positioned as safe havens or hedges. For Singapore (STI), XAUSGD is identified as a safe haven at the 0.10–0.20 quantiles and simultaneously operates as a hedge at the 0.40–0.50 quantiles, whereas XAGSGD, XPTSGD, and XPDSGD consistently co-move with STI even during distress, precluding both safe-haven and hedging roles within the quantile-dependence framework.

Table VIII presents the QREG estimates for the overall period. For Indonesia (JKSE), XAUIDR functions as a safe haven in extreme and moderate distress and remains a hedge in normal states, consistent with a negative relationship with JKSE. Conversely, XAGIDR, XPTIDR, and XPDIDR show co-movement with JKSE across all quantiles; their effects stay positive and significant even in the lower tail, so they cannot be classified as safe havens or hedges. For Malaysia (KLCI), XAUMYR exhibits safe-haven characteristics in extreme and moderate distress, implying that its protective role is most persuasive when market pressure is severe yet not necessarily at the most extreme level; at quantiles 0.40–0.50, XAUMYR serves as a hedge through a negative and significant linkage with KLCI. Meanwhile, XAGMYR, XPTMYR, and XPDMYR maintain strong co-movement with KLCI throughout the quantile spectrum and therefore do not qualify as safe havens or hedges. For Singapore (STI), XAUSGD is not confirmed as a safe haven in the distress tail because it behaves as a diversifier under extreme distress at quantile 0.10, but it functions as a safe haven at quantile 0.20 and operates as a hedge at quantiles 0.40–0.50. In contrast, XAGSGD, XPTSGD, and XPDSGD consistently co-move with STI across all quantiles.

Discussion

The quantile regression results suggest that the role of precious metals in ASEAN equity markets is state-dependent and varies across countries, consistent with the view that cross-asset correlations rise as stress intensifies and conventional diversification weakens (Longin & Solnik, 2001). In the First Window, gold (XAU) displays an uneven protective profile across markets. In Indonesia, XAUIDR primarily acts as a hedge under more typical conditions; during distress, XAU tends to provide only diversification in extreme downturns yet moves closer to safe-haven behaviour in moderate distress, implying regime-contingent protection (Baur & Lucey, 2010; Cheema et al., 2022). In Malaysia, XAUMYR is more stable as a hedge in the central quantiles, whereas at distress quantiles it resembles a weak safe haven, consistent with evidence that gold's defensive role is heterogeneous across markets (Baur & McDermott, 2010). In Singapore, XAUSGD is most evident as a hedge in non-distressed states, while under distress it behaves more like a diversifier than a confirmed safe haven, indicating that even for the benchmark monetary metal, effectiveness remains conditional on local market structure and investor behaviour (Robiyanto, 2017; Yousaf et al., 2021).

Across the Second Window and the overall period, the protective signal of gold strengthens, particularly under distress, consistent with flight-to-quality and flight-to-liquidity dynamics whereby investors rebalance away from risky assets toward instruments perceived as higher quality and lower downside exposure (Caballero & Krishnamurthy, 2008; Vayanos, 2004). Indonesia shows XAU becoming more relevant as a safe haven in distress while preserving its hedge function in more normal market states, whereas Malaysia continues to position XAU primarily as a hedge with more credible protection in severe but not extreme distress. Singapore exhibits a more mixed pattern over the overall period: XAU tends to operate as a hedge in general conditions, yet under extreme distress it aligns more closely with a diversifier, reinforcing that safe-haven status does not arise uniformly across shock episodes (Baur & Lucey, 2010; Cheema et al., 2022). By contrast, silver (XAG), platinum (XPT), and palladium (XPD) display persistent co-movement with the equity indices (JKSE, KLCI, STI) across quantiles, thereby offering neither safe-haven nor hedge properties; this configuration accords with evidence that non-gold metals are comparatively pro-cyclical because their pricing is more tightly linked to industrial demand (Lucey & Li, 2015).

Cross-window comparisons suggest that precious-metal effectiveness in the tri-nation setting is driven by shock-regime shifts and domestic market structure. In the First Window, reflecting the 2008–2009 GFC, global liquidity stress and regional contagion likely tightened cross-asset dependence and reduced diversification space; hence gold is more plausibly interpreted as a hedge in relatively normal states than as a consistently tail-protective asset, consistent with regime-dependent safe-asset performance under liquidity strain (Cheema et al., 2022) and crisis-time correlation surges (Akhtaruzzaman et al., 2021). In the Second Window, aligned with the COVID-19 episode, synchronized shocks, emerging-market outflows, and global risk repricing strengthened flight-to-quality incentives, making gold's defensive role more salient in distress, while non-gold metals remain tied to risk sentiment and real-activity channels and therefore more often display co-movement than protection (Beirne et al., 2021; Diaz et al., 2024). Country heterogeneity also matters: Singapore's greater openness and global integration can yield more mixed protection via stronger external transmission, whereas Malaysia's protection is more credible in non-extreme distress and Indonesia is more sensitive to risk-off repricing, consistent with evidence of volatility clustering and structural disturbances in the post-pandemic region (Lim et al., 2023; Permana et al., 2023).

The Theil coefficient serves as an appropriate robustness device because it offers a scale-free gauge of predictive closeness that remains comparable across heterogeneous specifications, GARCH under alternative error distributions and quantile regression across quantiles. Crucially, it is benchmarked against a naïve reference where U = 1, and values below 1 indicate superior predictive performance, thereby reducing the risk that the inferred asset role whether hedge, diversifier, or co-mover is merely an artefact of a particular estimator (Davidovic, 2021; Li et al., 2023; Tosunoğlu et al., 2023). Based on Table IX, most Theil coefficients fall below 1 in the First Window, Second Window, and overall period, implying generally satisfactory and, more importantly, specification-consistent performance, even though several values remain close to unity. This stability strengthens the internal coherence of the empirical narrative from GARCH and quantile regression: gold proxied by XAUIDR, XAUMYR, and XAUSGD exhibits regime-contingent defensive capacity, whereas non-gold metals (XAG, XPT, XPD) more frequently align with equity conditions, consistent with persistent co-movement rather than robust hedging or protection across market states (Robiyanto, 2018a).

Conclusion

Using GARCH and quantile regressions across three crisis windows (GFC, COVID-19, and the full sample), the findings are consistent: domestically priced gold (XAU) is the only metal that robustly hedges the JKSE, STI, and KLCI, evidenced by a negative average coefficient, while its safe-haven role is state-dependent, strengthening in several distress episodes—especially during COVID-19 and in the full period—but not uniformly at the most extreme tail across countries. In contrast, silver, platinum, and palladium (XAG, XPT, XPD) display positive betas even at low quantiles, indicating persistent co-movement and a profile closer to diversification or pro-cyclicality in the ASEAN tri-nation setting. Theoretically, this pattern confirms that "safe haven" is not an immutable attribute; it is contingent on regime, horizon, and shock transmission that reshape correlations and tail dependence. Practically, portfolio managers should treat gold as a state-contingent crisis overlay, monitor tail risk with quantile-based Value at Risk and Expected Shortfall (VaR/ES), and adjust weights adaptively, while limiting reliance on XAG, XPT, and XPD as equity protectors because they tend to amplify cyclical exposure precisely in left-tail market states.

This study has several limitations that motivate a focused research agenda. First, the daily-return design may understate intraday flight-to-liquidity effects, especially during crash episodes; subsequent studies should revisit safe-haven mechanics with intraday series and high-frequency spillover or connectedness measures to capture rapid volatility transmission (Farid et al., 2021). Second, while the bivariate equity-metal specification is suitable for identifying hedge and safe-haven behaviour, it can be extended to time-varying multivariate frameworks such as Time-Varying Parameter Vector Autoregression (TVP-VAR), time-frequency or quantile connectedness, and Extreme Value Theory (EVT) tail diagnostics to disentangle common shocks from genuinely protective tail dependence and to test stability across investment horizons (Echaust & Just, 2022; Wen et al., 2022). Third, the analysis does not internalise microstructure frictions such as market efficiency, liquidity constraints, and rebalancing costs that may condition realised protection; future work should incorporate liquidity or efficiency proxies and evaluate out-of-sample hedging effectiveness using utility-relevant criteria, including downside-risk and ES reduction (Okoroafor & Leirvik, 2023). Fourth, the narrow scope (three indices and domestic spot metals) warrants broader testing with futures or Exchange-Traded Fund (ETF) implementations, local bonds versus U.S. Treasury (UST) proxies, and foreign-exchange (FX)-hedged instruments, while explicitly accounting for basis risk, margin requirements, and currency conversion.

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Conflict of Interest

The authors declare no conflict of interest.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used AI-assisted tools such as Claude Opus 4.6 by Anthropic and ChatGPT 5.4 by OpenAI for language refinement and editing purposes. The authors reviewed and edited the output and take full responsibility for the content of the publication.

Author Contributions

Wijaya: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Visualization.
Hartono: Supervision, Validation, Writing – review and editing.
Ardyan: Writing – review and editing, Validation.

Ethics Approval

Not applicable. This study uses publicly available secondary market data and does not involve human or animal subjects.

Data Availability

The data used in this study are publicly available from Stooq (https://stooq.com/).

ABBREVIATION

Abbreviation	*Full Form*
ADF	Augmented Dickey-Fuller
ASEAN	Association of Southeast Asian Nations
CHF	Swiss Franc
COVID-19	Coronavirus Disease 2019
ES	Expected Shortfall
ETF	Exchange-Traded Fund
EVT	Extreme Value Theory
FX	Foreign Exchange
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GED	Generalized Error Distribution
GFC	Global Financial Crisis
IDR	Indonesian Rupiah
JB	Jarque-Bera
JKSE	Jakarta Composite Index
JPY	Japanese Yen
KLCI	Kuala Lumpur Composite Index
MGS	Malaysian Government Securities
MYR	Malaysian Ringgit
QREG	Quantile Regression
SGD	Singapore Dollar
SGS	Singapore Government Securities
STI	Straits Times Index
SUN	Surat Utang Negara
TVP-VAR	Time-Varying Parameter Vector Autoregression
USD	United States Dollar
UST	United States Treasury
VaR	Value at Risk
XAG	Silver
XAU	Gold
XPD	Palladium
XPT	Platinum

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