Gold or Bitcoin? Safe-Haven Characteristics and Portfolio Utility for Wealth Management Investors

Francis Tan
Indosuez Wealth Management

Wing-Keung Wong
Department of Finance, Quantum AI Research Center, Fintech & Blockchain Research Center, and Big Data Research Center, Asia University, Taiwan
Department of Medical Research, China Medical University Hospital, Taiwan
Business, Economic and Public Policy Research Centre, Hong Kong Shue Yan University
The Economic Growth Centre, Nanyang Technological University, Singapore
Email: wong@asia.edu.tw

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Abstract

This paper re-examines the comparison between gold and Bitcoin as portfolio diversifiers and potential safe-haven assets using Bloomberg monthly data through 31 July 2025. The common sample contains 180 monthly returns from August 2010 to July 2025.

A conventional 60/40 equity-bond portfolio is compared with monthly-rebalanced alternatives containing 10% gold, 10% Bitcoin, or 5% gold and 5% Bitcoin. The analysis covers return and downside-risk measures, conditional equity-tail tests, a paired 5,000-replication moving-block bootstrap, allocation sweeps, economic subperiods, 36-month rolling statistics, a 60-month rolling out-of-sample exercise, later-Bitcoin samples, and quantile regressions.

Gold modestly lowers volatility and maximum drawdown. Bitcoin raises long-run return but also volatility and tail risk. The mixed portfolio produces the highest fixed-weight Sharpe ratio (1.248 versus 0.925 for 60/40), and its Sharpe improvement remains positive across the 95% bootstrap interval (0.076 to 0.556).

In the worst 10% of equity months, gold averages 0.45% while Bitcoin averages -9.62%. Later-sample and quantile-regression results support a functional distinction: gold is the more defensive diversifier; Bitcoin is a risk-budgeted return enhancer. The assets are complements at modest weights, not interchangeable safe havens.

Keywords: gold; Bitcoin; safe haven; portfolio diversification; wealth management; downside risk; asset allocation
JEL classifications: G11, G12, G15

1. Introduction

Safe-haven assets occupy an unusual position in wealth management. Investors rarely buy them solely because they expect the highest return. They hold them because portfolios must survive periods in which conventional sources of diversification fail. Gold has filled this role for centuries (Hoang, Wong, and Zhu, 2015; Hoang, Lean, and Wong, 2015; Khamlichi et al., 2018; Do, 2025). Bitcoin, although much younger, is often described as 'digital gold' because of its fixed supply and independence from conventional monetary institutions (Lavanya & Mamilla, 2023; Dastkhan & Saber, 2024; Zheng & Woo, 2025; Imane & Ghizlane, 2025). The practical portfolio question is not which asset has risen more. It is the job each asset performs after it is embedded in a diversified portfolio. A volatile asset can fail as crisis insurance yet still improve long-horizon portfolio efficiency at a constrained weight. Conversely, a defensive asset can add value even when it does not materially raise compound return.

This study, therefore, asks whether gold and Bitcoin improve the risk-adjusted performance of a 60/40 portfolio, whether either behaves defensively during equity stress, whether observed Sharpe improvements are statistically robust, and whether results survive allocation sensitivity, regimes, and rolling out-of-sample implementation. The central proposition is functional: gold is closer to portfolio insurance, Bitcoin to asymmetric return optionality, and the two may be complements rather than substitutes.

2. Literature Review and Conceptual Framework

Baur and Lucey (2010) distinguish a **hedge**, which is uncorrelated or negatively correlated with another asset on average, from a **safe haven (**Dastkhan & Saber, 2024; Zada et al., 2025; Valadkhani & O'Mahony, 2024), which retains that property specifically during market stress. Baur and McDermott (2010) show that gold's safe-haven properties vary by market, shock severity, and horizon. The label should therefore describe conditional evidence rather than promise positive returns in every crisis.

Bitcoin complicates the comparison (Noorani & Mehrdoust, 2024). Its scarcity narrative resembles one aspect of gold (Hoang et al., 2020; Pho et al., 2021; Gupta, Pierdzioch, & Wong, 2021; Archer et al., 2022; Rohloff & Von Campe, 2023; Arfaoui & Yousaf, 2022; Cui et al., 2023), but its market history, investor base, and volatility differ materially. Recent research generally finds more stable defensive properties for gold and more episodic hedging properties for Bitcoin (Sharma, 2023; Ustaoglu, 2023). Portfolio utility must nevertheless be assessed separately: high volatility does not preclude a small allocation from improving efficiency when return compensation is sufficiently large.

3. Hypotheses

In this paper, we set the following hypotheses:

H1: Gold improves 60/40 portfolio efficiency primarily through lower volatility and drawdown rather than materially higher return.

H2: Bitcoin can improve long-run risk-adjusted return but materially increases volatility and downside tail risk.

H3: Gold displays stronger safe-haven characteristics than Bitcoin during severe equity declines.

H4: A modest combined allocation to gold and Bitcoin can outperform either 10% single-asset allocation on risk-adjusted performance.

H5: Benefits vary through time and with allocation size; ex post best weights are not unconditional strategic optima.

In this paper, we will examine whether the above hypotheses hold.

4. Data and Methodology

We will collect data and employ several models as discussed in this section to examine whether the hypotheses set in Section 3 hold.

4.1 Data and sample construction

The Bloomberg dataset contains daily levels for the S&P 500 Total Return Index (SPXT Index), Bloomberg U.S. Aggregate Bond Total Return Index (LUATTRUU Index), spot gold in U.S. dollars (XAU Currency), Bitcoin in U.S. dollars (XBTUSD Currency), and the U.S. three-month government yield (USGG3M Index). Bitcoin is the limiting series. The final common valid observation in each calendar month is selected from 30 July 2010 through 31 July 2025, yielding 181 month-end levels and 180 returns from August 2010 through July 2025.

4.2 Portfolios and performance measures

The benchmark holds 60% equities and 40% bonds. The alternatives are 55% equities/35% bonds/10% gold; 55% equities/35% bonds/10% Bitcoin; and 55% equities/35% bonds/5% gold/5% Bitcoin. All are rebalanced monthly. Metrics include annual return, CAGR, volatility, Sharpe and Sortino ratios, maximum drawdown, Calmar ratio, monthly 95% VaR and CVaR, and Information Ratio relative to 60/40. The three-month yield is converted to an effective monthly risk-free return.

The Sharpe ratio is defined as:

$$SR = \sqrt{12} \times \text{mean}(Rp - Rf) / \text{sd}(Rp - Rf)$$

For an alternative portfolio p relative to the 60/40 benchmark b, the Information Ratio is:

$$IR = \sqrt{12} \times \text{mean}(Rp - Rb) / \text{sd}(Rp - Rb)$$

4.3 Safe-haven, bootstrap, and robustness tests

Safe-haven behavior is evaluated for all months, negative-equity months, and the bottom 10%, 5%, and 1% of equity returns. Each condition reports average asset return, equity correlation, and conditional beta. The bottom-1% result has only two observations and is descriptive.

Sharpe differences are tested with a paired moving-block bootstrap: 5,000 replications, six-month blocks, and seed 42. Identical resampled histories are used for each portfolio and benchmark. Allocation sweeps test alternative weights from 0% to 20%. Rolling 36-month correlations and Sharpe ratios, four economic subperiods, a 60-month trailing maximum Sharpe/next-month out-of-sample test, and later samples beginning in 2015, 2018, and 2020, and quantile regressions complete the robustness analysis.

5. Empirical Results

5.1 Full-sample performance

Table 1. Risk-adjusted performance, August 2010–July 2025

Portfolio	CAGR	Volatility	Sharpe	Sortino	Max DD	CVaR 95%
60/40	9.49%	8.78%	0.925	1.487	-19.48%	-5.03%
10% Gold	9.51%	8.43%	0.963	1.588	-18.55%	-4.76%
10% Bitcoin	27.19 %	20.85%	1.188	3.546	-23.95%	-6.62%
5% Gold / 5% Bitcoin	18.40 %	13.16%	1.248	2.828	-21.04%	-5.56%

Gold barely changes CAGR (9.51% versus 9.49%) but lowers volatility and improves maximum drawdown, supporting H1. Bitcoin raises CAGR to 27.19% and Sharpe to 1.188, but volatility more than doubles, and maximum drawdown worsens. The mixed portfolio has the highest fixed-weight Sharpe (1.248) with materially less volatility than the 10% Bitcoin portfolio.

5.2 Bootstrap inference

Table 2. Paired moving-block bootstrap of Sharpe improvements

Alternative	Observed Δ	2.5%	97.5%	P(Δ≤0)
10% Gold	0.038	-0.068	0.116	25.70%
10% Bitcoin	0.264	-0.079	0.588	6.02%
5% Gold / 5% Bitcoin	0.323	0.076	0.556	0.68%

Gold's modest improvement is statistically uncertain. Bitcoin's observed improvement is larger but its 95% interval also crosses zero. The mixed portfolio's interval is entirely positive (0.076 to 0.556); only 0.68% of resamples are non-positive. This is the strongest support for H4.

5.3 Conditional safe-haven evidence

Table 3. Conditional asset performance during equity stress

Condition	N	Gold avg	Bitcoin avg	Gold corr./beta	Bitcoin corr./beta
All months	180	0.67%	14.62%	0.098 / 0.107	0.186 / 2.309
Equity down months	56	0.66%	1.84%	0.069 / 0.123	0.269 / 3.427
Bottom 10% equity months	18	0.45%	-9.62%	0.151 / 0.415	0.191 / 2.145
Bottom 5% equity months	9	-1.08%	-8.87%	-0.113 / -0.286	0.395 / 6.696
Bottom 1% equity months	2	-1.74%	-14.54%	n.m.	n.m.

In the worst 10% of equity months, gold averages 0.45%, whereas Bitcoin loses -9.62%. In the worst 5%, gold is also negative (-1.08%), so the evidence does not justify an absolute safe-haven claim. Bitcoin's loss (-8.87%) and conditional beta (6.696) are far larger. H3 is supported in relative rather than absolute terms.

5.4 Allocation sensitivity and regimes

The tested gold-only grid peaks at 15.00% gold (Sharpe 0.968); Bitcoin-only peaks at 5.00% (Sharpe 1.231). The combined grid peaks at 15.00% gold and 5.00% Bitcoin (Sharpe 1.266). These are ex post sensitivity results, not recommendations. They indicate that Bitcoin's benefit is captured at a small weight, while gold tolerates a larger allocation before materially destabilizing risk.

Table 4. Sharpe ratios by subperiod

Period	60/40	10% Gold	10% Bitcoin	Mixed
Aug 2010-Dec 2014	1.728	1.551	1.588	1.764
2015-2019	1.030	1.089	1.406	1.408

2020-2022	0.296	0.339	0.524	0.456
2023-Jul 2025	1.045	1.256	1.487	1.421

Rankings vary over time. This supports H5 and argues against reading any full-sample result as a permanent structural optimum.

5.5 Rolling out-of-sample allocation

Table 5. Rolling 60-month estimation and next-month implementation

Strategy	Avg selected wt	OOS CAGR	Volatility	Sharpe	IR vs 60/40
Gold	11.42%	9.43%	8.97%	0.831	0.220
Bitcoin	10.02%	15.15%	13.93%	0.944	0.852
60/40	0.00%	8.78%	9.76%	0.708	

Both rolling alternative-asset strategies exceed the 60/40 Sharpe of 0.708. Gold achieves 0.831; Bitcoin 0.944. The average selected weights are 11.42% and 10.02%, respectively. The result is robustness evidence, not a trading strategy, because costs, taxes, and implementation frictions are omitted.

6. Later-Sample and Quantile-Regression Robustness

Table 6. Later-Bitcoin samples

Sample	Portfolio	CAGR	Volatility	Sharpe	Max DD
2015-Jul 2025	60/40	8.53%	9.56%	0.708	-19.48%
	10% Gold	8.93%	9.04%	0.786	-18.55%
	10% Bitcoin	16.54%	13.50%	1.066	-23.95%
	5% Gold / 5% Bitcoin	12.75%	10.83%	0.992	-21.04%
2018-Jul 2025	60/40	8.95%	10.74%	0.623	-19.48%
	10% Gold	9.59%	10.17%	0.711	-18.55%
	10% Bitcoin	13.51%	14.34%	0.786	-23.95%
	5% Gold / 5% Bitcoin	11.61%	11.88%	0.778	-21.04%
2020-Jul 2025	60/40	8.90%	11.53%	0.568	-19.48%
	10% Gold	9.75%	10.95%	0.665	-18.55%
	10% Bitcoin	15.59%	15.29%	0.854	-23.95%
	5% Gold / 5% Bitcoin	12.70%	12.86%	0.791	-21.04%

From 2015 through July 2025, the mixed portfolio's Sharpe is 0.992 versus 0.708 for 60/40. Its bootstrap improvement is 0.284, with a 95% interval of 0.104 to 0.532. From 2018, the observed

gain remains positive, but the interval (-0.017 to 0.392) crosses zero. Early Bitcoin history matters materially.

Table 7. Quantile regression of asset returns on equity returns

Asset	Quantile	Equity coefficient	Std. error	p-value
Gold	5.00%	0.096	0.151	0.526
	10.00%	-0.038	0.136	0.778
	25.00%	0.092	0.100	0.358
	50.00%	0.200	0.099	0.044
Bitcoin	5.00%	1.740	0.511	<0.001
	10.00%	1.752	0.571	0.002
	25.00%	1.465	0.619	0.018
	50.00%	1.580	0.668	0.018

Gold's equity coefficients are small and statistically insignificant at the 5%, 10% and 25% quantiles. Bitcoin's coefficients are large and positive: 1.740 at 5% and 1.752 at 10%, both statistically significant. This reinforces the tail analysis: Bitcoin retains equity-like exposure in adverse states, while gold is more defensive.

7. Implications for Wealth Managers

- Define the objective before choosing the asset. Gold is better aligned with drawdown control and defensive diversification; Bitcoin with long-horizon return enhancement and high-risk capacity.
- Size Bitcoin through a risk budget, not capital-weight intuition. Equal capital weights in gold and Bitcoin are not equal risk allocations.
- Do not infer safe-haven status from low unconditional correlation. Conditional left-tail performance is the economically relevant test.
- Treat weight sweeps as sensitivity diagnostics. Governance ranges and rebalancing rules are more defensible than historical point optima.
- Frame the client conversation around how much insurance and asymmetric upside the portfolio needs, not which asset wins a popularity contest.

8. Limitations and Further Research

The common sample begins only in 2010 and cannot test earlier inflationary or geopolitical regimes. Bitcoin’s exceptional early appreciation can flatter full-sample return and Sharpe estimates, as the later-sample tests demonstrate. Monthly data are appropriate for strategic allocation but can miss

short-lived daily flight-to-quality effects. The bottom-1% tail contains only two observations. Quantile-regression inference is asymptotic and should be interpreted with the same sample-size caution. The analysis omits transaction costs, taxes, custody, liquidity constraints, and investable vehicle tracking error.

Further research should examine daily crisis windows, alternative bootstrap block lengths and rebalancing frequencies, multi-currency investor perspectives, investable instruments, and risk-budgeted rather than capital-weighted portfolios.

9. Conclusion

The evidence through July 2025 does not support treating gold and Bitcoin as interchangeable safe havens. Gold behaves primarily as a defensive diversifier: it lowers volatility and drawdown modestly and is far more resilient in severe equity declines. Bitcoin behaves primarily as a return enhancer: it raises long-run returns and can improve Sharpe ratios, but it also increases volatility, tail losses, and stress-state equity sensitivity.

The mixed 5% gold/5% Bitcoin portfolio produces the highest fixed-weight Sharpe (1.248), and its full-sample improvement remains positive across the 95% moving-block-bootstrap interval. The result is also strong from 2015, although statistical support weakens from 2018. This qualification is central: historical efficiency is evidence, not a forecast.

For wealth management, the enduring implication is portfolio function. Gold remains closer to insurance; Bitcoin remains closer to asymmetric growth optionality. A well-governed portfolio may use both, but each should be sized and evaluated against the job it is expected to perform.

To get better performance by incorporating gold and Bitcoin in the portfolio, one may incorporate other approaches with the approach used in this paper, for example, investing rules (Lu et al., 2021, 2018, 2022; Wong & McAleer, 2009), contagion (Hassan et al., 2023), market efficiency and anomalies (Li & Wong, 1999; Wong & LI, 1999; Wong, 2006, 2007; Wong & Ma, 2008; Wong & Chan, 2008; Wong & McAleer, 2009; Broll et al., 2010; Bai et al., 2011, 2015; Leung et al., 2012; Guo et al., 2017, 2018, 2019; Ng et al., 2017; Chan et al., 2020, 2022; Guo & Wong, 2016), risk measure (Leung & Wong, 2008; Ma & Wong, 2010; Wong et al., 2012; 2023; 2026; Bai et al., 2011, 2012, 2013; Guo et al., 2017; 2019; Niu et al., 2017, 2018), overreaction and underreaction (Fong et al., 2005; Lam et al., 2007, 2010, 2012; Fabozzi et al., 2013; Guo et al., 2017a), portfolio optimization (Bai et al., 2009, Li et al., 2022, 2025; Lv et al., 2021, 2023), diversification (Egozcue & Wong, 2010; Ortobelli Lozza et al., 2018), technical analysis (see, for example, Wong et al., 2001, 2003, 2005; Lam et al., 2007; Kung & Wong, 2009a,b; Chan, Lee & Wong, 2014), and herding behavior (see, for example, Munkh-Ulzii et al., 2018; Batmunkh et al., 2020; Choijil et al., 2022; Vieito et al., 2024) and others.

10. Data and Reproducibility Statement

The analysis uses the Bloomberg series supplied by the author. Because Bloomberg data are proprietary, redistribution may be restricted. The accompanying Excel audit workbook records the source identifiers, daily raw observations within the common-sample window through 31 July 2025, exact month-end row selections, monthly return and portfolio formulas, drawdowns, 5,000 bootstrap replications, weight sweeps, subperiods, rolling out-of-sample results, rolling 36-month statistics, later-sample tests, and quantile-regression outputs. The bootstrap uses six-month moving blocks and a seed of 42.

References

Archer, C., Junior, P. O., Adam, A. M., Asafo-Adjei, E., & Baffoe, S. (2022). Asymmetric dependence between exchange rate and commodity prices in Ghana. *Annals of Financial Economics*, *17*(02), 2250012.

Arfaoui, N., & Yousaf, I. (2022). Impact of COVID-19 on volatility spillovers across international markets: Evidence from VAR asymmetric BEKK GARCH model. *Annals of Financial Economics*, *17*(01), 2250004.

Bai, Z., Hui, Y., Wong, W. K., & Zitikis, R. (2012). Prospect performance evaluation: Making a case for a non-asymptotic UMPU test. *Journal of Financial Econometrics*, *10*(4), 703-732.

Bai, Z., Li, H., Liu, H., & Wong, W. K. (2011). Test statistics for prospect and Markowitz stochastic dominances with applications. *The Econometrics Journal*, *14*(2), 278-303.

Bai, Z., Li, H., McAleer, M., & Wong, W. K. (2015). Stochastic dominance statistics for risk averters and risk seekers: An analysis of stock preferences for USA and China. *Quantitative Finance*, *15*(5), 889-900.

Bai, Z., Liu, H., & Wong, W.-K. (2009). Enhancement of the applicability of Markowitz's portfolio optimization by utilizing random matrix theory. *Mathematical Finance*, *19*(4), 639–667. https://doi.org/10.1111/j.1467-9965.2009.00383.x

Bai, Z., Phoon, K. F., Wang, K., & Wong, W. K. (2013). The performance of commodity trading advisors: A mean-variance-ratio test approach. *The North American Journal of Economics and Finance*, *25*, 188-201.

Bai, Z., Wang, K., & Wong, W. K. (2011). The mean–variance ratio test—A complement to the coefficient of variation test and the Sharpe ratio test. *Statistics & probability letters*, *81*(8), 1078-1085.

Batmunkh, M. U., Choijil, E., Vieito, J. P., Espinosa-Méndez, C., & Wong, W. K. (2020). Does herding behavior exist in the Mongolian stock market?. *Pacific-Basin Finance Journal*, *62*, 101352.

Baur, D. G., & Lucey, B. M. (2010). Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. Financial Review, 45(2), 217–229. https://doi.org/10.1111/j.1540-6288.2010.00244.x

Baur, D. G., & McDermott, T. K. (2010). Is gold a safe haven? International evidence. Journal of Banking & Finance, 34(8), 1886–1898. https://doi.org/10.1016/j.jbankfin.2009.12.008

Broll, U., Egozcue, M., Wong, W. K., & Zitikis, R. (2010). Prospect theory, indifference curves, and hedging risks. *Applied Mathematics Research Express*, *2010*(2), 142-153.

Chan, R. H., Chow, S. C., Guo, X., & Wong, W. K. (2022). Central moments, stochastic dominance, moment rule, and diversification with an application. *Chaos, Solitons & Fractals*, *161*, 112251.

Chan, R. H., Clark, E., Guo, X., & Wong, W. K. (2020). New development on the third-order stochastic dominance for risk-averse and risk-seeking investors with application in risk management. *Risk Management*, *22*(2), 108-132.

Chan, R. H.F., Wong, A.W. K., & Lee, S.T.H. (2014). Technical analysis and financial asset forecasting: From simple tools to advanced techniques. World Scientific Publishing Company.

Cui, M., Wong, W. K., Wisetsri, W., Mabrouk, F., Muda, I., Li, Z., & Hassan, M. (2023). Do oil, gold and metallic price volatilities prove gold as a safe haven during COVID-19 pandemic? Novel evidence from COVID-19 data. *Resources policy*, *80*, 103133.

Dastkhan, H., & Saber, H. (2024). Does Bitcoin Add Any Value To The Investment Portfolios In Emerging Markets? A Case From Tehran Stock Exchange. *Annals of Financial Economics*, *19*(03), 2450012.

Do, Q. H. (2025). Forecasting ROA and ROE for Retail Companies in Vietnam by Using Machine Learning Techniques. *Advances in Decision Sciences*, *29*(4), 1-30.

Egozcue, M., & Wong, W. K. (2010). Gains from diversification on convex combinations: A majorization and stochastic dominance approach. *European Journal of Operational Research*, *200*(3), 893-900.

Fabozzi, F. J., Fung, C. Y., Lam, K., & Wong, W. K. (2013). Market overreaction and underreaction: Tests of the directional and magnitude effects. *Applied Financial Economics*, *23*(18), 1469-1482.

Fong, W. M., Wong, W. K., & Lean, H. H. (2005). International momentum strategies: A stochastic dominance approach. *Journal of Financial Markets*, *8*(1), 89-109.

Guo, X., Chan, R. H., Wong, W. K., & Zhu, L. (2019). Mean–variance, mean–VaR, and mean–CVaR models for portfolio selection with background risk. *Risk Management*, *21*(2), 73-98.

Guo, X., Jiang, X., & Wong, W. K. (2017). Stochastic dominance and omega ratio: Measures to examine market efficiency, arbitrage opportunity, and anomaly. *Economies*, *5*(4), 38.

Guo, X., McAleer, M., Wong, W. K., & Zhu, L. (2017a). A Bayesian approach to excess volatility, short-term underreaction and long-term overreaction during financial crises. *The North American Journal of Economics and Finance*, *42*, 346-358.

Guo, X., Niu, C., & Wong, W. K. (2019). Farinelli and Tibiletti ratio and stochastic dominance. Risk Management, 21(3), 201-213.

Guo, X., Wagener, A., Wong, W. K., & Zhu, L. (2018). The two-moment decision model with additive risks. *Risk Management*, *20*(1), 77-94.

Guo, X., & Wong, W. K. (2016). Multivariate stochastic dominance for risk averters and risk seekers. *RAIRO-Operations Research*, *50*(3), 575-586.

Gupta, R., Pierdzioch, C., & Wong, W. K. (2021). A note on forecasting the historical realized variance of oil-price movements: the role of gold-to-silver and gold-to-platinum price ratios. *Energies*, *14*(20), 6775.

Hassan, K., Hoque, A., Gasbarro, D., & Wong, W. K. (2023). Are Islamic stocks immune from financial crises? Evidence from contagion tests. *International Review of Economics & Finance*, *86*, 919-948.

Hoang, T. H. V., Lean, H. H., & Wong, W. K. (2015). Is gold good for portfolio diversification? A stochastic dominance analysis of the Paris stock exchange. *International review of financial analysis*, *42*, 98-108.

Hoang, T. H. V., Wong, W. K., & Zhu, Z. (2015). Is gold different for risk-averse and risk-seeking investors? An empirical analysis of the Shanghai Gold Exchange. *Economic Modelling*, *50*, 200-211.

Hoang, T. H. V., Zhu, Z., Xiao, B., & Wong, W. K. (2020). The seasonality of gold prices in China does the risk-aversion level matter?. *Accounting & Finance*, *60*(3), 2617-2664.

Imane, E., & Ghizlane, K. (2025). Exploring tail risk transmission between volatility indices and cryptocurrencies: Evidence from quantile connectedness. *Advances in Decision Sciences*, *29*(3), 1-38.

Khamlichi, A. E., Hoang, T. H. V., Wong, W. K., & Zhu, Z. Z. (2018). Does the Shari'ah Screening Impact the Gold-Stock Nexus? A Sectorial Analysis. Resources Policy 61, 617-626.

Kung, J. J., & Wong, W. K. (2009a). Profitability of technical analysis in the Singapore stock market: Before and after the Asian financial crisis. Journal of Economic Integration, 24(1), 133-150.

Kung, J. J., & Wong, W. K. (2009b). Efficiency of the Taiwan stock market. *The Japanese Economic Review*, *60*(3), 389-394.

Lam, K., Liu, T., & Wong, W. K. (2010). A pseudo-Bayesian model in financial decision making with implications to market volatility, under-and overreaction. *European Journal of Operational Research*, *203*(1), 166-175.

Lam, K., Liu, T., & Wong, W. K. (2012). A new pseudo-Bayesian model with implications for financial anomalies and investors' behavior. *Journal of Behavioral Finance*, *13*(2), 93-107.

Lam, W. S. V., Chong, T. T. L., & Wong, W. K. (2007). Profitability of intraday and interday momentum strategies. *Applied Economics Letters*, *14*(15), 1103-1108.

Lavanya, R., & Mamilla, R. (2023). Bibliometric characteristics of cryptocurrency through citation network analysis. *Advances in Decision Sciences*, *27*(2), 46-74.

Leung, P.L., Ng, H.Y., & Wong, W. K. (2012). An improved estimation to make Markowitz's portfolio optimization theory users friendly and estimation accurate with application on the US stock market investment. *European Journal of Operational Research*, *222*(1), 85-95.

Leung, P. L., & Wong, W. K. (2008). On testing the equality of the multiple Sharpe ratios, with application on the evaluation of Ishares. Journal of Risk, 10(3), 1-16.

Li, C. K., & Wong, W. K. (1999). Extension of stochastic dominance theory to random variables. *RAIRO-Operations Research-Recherche Opérationnelle*, *33*(4), 509-524.

Li, H., Bai, Z., Wong, W. K., & McAleer, M. (2022). Spectrally-corrected estimation for high-dimensional Markowitz mean-variance optimization. *Econometrics and Statistics*, *24*, 133-150.

Li, Z., Hui, Y., Wong, W. K., & Lin, R. (2025). Portfolio Selection Based on Mean-Generalized Variance Analysis: Evidence from the G20 Stock Markets. *Asia-Pacific Journal of Operational Research*, *42*(03), 2450016.

Lu, R., Hoang, V. T., & Wong, W. K. (2021). Do lump-sum investing strategies really outperform dollar-cost averaging strategies?. *Studies in Economics and Finance*, *38*(3), 675-691.

Lu, R., Wang, J.J., & Wong, W. K. (2022). Investment based on size, value, momentum and income measures: a study in the Taiwan stock market. *Annals of Financial Economics*, *17*(04), 2250027.

Lu, R., Yang, C. C., & Wong, W. K. (2018). Time diversification: Perspectives from the economic index of riskiness. *Annals of Financial Economics*, *13*(03), 1850011.

Lv, Z., Chu, A. M., Wong, W. K., & Chiang, T. C. (2021). The maximum-return-and-minimum-volatility effect: evidence from choosing risky and riskless assets to form a portfolio. *Risk Management*, *23*(1), 97-122.

Lv, Z., Tsang, C. K., Wagner, N. F., & Wong, W. K. (2023). What is an optimal allocation in Hong Kong stock, real estate, and money markets: an individual asset, efficient frontier portfolios, or a naïve portfolio? Is this a new financial anomaly?. *Emerging Markets Finance and Trade*, *59*(5), 1554-1571.

Ma, C., & Wong, W. K. (2010). Stochastic dominance and risk measure: A decision-theoretic foundation for VaR and C-VaR. *European Journal of Operational Research*, *207*(2), 927-935.

Munkh-Ulzii, B. J., McAleer, M., Moslehpour, M., & Wong, W. K. (2018). Confucius and herding behaviour in the stock markets in China and Taiwan. Sustainability, 10 (12), 4413.

Ng, P., Wong, W. K., & Xiao, Z. (2017). Stochastic dominance via quantile regression with applications to investigate arbitrage opportunity and market efficiency. *European Journal of Operational Research*, *261*(2), 666-678.

Niu, C., Guo, X., McAleer, M., & Wong, W. K. (2018). Theory and application of an economic performance measure of risk. *International Review of Economics & Finance*, *56*, 383-396.

Niu, C., Wong, W. K., & Xu, Q. (2017). Kappa ratios and (higher-order) stochastic dominance. *Risk Management*, *19*(3), 245-253.

Ortobelli Lozza, S., Wong, W. K., Fabozzi, F. J., & Egozcue, M. (2018). Diversification versus optimality: is there really a diversification puzzle?. *Applied Economics*, *50*(43), 4671-4693.

Noorani, I., & Mehrdoust, F. (2024). Forecasting Bitcoin Price by a Hybrid Structure Based on ARIMA, SVM and LSSVM Models. *Annals of Financial Economics*, *19*(04), 2450020.

Pho, K. H., Ly, S., Lu, R., Hoang, T. H.V, & Wong, W. K. (2021). Is Bitcoin a better portfolio diversifier than gold? A copula and sectoral analysis for China. *International Review of Financial Analysis*, *74*, 101674.

Pierdzioch, C., Rohloff, S., & Von Campe, R. (2023). On the predictive value of the (shadow) real interest rate for the realized volatility of gold-price returns. *Annals of Financial Economics*, *18*(01), 2241001.

Sharma, U. (2023). Are gold, USD, and Bitcoin hedge or safe haven against stock? The implication for risk management. Review of Financial Economics, 41(1), 43–64. https://doi.org/10.1002/rfe.1160

Ustaoglu, E. (2023). Diversification, hedge, and safe-haven properties of gold and bitcoin with portfolio implications during the Russia–Ukraine war. Resources Policy, 85, 103791. https://doi.org/10.1016/j.resourpol.2023.103791

Valadkhani, A., & O'Mahony, B. (2024). Market fear and emerging market returns: Analyzing the impacts of VIX and Dollar Index. *Annals of Financial Economics*, *19*(03), 2450015.

Vieito, J. P., Espinosa, C., Wong, W. K., Batmunkh, M. U., Choijil, E., & Hussien, M. (2024). Herding behavior in integrated financial markets: the case of MILA. *International Journal of Emerging Markets*, *19*(11), 3801-3827.

Wong, W. K. (2006). Stochastic dominance theory for location-scale family. Advances in Decision Sciences, 82049-1.

Wong, W.-K. (2007). Stochastic dominance and mean-variance measures of profit and loss for business planning and investment. *European Journal of Operational Research*, *182*(2), 829–843. https://doi.org/10.1016/j.ejor.2006.09.032

Wong, W. K., & Chan, R. (2008). Markowitz and prospect stochastic dominances. *Annals of Finance*, *4*(1), 105-129.

Wong, W. K., Chew, B. K., & Sikorski, D. (2001). Can the forecasts generated from E/P ratio and bond yield be used to beat stock markets?. *Multinational Finance Journal*, *5*(1), 59-86.

Wong, W. K., Du, J., & Chong, T. T. L. (2005). Do the technical indicators reward chartists in Greater China stock exchanges. *Review of Applied Economics*, *1*(2), 183-205.

Wong, W. K., & Li, C. K. (1999). A note on convex stochastic dominance. *Economics Letters*, *62*(3), 293-300.

Wong, W. K., & Ma, C. (2008). Preferences over location-scale family. *Economic Theory*, *37*(1), 119-146.

Wong, W. K., Manzur, M., & Chew, B. K. (2003). How rewarding is technical analysis? Evidence from Singapore stock market. *Applied Financial Economics*, *13*(7), 543-551.

Wong, W. K., & McAleer, M. (2009). Mapping the Presidential Election Cycle in US stock markets. *Mathematics and Computers in Simulation*, *79*(11), 3267-3277.

Wong, W. K., Wright, J.A., Yam, S.C.P., & Yung, S.P. (2012). A mixed Sharpe ratio. *Risk and Decision Analysis*, *3*(1-2), 37-65.

Wong, W. K., Yeung, D., & Lu, R. (2023). The mean-variance rule for investors with reverse S-shaped utility. *Annals of Financial Economics*, *18*(01), 2250030.

Wong, W. K., Zhu, Z., Jiang, I. M., & Bouri, E. (2026). Arbitrage opportunities in no-arbitrage portfolios: The case of Bitcoin and Treasury Bills. *Investment Analysts Journal*, *55*(1), 55-86.

Zada, H., Parahara, N., Nanayakkara, M., Usman Masood, S. M., & Wong, W. K. (2025). Connectedness between Industrial and Rare Earth Metals: Implications for Portfolio Diversification During the COVID-19 Pandemic and the Russia–Ukraine Conflict. *Annals of Financial Economics*, *20*(04), 2550021.

Zheng, Z., & Woo, K. Y. (2025). Hedging Global Stock Markets with Bitcoin, Precious Metals, Copper, Crude Oil, and Agricultural Commodities: Evidence from Bivariate Threshold GARCH Approach. *Advances in Decision Sciences*, *29*(1), 1-18.