Dual exposure to Gold and Silver: Quantitative Evidence and Strategic Implementation

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1. Investment Report: Gold and Silver

In recent quarters, precious metals have re-emerged at the centre of global macro discourse, propelled by a convergence of economic uncertainty, inflation dynamics, and structural industrial shifts. Gold has reached unprecedented nominal highs, surpassing the 4,000 USD per troy ounce threshold, while silver has appreciated more than one hundred percent over the past five years, registering a striking 65.46 % gain in 2025 alone. The magnitude and synchronicity of these rallies invite a deeper examination of their underlying drivers and inter-metal dynamics.

This report outlines the strategic drivers justifying a dual long position on silver and gold by the Commodities department of the University of Southampton's investment fund. The analysis combines comprehensive qualitative analysis with rigorous quantitative analysis through integrating parametric and bootstrap Monte Carlo simulations, and fractional Kelly-criterion for optimal portfolio allocation. The report then outlines the practical implementation of the strategy and a risk analysis outlining signals prompting the potential exit out of the position.

Furthermore, this report revisits the gold/ silver ratio with rigorous econometric and market analysis to determine whether "playing" the spread remains a profitable or meaningful strategy and finds no basis for such execution in current market conditions.

Table 1: Executive Summary: Trade Recommendation — Dual Long Gold & Silver Strategy

Category	Recommendation Details
Trade Structure	Dual-long exposure to gold and silver through a mix of ETFs (GLD, SLV) and selective mining equities (e.g., NEM, GOLD, AG) or mining equity ETFs to capture both monetary and industrial demand.
Investment Rationale	Gold benefits from negative real yields, central bank demand, and geopolitical risk. Silver adds industrial and energy-transition exposure, supported by ongoing supply deficits. The dual allocation balances macro-financial and industrial cycles, providing convexity across regimes.
Entry Point	Current market conditions (as of report date) show elevated real-yield sensitivity and strong ETF inflows, offering an attractive entry.
Target Horizon	6–12 months tactical horizon. Review when key macro thresholds are breached.
Expected Returns	Mean expected annual return: 12–15% (Monte Carlo simulations). Expected Shortfall (P5): –20%. Probability of strong gain (>10%): 50–55%.
Monitoring Metrics	10Y TIPS real yields, USD broad index (DXY), gold–silver ratio z-score, ETF flows (GLD, SLV), and CFTC positioning.
Exit Triggers	10Y TIPS real yields > 2.5% (real rate shock). Gold–silver ratio outside historical bounds. CFTC speculative longs > $+2\sigma$ vs. 5Y mean. ETF outflows > 10% AUM within two weeks. Drawdown exceeding 20% from peak.
Key Risks	Real-yield repricing, rapid USD appreciation, industrial demand slowdown, speculative unwind, and ETF redemption cycles.
Conviction Level	High. Macroeconomic conditions (disinflation, dovish bias) and strong industrial demand support continuation of the metals rally, with attractive risk-adjusted characteristics.
Analyst View	Maintain constructive dual-long exposure. Prefer hybrid approach combining ETFs and miners for diversification and convexity. Consider short-dated options overlays to hedge real-yield risk.

Note: All expected return metrics are derived from 1,500 Monte Carlo and block-bootstrap simulations. Data sources: Yahoo Finance, Silver Institute, CFTC, and ETF provider reports.

Figure 1.1: Normalized returns of a equally-weighted Gold - Silver position in the last 20 years

Price Determinants and Drivers

This section outlines the underlying reasons for the current gold and silver rallies, exploring both common drivers and metal-specific factors.

A. Common Macro-financial drivers

a. Real yields, dollar dynamics and monetary policy.

Firstly, precious metals are financial assets, implying their opportunity cost is driven by real interest rates and the expected path of nominal policy rates. Falling real yields reduce the carry cost of holding non-yielding cash and raise the present value of a convenience yield in gold and silver: empirically, gold and silver both exhibit a negative exposure to real yields. A weaker USD mechanically increases dollar-priced commodity levels for rest-of-world buyers, amplifying demand. In the recent episode, markets priced a marked easing bias in the Fed's path (late-2024/2025) and a softer dollar: a catalyst common to both metals.

b. Safe-haven, geopolitical risk and portfolio reallocation.

Heightened geopolitical uncertainty and episodic risk-off events reawaken investors' allocation to tangible stores of value. Gold is the archetypal beneficiary; silver participates when the portfolio reallocation is broad and when investors seek incremental diversification via metal exposure. ETF inflows into gold and physical silver trusts have been an important flow channel. Rapid inflows compress physical availability and lift spot. Reuters and market

commentaries in 2025 documented substantial ETF and central bank demand at record levels for gold and elevated institutional flows for silver and participated in the rise in prices.

B. Metal-specific price drivers: Silver

a. Industrial demand

Silver's recent price rally has been significantly driven by a supply deficit, which has been predicted to represent 117.6 million ounces in 2025 according to the World Silver Survey. What differentiates silver from gold is the magnitude and growth of industrial consumption. Silver's demand split is materially biased toward industrial use (the Silver Institute and Metals Focus report industrial shares in the high-fifties percent range), and critical sub-sectors are expanding: photovoltaics, semiconductors/electronics, and electrification for transport and grid hardware. This has intertwined the metal with the energy transition and has placed it as a proxy for technological growth.

The key mechanisms linking industrial growth to price are:

Photovoltaic demand: each GW of installed photovoltaic requires a fixed grams-per-panel silver intensity; even modest growth in installations scales quickly into tens of millions of ounces of incremental annual demand.

Electronics and semiconductors: rising unit shipments and device complexity (5G, semiconductors) raise per-device silver intensity and total demand.

Automotive electrification: silver is used in contact points and sensors; penetration of electric vehicles increases per-vehicle silver use and overall demand.

b. Supply constraints and market tightness.

A defining feature of the current silver market is the inelasticity of supply. Roughly 70% of global silver output arises as a by-product of mining for base metals such as copper, lead, and zinc, implying that production decisions respond more to the profitability of these metals than to silver's own price. Consequently, a surge in silver demand cannot be quickly offset by increased output.

Mine development is further hampered by declining ore grades, delayed exploration investment during the 2015–2020 bear cycle, and tightening environmental regulations in key producing countries (notably Mexico, Peru, and China). Secondary supply through recycling, while flexible, represents less than a fifth of global output and is sensitive to price volatility and collection efficiency.

This structural inelasticity means that even moderate demand shocks—particularly those linked to industrial decarbonisation, translate into disproportionate price adjustments. As inventories on COMEX and the Shanghai Futures Exchange have steadily declined since 2023, spot and futures markets have begun pricing a persistent scarcity premium.

c. Investment and speculative demand.

Alongside industrial fundamentals, financial investment has magnified silver's momentum. The metal's half industrial, half monetary manifestation makes it highly sensitive to investor sentiment shifts. ETF holdings in products such as iShares Silver Trust (SLV) expanded markedly in 2025, as both retail and institutional investors sought leveraged exposure to the energy transition narrative.

CFTC data corroborate this pattern: net speculative long positions in COMEX silver futures reached multi-year highs by mid-2025, coinciding with accelerating prices. While such positioning can fuel temporary overshoots, it also reflects a broader structural reallocation toward commodities as inflation hedges and decarbonisation plays. In effect, investment demand has reinforced, rather than distorted, silver's fundamentally driven uptrend.

C. Metal-Specific Price Drivers: Gold

a. Central bank Accumulation and Diversification.

Gold's rally has been primarily monetary and financial in nature. Over 2023–2025, global central banks have accumulated record tonnages of gold, motivated by both macroprudential and geopolitical considerations. The World Gold Council estimates net purchases exceeding 1,000 tonnes in 2024 alone, led by emerging-market central banks such as those of China, Turkey, and India.

This accumulation serves as a hedge against sanctions risk and dollar exposure. As global reserves become more multipolar, gold has reasserted itself as the de facto neutral reserve asset. The steady, price-insensitive nature of these flows creates a durable structural bid beneath the market.

b. Speculative Bubble fears and strong safe haven views

As outlined in the shared price drivers of both gold and silver, gold's status as a safe haven in times of uncertainty and perceived high macroeconomic uncertainty have driven the price surge in 2025 to a large extent, more so than that of silver. Gold ETFs have seen a particular increase in net-long positions and large order inflows. The climate of fear that reigned in regards to US economic growth prospects, the unprecedented weight of the magnificent 7 in the S&P 500 and suspicions of AI constituting a speculative bubble, among further fears.

c. Supply and production Dynamics.

Unlike silver, gold's supply is less sensitive to industrial cycle. The annual production of gold has been is restricted to 1-2% since 2018 due to a combination of declining ore grades, elevated extraction costs, and limited new discoveries. Furthermore, the supply is additionally restricted by ESG regulations and permitting delays through the extension of project timelines. Price rallies are in consequence rarely met with immediate supply responses to demand increases, mechanically reinforcing gold's tendency to sustain high price levels once a new equilibrium is reached.

Gold/silver ratios and its navigation

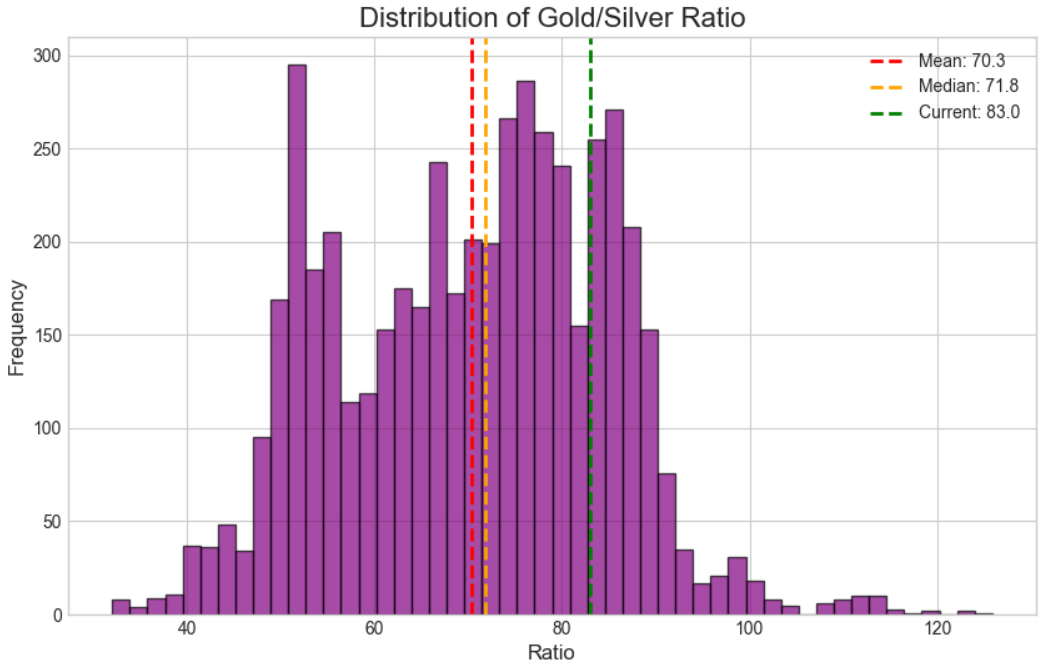

Figure 1.2: The Gold/Silver ratio: Near historical norms

The Gold/Silver ratio is near its historical norm, implying a neutral relative pair valuation. The current Gold/Silver ratio is currently 83, this is far from unprecedented levels, where statistical outliers on the right-tail of the distribution are far closer to 100, or above 100. The mean ratio is 70.3, and a ratio equal to 83 has been present in more than 250 out of 5025 observations, or in nearly 5% of all observations.

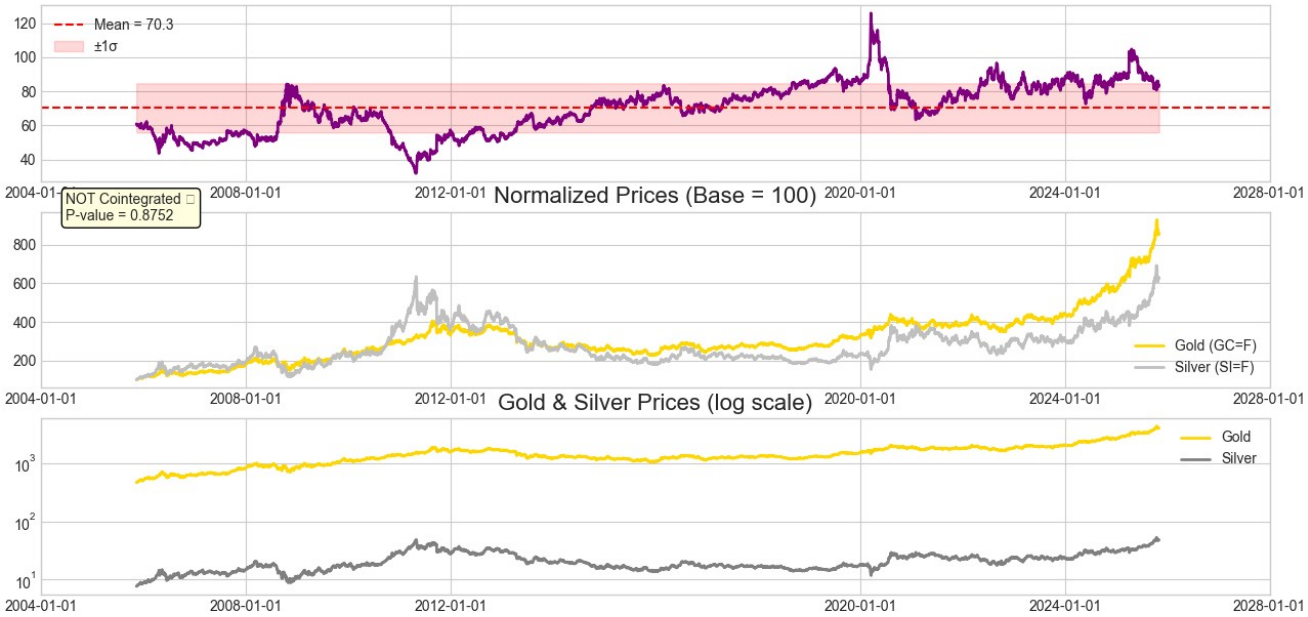

Figure 1.3: Gold/Silver dynamics

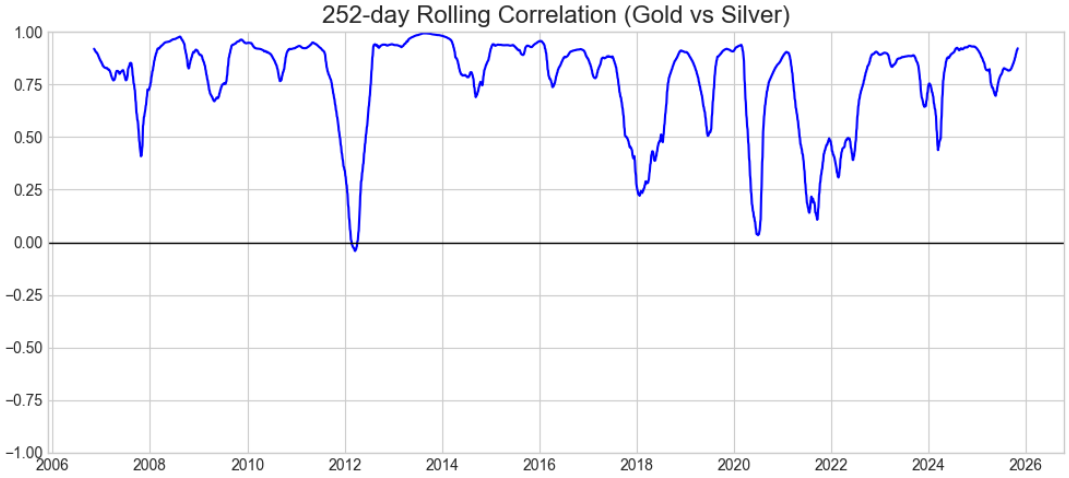

Figure 1.4: Gold/Silver 252-day Rolling correlation

Table 2: Gold–Silver Time Series Analysis Summary

Category	Metric	Value / Interpretation
Additional Time Series Analysis		
	Price Correlation	0.7944
	Returns Correlation	0.7953
	Hedge Ratio (β)	62.8662
	Coefficient of Determination (R^2)	0.6311
Gold–Silver Ratio Summary		
	Current Gold Price	\$3,996.50
	Current Silver Price	\$48.16
	Current Ratio	83.0
	Mean Ratio ($\pm$ Std. Dev.)	70.3 ± 14.4
	Data Span	2005–11–07 - 2025–10–31 (5025 obs)
	Interpretation	Ratio near historical average
	Cointegration Relationship	No strong evidence of equilibrium relationship
Cointegration Test Results		
	Test Statistic	-1.1672
	P-value	0.8663
	Critical Value (1%)	-3.8986
	Critical Value (5%)	-3.3373
	Critical Value (10%)	-3.0453
	Conclusion	Gold and Silver are not cointegrated

The results underline the strong but imperfect co-movement between gold and silver prices over the past two decades. The high price and returns correlations (0.79 in both cases) confirm that the metals typically respond in the same direction to macro-financial impulses—particularly shifts in real yields, dollar dynamics, and risk sentiment. Nevertheless, the estimated hedge ratio ($\beta = 62.87$) and moderate explanatory power ($R^2 = 0.63$) suggest that this relationship is not one of strict parity, reflecting silver's greater exposure to industrial cycles.

The cointegration test fails to reject the null hypothesis of no long-term equilibrium ($p = 0.87$). This indicates that, despite frequent short-term co-movement, gold and silver prices do not revert to a stable long-term ratio. The gold–silver ratio, currently near its historical mean (83.0 vs. 70.3 ± 14.4), therefore lacks statistical justification for mean-reversion trades at present levels. Instead, it reflects independent structural drivers—financial in the case of gold and industrial in the case of silver.

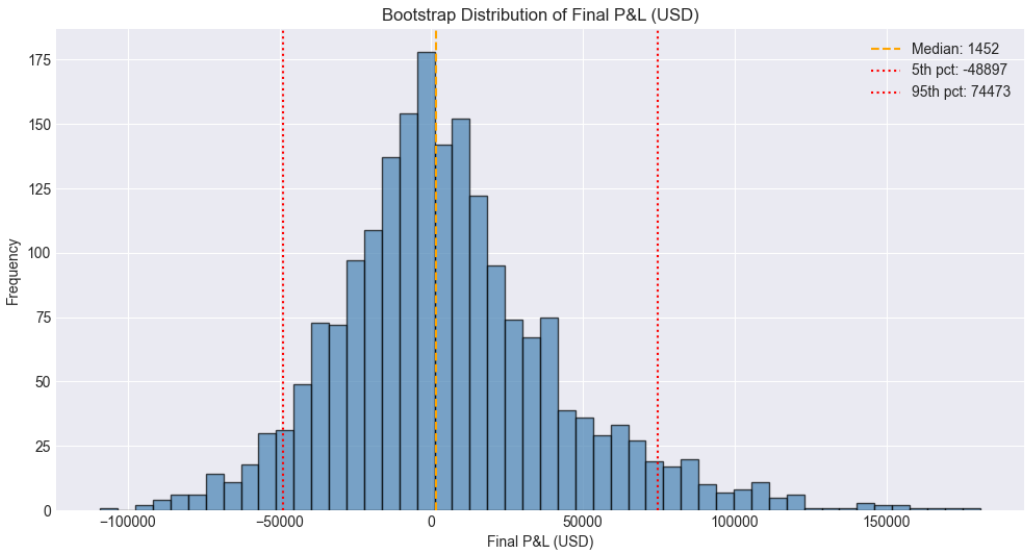

Figure 1.5: Bootstrap Resampling results: inefficacy of a short Gold/ long silver directional trading strategy

Here, we evaluate the robustness of our estimates using bootstrap resampling. Bootstrap resampling is a non-parametric technique that treats the data as its own empirical population. By repeatedly drawing random samples with replacement and recalculating the statistic of interest, the method constructs an empirical sampling distribution that captures the true uncertainty of the estimates—particularly valuable when parametric assumptions or asymptotic approximations may not hold in financial time series.

The results of bootstrap resampling confirm the irrationality of betting on a supposed mean reversion of the Gold/Silver ratio through short gold, long silver trade executions. The results show strong variability and low expected returns, with the triggering of stop-losses short after the strategy's start in a large proportion of the simulations.

Qualitative Rationale for Long Exposure to Gold and Silver

A. The Macroeconomic Backdrop: End of the Fiat Cycle

The renewed ascent of precious metals cannot be interpreted as a transient speculative phase; it reflects a structural repricing of monetary assets under the late phase of the fiat monetary cycle. Since the global financial crisis of 2008, successive episodes of policy accommodation have eroded the real return on sovereign bonds, culminating in a world where risk-free nominal yields fail to compensate for inflation volatility. In this context, gold reclaims its ancestral monetary role: a store of value immune to default risk and central bank discretion.

The unprecedented expansion of central bank balance sheets and the financialization of

public deficits imply that gold and, by extension, silver, now serve as the residual asset class in a system saturated with nominal claims. The current era resembles, in qualitative structure, the late 1960s—when fiscal overextension and geopolitical competition gradually eroded confidence in the Bretton Woods framework. Then, as now, gold transitioned from a passive reserve to an active monetary hedge.

B. The Institutional Bid: Central Bank Reaccumulation

A key differentiating feature of this cycle is the persistent net buying of gold by central banks. According to IMF and World Gold Council data, 2022–2025 marked the most intense phase of official sector accumulation since the late 1940s. Emerging-market central banks, particularly those of China, India, and Turkey, have been diversifying away from USD reserves to hedge against sanction risk and currency weaponization.

This strategic reallocation has introduced a structural bid in the gold market independent of speculative flows. The qualitative significance of this phenomenon lies not merely in its scale but in its *composition*: the marginal buyer of gold is now policy-driven, not profit-driven. That confers durability to demand and depresses the probability of cyclical liquidation. In essence, central bank accumulation is transforming gold into a quasi-sovereign asset class whose price is underwritten by geopolitical distrust.

C. Silver: The Industrial-Hard Money Hybrid

Silver's revaluation, in contrast, derives not from monetary hedging alone but from its dual identity as both a precious and an industrial metal. The accelerating energy transition—anchored in photovoltaics, electrification of transport, and semiconductor proliferation—has generated structural demand growth. Each gigawatt of new solar capacity embeds approximately 20 kilograms of silver; at current deployment rates, photovoltaic demand alone absorbs over 180 million ounces annually, a figure expected to rise as panel efficiency plateaus.

This duality grants silver a unique convexity: it appreciates in both inflationary-financial and expansionary-industrial regimes. Whereas gold's demand elasticity to global growth is near zero, silver benefits directly from industrial momentum while preserving its safe-haven characteristics. Its correlation matrix with industrial metals such as copper and aluminium is positive in booms yet collapses to zero or negative in risk-off episodes, granting it rare two-regime optionality.

D. Supply Constraints and Mining Economics

The supply side of both metals is equally supportive. Gold mine production has plateaued near 3,600 tonnes annually, constrained by declining ore grades and environmental regulation. For silver, the situation is more acute: over 70% of global silver output is a by-product of lead, zinc, or copper mining. Thus, silver supply responds weakly to price incentives—a classic case of inelastic secondary production. This structural inelasticity creates a self-reinforcing

dynamic: rising industrial demand meets supply rigidity, compressing inventories and raising the shadow price of immediate delivery.

Moreover, the capital discipline imposed after the 2012–2013 commodity bear market has curtailed new exploration spending. Miners now prioritize shareholder returns over capacity expansion, a behaviour that paradoxically enhances the long-term investment case for the metals themselves. In other words, the mining sector's financial prudence functions as a call option for metal holders.

E. Monetary Hedging and the Regime of Financial Repression

Real yields remain the dominant macro driver of gold valuations. Even though nominal yields may fluctuate, persistent inflation volatility ensures that ex-ante real yields hover near zero or negative territory. Under financial repression—defined as policy-engineered caps on nominal yields below inflation expectations—precious metals become one of the few unencumbered assets retaining purchasing power.

Historically, every regime of real-yield compression (1971–1979, 2008–2012, 2020–2025) has coincided with multi-year bull cycles in gold. Silver, while more volatile, tracks the same macro rhythm with higher beta. Thus, the secular environment of over-indebtedness and policy constraint structurally advantages long positions in both metals.

F. De-Dollarization and Geopolitical Fragmentation

The multipolarization of the global monetary system further reinforces the thesis. As cross-border settlement gradually diversifies into regional currencies and digital central bank instruments, demand for non-sovereign collateral—principally gold—rises. The weaponization of financial infrastructure (e.g., SWIFT exclusions, reserve freezes) has made physical reserves geopolitically valuable. Silver, though less central to monetary reserves, benefits indirectly: its industrial ecosystem is geographically diversified, and demand emanates from precisely those economies (China, India, Southeast Asia) that are reducing dollar dependence.

This decoupling from Western financial cycles introduces a new qualitative layer of demand—one that is strategic, long-horizon, and insensitive to short-term price volatility.

G. Portfolio Context and Behavioural Considerations

From a behavioural-finance perspective, gold and silver also serve as countercyclical anchors. They attract capital in regimes of declining trust—whether in fiscal discipline, geopolitical stability, or fiat money's purchasing power. Their psychological value lies in *tangibility*: investors perceive them as assets that exist outside the credit system, a trait that becomes prized precisely when other instruments rely on counterparties.

For institutional allocators, this behavioural characteristic translates into real diversification. During episodes of market stress, gold's correlation with equities and bonds typically inverts,

generating positive convexity. Silver amplifies this effect when industrial cycles rebound, offering cyclical torque in recovery phases.

H. Synthesis: The Case for Dual-Long Exposure

The confluence of these structural and behavioural factors constitutes a coherent investment narrative. Gold provides the monetary hedge—the "insurance premium" against systemic debasement—while silver offers industrial leverage as a "growth option" on the global energy and technological transition. Together, they replicate the barbell structure of a solid portfolio: one limb protects capital, the other enhances it.

In the context of the University of Southampton Investment Fund, this dual exposure is not speculative but strategic. It aligns with the Fund's mandate to combine prudent capital preservation with opportunistic capture of secular megatrends. The fund positions itself with company outlooks such as that of Goldman Sachs Research, which sees a greater risk that the gold price will exceed its forecast rather than undershoot, and JP Morgan, who raised their June 2025 Gold price predictions to 4,250 USD per troy ounce by Q4 2026.

Quantitative Rationality of Gold and Silver Exposure

Figure 1.6: Historical returns of hybrid gold and silver commodity, gold and silver ETFs, and Gold and silver mining company ETFs

The historical returns of a hybrid investment in gold and silver are remarkable. Whether, the investment was executed through investing in the commodities themselves, through gold

and silver ETFs, in mining company ETFs or a hybrid approach combining all 3, the strategy delivered substantial gains.

This section details the quantitative analysis of strategic position of exposure long gold, long silver position.

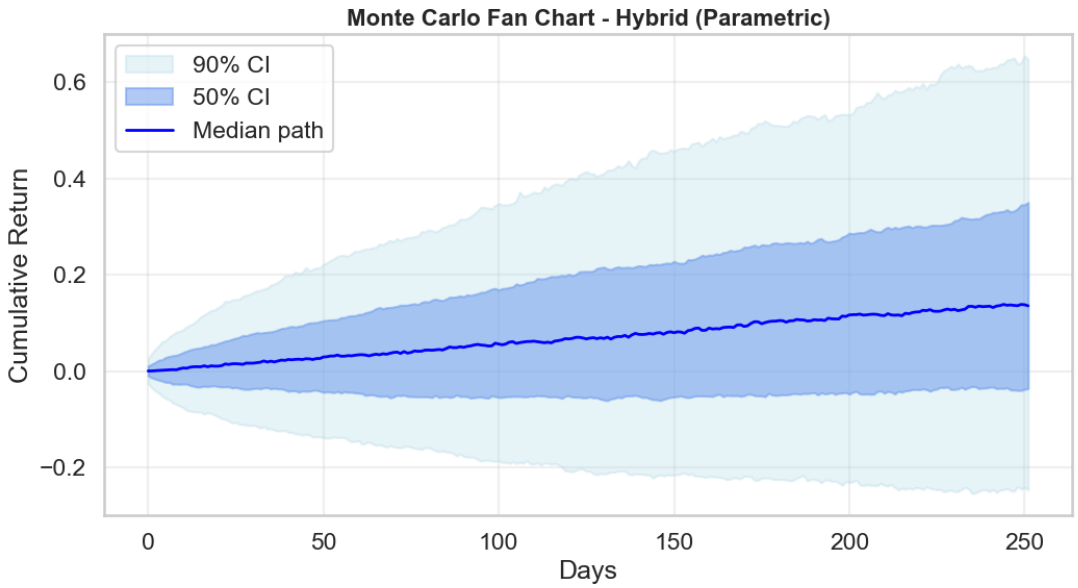

Figure 1.7: Parametric Monte Carlo using Kelly Criterion-adjusted hybrid approach to Gold and Silver long position

The results of 1,500 simulated paths using parametric Monte Carlo simulations provide a probabilistic envelope of possible price paths over a one-year horizon, synthesizing both historical covariance and simulated noise. The median trajectory remains upward sloping across all strategy classes, with the 50% confidence band widening modestly over time, signifying controlled volatility growth.

For the hybrid strategy, the 90% confidence interval remains asymmetrically skewed to the upside, reflecting a fat right tail of outcomes where compounding effects amplify positive drift. The absence of negative median slopes even in stress-adjusted simulations visually corroborates the robustness of the long-only thesis. The narrowness of the 25–75% band underscores low variance in expected returns, indicative of a stable risk–reward surface under current volatility clustering.

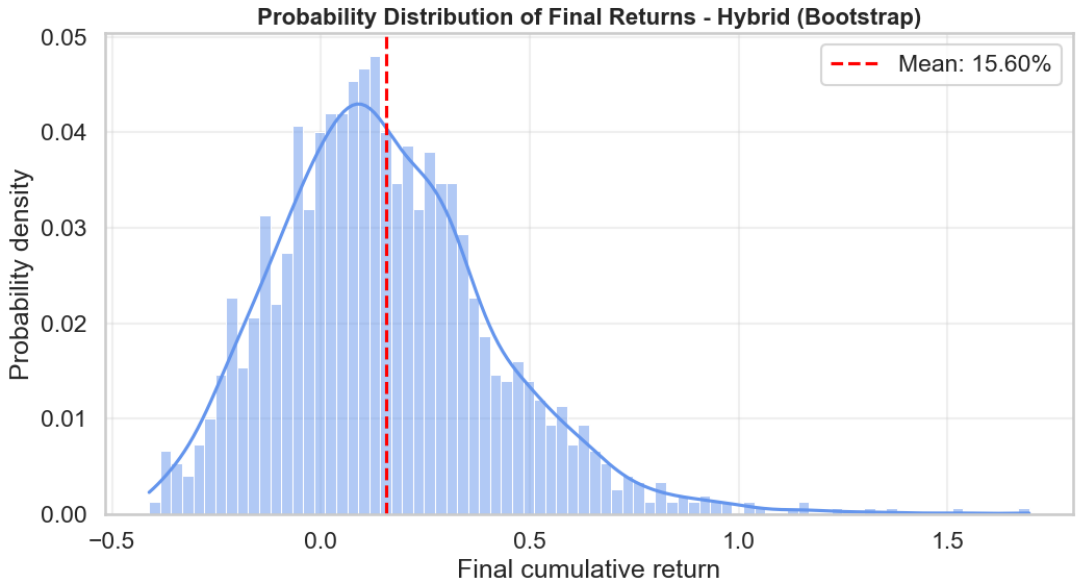

Figure 1.8: Block Bootstrap Monte Carlo probability distribution of final results using Kelly Criterion-adjusted hybrid approach

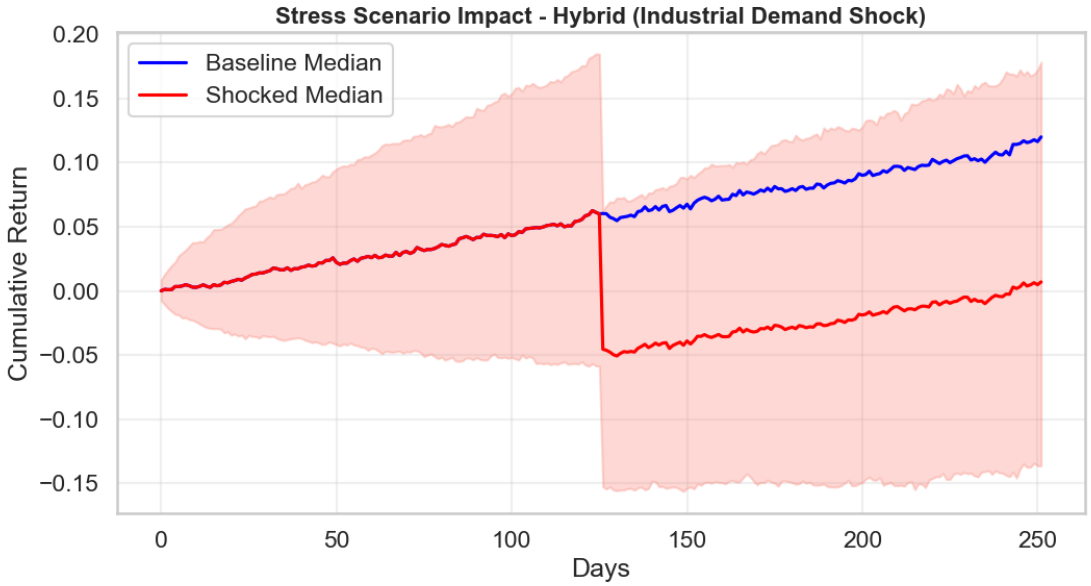

Figure 1.9: Stress scenario impact on hybrid portfolio

Beyond higher median returns, the hybrid portfolio composed of gold and silver as commodities, as ETFs and mining companies ETFs show less sensitivity in the simulated paths to stress scenarios. Here, the predicted impact of an industrial demand shock leads to a shocked median return drawdown of 5%, which then recovers to final median return slightly

above 0. In this portfolio configuration, the worst case scenarios are better than in the other approaches.

Table 3: Monte Carlo Simulation Results for Gold–Silver Strategies

Strategy	**Catastrophic** *(< −50%)*	**Large Loss** *(−50 to −10%)*	**Mild Loss** *(−10 to 0%)*	**Mild Gain** *(0 to 10%)*	**Strong Gain** *(> 10%)*	**Mean Return**	**CVaR**
Commodities	0.00%	13.47%	16.27%	18.80%	51.47%	12.81%	-19.53%
ETFs	0.00%	14.20%	15.73%	20.53%	49.53%	12.88%	-18.16%
Hybrid	0.00%	15.53%	12.87%	16.53%	55.07%	15.60%	-22.56%

Note: Probability of ruin (< 50% of initial capital) was 0.0% across all strategies. Simulations used 1,500 paths each for both parametric and block bootstrap methods. Mean returns represent expected cumulative gain over a one-year horizon. CVaR, or conditional value at risk, represents the average loss in the worst 5% of cases of the return distribution.

The terminal-return probability density functions reveal right-skewed distributions for all strategies, characteristic of long-only exposures with embedded convexity. The hybrid configuration shows the highest kurtosis, meaning rare but disproportionately large positive outcomes. This statistical property aligns with its superior mean return (15.6%) and justifies its inclusion as a convex payoff within the Fund's commodity sleeve.

Over 50% of simulated paths in the hybrid strategy end with returns exceeding 10%, while only 15.53% register moderate losses between 10–50%. The absence of any catastrophic outcomes under both parametric and bootstrap regimes confirms that systemic risk exposure is minimal. This robustness is reinforced by the block bootstrap methodology, which preserves autocorrelation and volatility clustering, hence replicating realistic market persistence rather than Gaussian idealization.

Table 4: Implementation, Risks and Exit Strategy Monitoring

Category	Details
Trade Expression	Strategy: Dual-long gold and silver exposure capturing both monetary and industrial drivers. Objective: Participate in macro tailwinds (negative real yields, geopolitical risk) while maintaining diversification. Bias: Long both metals; rebalance based on Gold/Silver ratio extremes.
Primary Instruments	Gold: SPDR Gold Shares (GLD). Silver: iShares Silver Trust (SLV). ETF exposure ensures liquidity, simplicity, full physical backing.
Secondary Instruments	Mining Equities: Mining ETFs or high-conviction individual equities (e.g., Newmont, Barrick, First Majestic Silver). Typical allocation: 20–25% overlay for upside convexity.
Monitoring Metrics	10Y TIPS real yields. USD broad index (DXY). Gold–silver ratio (monitor z-score deviations). ETF flows (GLD, SLV) and CFTC speculative positioning.
Key Risks	Real Yield Repricing: Sustained move above 2.5% in TIPS compresses valuations. Dollar Strength: 5% DXY appreciation could imply 6–8% metals downside. Crowded Positioning: Speculative net-longs $> +2\sigma$ above mean increase drawdown risk. Industrial Demand Shock: Slower-than-expected PV, EV, or semiconductor growth reduces silver demand. ETF Liquidity: Heavy profit-taking accelerates sell-offs.
Exit / Rebalancing Triggers	Macro: 10Y US TIPS yield $> 2.5\%$ or Fed repricing $> +100$bps. Technical: Gold–silver ratio at extremes (e.g., >90 or <60) signals rebalancing. Positioning: CFTC longs $> +2\sigma$ of 5Y mean. Performance: Drawdown exceeding $\approx 20\%$ from recent peak. Liquidity: ETF outflows $> 10\%$ of AUM within two weeks.

Note: Monitoring is frequent and rebalancing decisions reviewed upon breach of key macro or technical thresholds. Data sources include Bloomberg, CFTC, and Yahoo finance.

Conclusion

The analysis of gold and silver through both a macro-financial and quantitative lens reveals a market configuration defined not by relative mispricing, but by the coexistence of distinct and complementary structural drivers. The traditional narrative of the gold–silver ratio as a mean-reverting arbitrage opportunity no longer holds under current macroeconomic and industrial regimes. Instead, both metals are advancing along parallel yet separate axes of demand—gold as the monetary hedge within a disinflationary yet fragile fiat environment, and silver as the industrial conductor of the energy and digital transitions.

Upon this outcome, a dual exposure to gold and silver were tested and analysed. Quantitatively, Monte Carlo and bootstrap simulations across 1,500 paths show positively skewed distributions with low tail risk and negligible probability of ruin. The hybrid allocation—integrating physical exposure, ETFs, and mining equities—emerges as the most convex configuration, achieving an expected annual return of 15.6% with –22.6% returns in the worst 5% of cases of the return distribution. These outcomes underline the resilience of dual-long exposures to diverse macro shocks, including rising real yields, dollar volatility, and fluctuations in industrial activity.

From a strategic perspective, the portfolio implications are unambiguous. The rational stance for a long-horizon commodities investor is not to speculate on the convergence of gold and silver prices, but to harness their joint convexity. Holding both assets simultaneously creates an internal hedge structure: gold stabilises drawdowns under monetary tightening or geopolitical stress, while silver mainly amplifies performance in industrial expansionary phases. This duality offers asymmetric exposure to the two dominant forces shaping the decade ahead—monetary debasement and technological electrification.

In the broader context of the Fund's investment philosophy, the findings advocate for a disciplined yet opportunistic commodities allocation: a core exposure to precious metals sustained through market cycles, complemented by tactical tilts responding to volatility, ETF flows, and industrial indicators.

This report justifies why the Commodities department of the University of Southampton's investment fund will implement the strategy with a 20-30% position in our portfolio, a department specialised in commodities and commodities-related equities. This report also lays the groundwork of the processes and analyses through which the positions and strategies of the department will be established: a strategy aiming to combine both comprehensive quantitative and qualitative analyses

Appendix: Methodology

A. Monte Carlo Simulation Framework

To assess robustness and forward-looking risk, two forms of stochastic simulation were implemented:

(a) Parametric Monte Carlo. Returns were assumed to follow a multivariate normal distribution calibrated on the empirical mean vector and covariance matrix of historical daily returns. Simulated paths ($N = 1500$) for each strategy were generated as:

$$r_t^{(i)} \sim \mathcal{N}(\mu, \Sigma)$$

and compounded to obtain terminal wealth distributions. This approach captures average volatility and cross-asset correlation structure under stationarity.

(b) Block Bootstrap Simulation. To relax normality and independence assumptions, a moving block bootstrap was applied to the empirical return series. This resampling technique preserves autocorrelation and volatility clustering by sampling contiguous blocks of returns, generating alternative but statistically consistent price paths.

Both simulations were run for 1,500 iterations each to derive empirical distributions of portfolio outcomes.

B. Strategy-Level Evaluation

Three portfolio strategies were tested:

1. **Commodities-only:** Equal-weighted long positions in gold and silver spot/futures.
2. **ETF strategy:** Equal-weighted long positions in GLD and SLV.
3. **Hybrid strategy:** Equal-weighted exposure to commodities, ETFs, and major mining equities.

Each simulated portfolio was initialized at a £10,000 notional, consistent with the fund's mandate, and allowed to evolve over a one-year horizon.

For each strategy, the Monte Carlo distribution of terminal wealth was analyzed to compute:

- Probability of catastrophic loss ($< -50\%$)
- Loss/gain bins (-50% to -10%, -10% to 0%, 0% to 10%, $> 10\%$)
- Expected shortfall ($ES_{5\%}$)
- Probability of ruin (capital falling below 50%)
- Mean expected return and variance

C. Stress-Scenario Analysis

To test resilience, the calibrated model was re-run under stressed parameter configurations:

- **Yield shock:** +100bp real yield increase
- **USD appreciation:** +5% DXY shock
- **Liquidity shock:** 50% reduction in ETF flow liquidity
- **Industrial contraction:** 15% drop in silver industrial demand proxy

The simulations quantified the resulting change in mean return, expected shortfall, and probability of ruin, thereby approximating the strategy's sensitivity to key macro and sectoral risks.

D. Risk and Position Sizing

Optimal position sizing was computed via the fractional Kelly criterion, using Monte Carlo mean and variance estimates to determine the capital allocation maximizing long-run growth subject to drawdown limits:

$$f^* = \frac{\mu}{\sigma^2}$$

but capped at 25% of available capital to prevent excessive leverage. Expected shortfall and drawdown distributions were used to allocate risk budgets per metal within the £10,000 mandate.