Decomposing Gold Returns: a Returns-Based Style Analysis

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Abstract

This study employs a returns-based style analysis framework to decompose gold returns into three groups of explanatory factors that relate to macroeconomic variables, capital flows, and systemic risk indicators.

Our empirical analysis identifies the exchange rate dynamics as the main factor influencing gold returns. Additionally, we discover that investment flow variables play a crucial role in driving gold, with official sector purchases and ETF demand leading the way. The impact of uncertainty indicators on gold returns appears to be restricted to tail-risk events, as evidenced by their limited explanatory power.

According to our research, gold has a special place in the financial markets because it serves not only as a conventional safe-haven asset but also as a monetary asset, a macro-financial hedge, and a means of diversifying institutional portfolios.

Introduction

This study implements a returns-based style analysis (RBSA) on gold returns using three groups of explanatory factors: macro variables, capital flows, and risk indicators. We find that exchange rate fluctuations, institutional demand flows, and interest rate conditions are the main drivers of gold's behavior.

This empirical work contributes to two different lines of empirical research: the literature on portfolio style attribution and studies looking at the factors influencing gold prices. The former focuses on breaking down asset returns into exposures to underlying factors, whereas the latter aims to determine the macroeconomic and financial drivers of gold price dynamics. A large body of literature (see O'Connor et al., 2015 for a relevant literature survey) identifies several key determinants of gold prices, reflecting the metal's dual role as both a financial asset and a physical commodity. In particular, macroeconomic factors are crucial, especially real interest rates and inflation expectations. Because investors typically replace fixed-income assets with gold when inflation expectations rise to protect against currency depreciation and a decline in purchasing power, gold is particularly well-known as an inflation hedge. At the same time, gold has a well-known opposite relationship with real interest rates. This is because gold is a non-yielding asset, so it becomes more appealing when real yields go down as the cost of holding it goes down. Changes in the value of the U.S. dollar, are another important factor. When the dollar gets weaker, the price of gold goes down for foreign investors, making gold more appealing and leading to higher nominal prices.

In addition, gold is widely viewed as a safe-haven asset as investors rush to gold during periods of financial stress, geopolitical tensions, or heightened economic policy. Therefore, major global financial crises and stock market shocks are significant positive drivers of returns for gold. Separately, the commodity market dynamics also influence gold prices, as gold often co-moves with other commodities such as oil and silver through inflationary channels and substitution effects. Finally, developments in both the physical and financial gold markets affect prices. Physical demand arises primarily from jewelry consumption, and industrial uses, while financial demand has grown significantly following the introduction of gold-backed exchange-traded funds (ETFs). Central bank purchases and sales also play an important role in shaping gold's supply and demand conditions.

The relative importance of the different drivers of gold prices is hard to measure, as they often act at the same time, can move in opposite directions, and change over time. Much of the existing research focuses on individual determinants, and/ or uses traditional regression frameworks that impose specific structural relationships between variables. In contrast, our empirical analysis draws on the seminal returns-based style analysis (RBSA) of Sharpe (1992) to estimate the relative contribution of different economic and market factors to gold returns. Specifically, we model gold returns as a combination of macroeconomic, risk, and market flow factors. The macroeconomic dimension is captured by the ICE U.S. Dollar Index, the U.S. 2-year Treasury yield, and one-year expected inflation, which proxy currency dynamics, interest-rate conditions, and inflation expectations respectively. Measures of uncertainty and risk are proxied by the Monetary Policy Uncertainty Index and the Geopolitical Risk Index, while market positioning and demand conditions are measured by central bank gold flows, gold-backed ETF flows, and COMEX speculative positioning.

Our empirical results show that macro variables, particularly movements in the U.S. dollar, account for a substantial share of gold's behavior, while demand-related factors, such as central bank purchases and speculative futures positioning, also play a meaningful role. By contrast, measures of inflation expectations and policy uncertainty tend to exhibit smaller average contributions. In addition, we employ a rolling estimation framework to examine how the importance of these drivers evolves over time and find that the influence of these factors is not constant over time. Furthermore, one of the methodological limitations of traditional returns-based style analysis is the absence of straightforward measures of statistical reliability for the estimated factor exposures. Lobosco and DiBartolomeo (1997) address this issue by proposing an approximation for the confidence intervals of RBSA style weights using Monte Carlo simulations. In contrast, this paper adopts a block bootstrap approach to construct confidence intervals for the estimated factor weights. By resampling blocks of observations from the empirical data, the bootstrap procedure preserves the temporal dependence structure of financial time series and generates empirical distributions of the RBSA estimates, allowing for direct inference on factor exposures without relying on parametric approximations.

The rest of the paper is organized as follows: the next section reviews the existing relevant empirical literature. Section 3 describes the data used, while Section 4 describes the methodology employed in the empirical analysis. The results are presented and analyzed in Section 5, while Section 6 includes the concluding remarks.

Literature Review

Our paper contributes to two strands of literature: studies looking at the factors influencing gold prices, and the literature on return or performance attribution.

Existing research identifies a wide range of drivers of gold price, including, among others, economic and geopolitical uncertainty, monetary variables, and fundamental supply and demand shifts. According to Baur and Lucey (2010) and Baur and McDermott (2010), investors gravitate toward gold during market crashes, which is consistent with the safe-haven qualities of gold. Separately, Batten et al. (2024) find that economic policy uncertainty (EPU) is the most significant positive driver of returns for gold, while Bouoiyour et al. (2018) identify a composite uncertainty indicator – encompassing economic, macroeconomic, microeconomic, monetary policy, financial, and political dimensions – as the core driver of gold returns. Similarly, Ryan et al. (2024) show that gold prices are driven by the specific catalysts of market declines, notably macroeconomic news, terrorist attacks, and trade policy developments.

Other studies highlight macroeconomic and financial market variables as key drivers. Reboredo (2013) finds that movements in the U.S. dollar and exchange rates are among the most important factors affecting gold prices, showing that gold acts as both a hedge against average currency movements and a safe haven during extreme exchange-rate fluctuations. Commodity market dynamics may also play an important role: Jabeur, Mefteh-Wali, and Viviani (2024) show that silver prices are among the most influential predictors of gold prices, followed by inflation, while crude oil prices and major exchange rates also contribute significantly. At the same time, gold price dynamics may be influenced by factors internal to the gold market itself. Faraj et al. (2025) identify gold's own volatility and market instability as an important determinant of its diminishing safe-haven role, while Zhang et al. (2025) emphasize the importance of the share of gold in a country's official reserves for understanding its safe-haven effectiveness. Finally, Bouri et al. (2020) argue that gold's relatively weak or negative relationship with equity markets arises precisely because its price is driven by a different set of macroeconomic and financial determinants than those affecting traditional financial assets. Taken together, these studies suggest that gold returns reflect the interaction of macroeconomic conditions, currency movements, market uncertainty, commodity market linkages, and gold-specific demand and supply dynamics, confirming the metal's dual role as both a financial asset and a safe-haven investment.

In addition, this paper contributes to the portfolio style attribution and factor exposure literature based on the returns-based style analysis (RBSA) framework. Since the introduction of RBSA by Sharpe (1992), a substantial literature has applied and extended this methodology to evaluate portfolio exposures, while also discussing its empirical applications, methodological limitations, and potential improvements.

One of the primary criticisms of Sharpe's original model is the lack of measures for the quality of fitness, or confidence intervals, for individual style weights. In this regard, Lobosco and DiBartolomeo (1997) propose a two-step procedure to approximate confidence intervals for Sharpe style weights, while Vistocco (2024) use quantile regression to draw robust inferences, particularly to handle outliers that can bias classical least squares estimators. Kim et al. (2005) propose solutions in the case parameters lie on the boundaries (that is, near 0 or 1), in which traditional approximations often fail. Another limitation of the original RBSA is the assumption that a fund's style remains fixed over the sample period, as this hypothesis is often contradicted in practice. Swinkels and Van Der Sluis (2006) argue that rolling regressions are inefficient due to arbitrary window sizes and propose using the Kalman filter to explicitly model time-varying exposures as a random walk. In addition, Sharpe's conventional RBSA imposes two key constraints (style weights must be non-negative and must sum to 100%) which may be inappropriate for certain strategies: indicatively, Agarwal and Naik (2000) develop a generalized RBSA suitable for hedge funds, relaxing the traditional long-only constraints to account for short positions and significant cash holdings, while De Roon et al. (2004) distinguish between weak, semi-strong, and strong specifications based on whether portfolio and non-negativity restrictions are imposed.

Furthermore, evidence is mixed regarding whether returns or actual portfolio holdings better identify a fund's style. Mason et al. (2013) combine returns-based and holdings-based style analysis to enhance explanatory power for fund performance, while Rekenthaler et al. (2006) compare RBSA with portfolio-based fundamental style analysis and highlight the trade-off between cost and accuracy. Finally, literature extensively uses RBSA to identify when a fund's return behavior differs from its declared objective (e.g., diBartolomeo and Witkowski, 1997), while recent research has applied RBSA to non-traditional areas. Fassas and Papadamou (2025) use RBSA to decompose implied volatility indexes (VIX and VDAX) into two components: investor risk aversion and market uncertainty, finding that risk aversion is the predominant driver of volatility daily changes.

Data

We group the explanatory variables employed in the returns-based style analysis into three broad categories: macro factors, demand flows, and risk indicators. Table 1 summarizes the variables used in the analysis, their data sources, and the transformations applied.

< Insert Table 1 about here >

More specifically, we use the US Dollar Index (DXY) to measure currency dynamics, given that gold is priced in dollars. The 2-year US Treasury yield serves as a proxy for short-term interest rate conditions and monetary policy expectations, while the one-year expected inflation series reported by the Federal Reserve Bank of Cleveland represents forward-looking inflation expectations derived from a model that combines market-based and survey-based information. We also include three flow variables that capture changes in demand from financial and institutional market participants: (i) ETF flows, which measure net inflows into physically backed gold exchange-traded funds worldwide and reflect investor demand through financial markets, (ii) Central bank flows, which represent net changes in official sector gold holdings and capture the role of official reserves in the gold market, and (iii) COMEX net non-commercial long positions scaled by total open interest, which reflects speculative activity in gold futures markets. Finally, we include two variables that capture broader measures of economic and geopolitical uncertainty: the Monetary Policy Uncertainty index, which is a newspaper-based indicator constructed following the methodology of Baker, Bloom, and Davis (2016) and the Geopolitical Risk index, developed by Caldara and Iacoviello (2022), which measures geopolitical tensions based on automated text analysis of major international newspapers. Together, these variables capture the macro-financial, institutional, and risk-related forces that potentially drive gold returns, allowing the RBSA framework to identify the relative importance of each factor in explaining gold price dynamics.

In our empirical analysis we use monthly observations from April 2003 to August 2025, (totally 269 observations). All variables are expressed as monthly log changes:

$$\Delta\log(X_t) = \log(X_t) - \log(X_{t-1})$$

in which, X_t denotes the value of the variable X (with $X = \text{DXY}, \text{Yield}_{2Y}$, MPU, InflExp, CB, GPR, ETF, Spec corresponding respectively to the ICE U.S. Dollar Index, the U.S. 2-year Treasury yield, the Monetary Policy Uncertainty index, one-year expected inflation, central bank gold flows, the Geopolitical Risk index, gold ETF flows, and COMEX speculative positioning) in month t.

< Insert Table 2 about here >

Table 2 presents summary statistics for gold returns and the factors included in the empirical analysis, while Table 3 presents their pairwise correlations. As suggested by economic theory, gold returns exhibit a strong negative correlation with the US dollar index and a moderate negative correlation with short-term interest rates. Since gold is priced in US dollars, a stronger dollar typically reduces the dollar price of gold. Similarly, higher interest rates increase the opportunity cost of holding a non-yielding asset such as gold, which tends to exert downward pressure on gold prices.

Because the RBSA framework imposes long-only constraints on factor weights, these two variables that historically exhibit a negative relationship with gold prices are inverted prior to the estimation. In particular, both the US Dollar Index and the 2-year US Treasury yield are multiplied by −1 after computing log changes:

$$-\Delta\log(X_t)$$

This transformation preserves the economic interpretation of relationships while allowing the model to assign non-negative factor weights.

< Insert Table 3 about here >

Methodology

Our empirical framework applies the returns-based style analysis (RBSA) methodology proposed by Sharpe (1992). RBSA estimates the exposures of an asset's returns to a set of explanatory factors by fitting a constrained regression that minimizes the tracking error between the asset returns and a linear combination of factor returns.

In this study, the approach is applied to monthly gold returns, which are modeled as a portfolio of a set of economic and market-based factors. These factors are grouped into three categories, capturing different channels through which macro-financial conditions may affect gold prices: macroeconomic factors, flow-based factors, and risk-related factors. Formally, the RBSA model can be written as:

$$\Delta Gold_t = \sum_{i=1}^{N} w_i F_{i,t} + \varepsilon_t$$

in which, $\Delta \mathrm{Gold}_t$ denotes the monthly log return of gold at month t, $\mathrm{F}_{i,t}$ represents the return (or log change) of factor i (with $i =$ DXY, Yield_{2Y}, MPU, InflExp, CB, GPR, ETF, Spec corresponding respectively to the ICE U.S. Dollar Index, the U.S. 2-year Treasury yield, the Monetary Policy Uncertainty index, one-year expected inflation, central bank gold flows, the Geopolitical Risk index, gold ETF flows, and COMEX speculative positioning) at month t; w_i is the weight associated with factor i, and ε_t is the residual component capturing the portion of gold returns not explained by the selected factors. The model is estimated subject to the following two constraints:

$$w_i \geq 0 \text{ and} \sum_{i=1}^{N} w_i = 1$$

These restrictions ensure that the estimated exposures can be interpreted as long-only portfolio weights, representing the contribution of each factor to the behavior of gold returns. The optimal set of weights is obtained by minimizing the variance of the residuals, which is equivalent to minimizing the tracking error between observed gold returns and the factor-replicating portfolio. Following the standard RBSA implementation, we solve the constrained optimization problem using quadratic programming.

Furthermore, we create confidence intervals using a moving block bootstrap procedure, which maintains the temporal dependence structure of the data while creating resampled datasets, in order to evaluate the statistical uncertainty surrounding the estimated RBSA exposures (Politis and Romano, 1994). In particular, bootstrap samples are created by randomly choosing overlapping blocks of consecutive observations of fixed length b (set to six months) from the original dataset, where T represents the number of monthly observations available after missing values are eliminated. These blocks are concatenated until a bootstrap sample of length T is obtained. By resampling blocks rather than individual observations, the procedure retains short-run autocorrelation and cross-correlation patterns among the variables. For each bootstrap sample, the RBSA model described above is re-estimated under the same constraints (long-only weights and weights summing to one) using the same quadratic programming algorithm. This procedure is repeated $B = 2000$ times, producing a distribution of estimated factor weights $w_i^{(b)}$ for each factor i.

The empirical distribution of bootstrap estimates is then used to compute percentile confidence intervals for the factor exposures. In particular, the lower and upper bounds of the $100(1-\alpha)\%$ confidence interval are given by the $\alpha/2$ and $1-\alpha/2$ percentiles of the bootstrap distribution of weights. In addition, the bootstrap mean and standard error of each factor weight are calculated, allowing the construction of approximate t-statistics defined as the ratio of the point estimate to its bootstrap standard error. The same bootstrap procedure is also applied to key goodness-of-fit metrics of the RBSA regression, including the coefficient of determination (R^2), the correlation between actual and fitted gold returns, and the tracking error volatility, defined as the standard deviation of the residuals. Confidence intervals for these statistics are obtained from the corresponding empirical bootstrap distributions.

Finally, to examine the time variation in gold's factor exposures, the RBSA model is also estimated using a rolling window procedure. Specifically, the constrained regression described above is re-estimated over rolling windows of 36 months, corresponding to approximately three years of monthly observations. For each window t, we solve the RBSA optimization problem by minimizing the variance of the residuals between observed gold returns and the factor-replicating portfolio, subject to the same constraints imposed in the baseline specification: that is non-negative weights and the requirement that factor weights sum to unity. The resulting rolling estimates provide a dynamic decomposition of gold returns, allowing us to document how the impact of risk factors, investment flows, and macroeconomic variables changes over time.

Empirical Results

The results of the baseline model are summarized in Table 4 and illustrated in Figure 1. We also calculate and report inference statistics based on bootstrapping since the RBSA method restricts factor weights to be non-negative, which can make the estimates skewed. Bootstrap confidence intervals and their corresponding t-statistics may occasionally provide slightly different signals regarding statistical significance. Therefore, by checking whether the confidence interval includes zero, we assess, in a more reliable way, factors' significance.

< Insert Table 4 and Figure 1 about here >

We find that several factors play a meaningful role in explaining gold returns. In particular, the U.S. Dollar Index is the most influential driver, with the largest estimated weight and a confidence interval well above zero. This finding supports the well-established relationship between gold and the U.S. dollar, highlighting gold's function as a hedge against dollar depreciation. Central bank flows also emerge as a key determinant, with a large and statistically significant weight, of approximately 33%. This suggests that official sector demand has been a major force in gold price movements over the sample period. Among the market-based demand factors, speculative long futures positions are found to be statistically significant, indicating that futures market positioning contributes meaningfully to fluctuations in gold returns. ETF flows, by contrast, have a smaller estimated weight and a relatively wide confidence interval, pointing to greater uncertainty in their estimated effect. Although the confidence interval remains above zero, the large bootstrap standard error suggests that ETF flows are less precisely measured compared to other demand-related variables.

Macroeconomic variables play a more moderate role. In particular, the 2-year U.S. Treasury yield has a positive and statistically significant weight of about 6%, supporting the view that gold is influenced by interest rates, as it is a non-yielding asset. Inflation expectations, however, carry a very small weight, and their confidence interval includes zero, implying that their contribution is not statistically distinguishable from zero.

Finally, measures of uncertainty and geopolitical risk show limited explanatory power. Geopolitical risk has a low estimated weight and a confidence interval that includes zero, indicating weak statistical significance. On the other hand, monetary policy uncertainty, has a small in magnitude (around 1%) coefficient, but has a confidence interval above zero, suggesting a modest but statistically significant effect.

The estimated coefficients of the factors under review indicate that currency movements and demand-related factors dominate gold returns, while traditional macroeconomic and uncertainty indicators play a comparatively smaller role. Moreover, the use of bootstrap confidence intervals highlights the importance of accounting for the non-negativity constraint in RBSA estimation, which can affect the distribution of estimated weights and the interpretation of statistical significance.

Time-Varying Drivers of Gold Returns: Rolling RBSA Analysis

We also estimate a 36-month rolling RBSA specification in order to examine whether the drivers of gold returns vary over time. The rolling results reveal substantial variation in the relative importance of macro, flow, and risk factors across different market regimes. For illustrative purposes, we present the rolling estimates grouped into three broad categories – macro factors, demand flows, and risk indicators – across three separate graphs.

< Insert Figure 2 about here >

Figure 2 shows the rolling exposures to the three macroeconomic factors: U.S. Dollar Index, the 2-year Treasury yield, and one-year inflation expectations. Dollar weight ranges between 0.20 and 0.40, suggesting currency fluctuations are the dominant driver of gold prices throughout the sample period. This persistent exposure confirms the strong inverse relationship between gold and the dollar identified in the baseline RBSA model. On the other hand, the exposure to the 2-year Treasury yield remains smaller and more variable over time. It increases temporarily during periods characterized by strong monetary policy shifts, particularly around the 2012–2014 and 2018–2020 periods, consistent with the interpretation that gold prices are influenced by interest rates, as gold is a non-yielding asset. Finally, inflation expectations play only a minor role throughout the sample, with estimated weights remaining close to zero for most periods, indicating that inflation dynamics contribute relatively little to gold returns.

< Insert Figure 3 about here >

Figure 3 presents the rolling exposures to geopolitical risk and monetary policy uncertainty with both factors exhibiting relatively low contributions. Nevertheless, the exposure to geopolitical risk increases markedly during periods associated with elevated global tensions, particularly around 2010–2012 and again after 2020, indicating that gold's safe-haven role becomes more pronounced during episodes of geopolitical instability. Similarly, the contribution of monetary policy uncertainty remains consistently small but shows modest increases during periods of heightened policy debate, such as during the post-financial-crisis monetary policy transition and more recently during the tightening cycle following the COVID-19 pandemic.

< Insert Figure 4 about here >

Figure 4 shows the rolling exposures to investment flows, investigating the importance of demand-side dynamics in the gold market. Central bank flows exhibit relatively stable and persistently high weights throughout the sample, generally remaining within the range of 0.20–0.30, which is consistent with the strong contribution identified in the baseline analysis. Exchange Trade Funds' flows display greater variability, with occasionally sharp spikes, which suggest that financial investment demand can temporarily dominate gold price movements. In contrast, futures speculative long positions show a declining trend over time, with relatively high weights during the late 2000s and early 2010s, followed by a gradual reduction in importance after the mid-2010s. This pattern may reflect structural changes in gold market participation, with institutional and official sector demand becoming increasingly important relative to speculative futures positioning.

In conclusion, the rolling RBSA analysis identifies three main phases in gold price behavior. During the period surrounding the global financial crisis (2006–2010), gold returns were driven by a mix of macroeconomic factors and geopolitical risk amid high uncertainty. In the post-crisis period (2011–2017), financial flows and speculative activity became more influential, with ETFs and futures markets playing a central role. In the more recent period (2018–2025), the influence of central bank flows and macroeconomic variables has increased relative to speculative activity.

Conclusion

This paper extends the return-based style analysis (RBSA) framework, which is traditionally applied to mutual funds and equity portfolios, to the analysis of gold price dynamics. By modelling gold returns as a combination of macroeconomic, market uncertainty, and investor flow factors, our analysis provides a unified assessment of the relative importance of different drivers of gold price. The empirical results indicate that gold returns are predominantly influenced by macro-financial conditions and demand-side flows, particularly movements in the U.S. dollar and central bank activity, while broader measures of macroeconomic and geopolitical uncertainty play generally a comparatively smaller role. The prominent role of the U.S. dollar identified in our analysis is consistent with the findings of existing research. In particular, O'Connor et al. (2015) highlight in their survey of the gold price literature that movements in the trade-weighted U.S. dollar are frequently identified as the primary driver of gold price dynamics.

Additionally, the rolling estimates show that other factors, like interest rates, ETF flows, and geopolitical risk, show time-varying importance over the last twenty years, while the U.S. dollar and central bank flows are consistently dominant drivers of gold returns. Our results support the idea that gold is a hybrid asset that combines features of a safe haven investment that becomes especially important during periods of high uncertainty, and a portfolio diversification asset impacted by investor flows and currency fluctuations.

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APPENDIX

Table 1 – Variables and Data Transformations

Variable	Source	Description	Transformation
Gold returns	LSEG	Gold Spot Multi-Contributor price returns	Monthly log returns $\Delta\log(\text{Gold}_t)$
Dollar returns	LSEG	ICE U.S. Dollar Index (DXY) returns	Inverted monthly log changes $-\Delta\log(\text{DXY}_t)$
2Y Treasury Yield	Federal Reserve Bank of St. Louis	Market Yield on U.S. Treasury Securities at 2-Year Constant Maturity	Inverted monthly log changes $-\Delta\log(\text{Yield}_{2Y,t})$
Monetary Policy Uncertainty Index	Federal Reserve Bank of St. Louis	Newspaper-based Monetary Policy Uncertainty index (Baker, Bloom & Davis, 2016 methodology)	Monthly log changes $\Delta\log(\text{MPU}_t)$
Inflation Expectations	Federal Reserve Bank of Cleveland	One-year expected inflation estimated using a model that combines market-based and survey-based information	Monthly log changes $\Delta\log(\text{InflExp}_t)$
Central Bank Flows	World Gold Council	Official sector gold holdings measured in tonnes	Monthly log changes $\Delta\log(\text{CB}_t)$
Geopolitical Risk	www.matteoiacoviello.com/gpr.htm	Geopolitical Risk (GPR) index (Caldara & Iacoviello, 2022 methodology)	Monthly log changes $\Delta\log(\text{GPR}_t)$
ETF Flows	World Gold Council	Aggregate holdings for more than 100 physically backed gold ETFs and similar products worldwide, measured in tonnes	Monthly log changes $\Delta\log(\text{ETF}_t)$
Derivatives Long Positions	LSEG	COMEX gold net non-commercial long positions scaled by total open interest in gold futures	Monthly log changes $\Delta\log(\text{Spec}_t)$

Notes: This table presents the variables employed in the return-based style analysis (RBSA) of gold. All variables are expressed as monthly log changes. To accommodate the long-only constraints of the RBSA framework and reflect the negative relationship between gold prices and both the US dollar and interest rates, the DXY and 2-year Treasury yield series are multiplied by −1 prior to estimation.

Table 2 – Summary Statistics for Returns and Macro-Financial Variables

	# obs	*Mean*	*Median*	*St. Dev.*	*Min*	*Max*
Gold returns	269	0.0090	0.0060	0.0470	-0.1840	0.1210
Dollar returns	269	0.0000	0.0000	0.0220	-0.0680	0.0750
2Y Treasury Yield	269	0.0030	0.0000	0.1870	-1.3190	0.5800
Expected 1Y Inflation	269	0.0060	0.0150	0.4810	-3.5570	3.3450
Geopolitical Risk	269	-0.0040	-0.0090	0.1950	-0.6000	0.7150
Monetary Policy Uncertainty	269	0.0000	-0.0440	0.4950	-1.3450	1.7670
Central Bank Flows	269	0.0230	0.0080	0.0920	-0.2500	0.9140
ETF Flows	269	0.0000	0.0010	0.0020	-0.0050	0.0080
Futures Long Positions	269	0.0040	-0.0020	0.1240	-0.3550	0.4880

Notes: This table reports descriptive statistics for gold returns and the macro-financial factors used in the empirical analysis. In particular, it reports the number of observations, mean, median, standard deviation, and minimum and maximum values for each series. The sample spans from April 2003 to August 2025.

Table 3 – Correlations Between Gold Returns and Macro-Financial Factors

	Gold	US Dollar Index	2Y Treasury Yield	1Y Inflation Expectations	Geopolitical Risk	Monetary Policy Uncertainty	ETF Flows	Central Bank Flows	Futures Long Positions
Gold	1.00	-0.47	-0.32	0.04	0.05	0.16	0.20	-0.07	0.42
US Dollar Index	-0.47	1.00	0.19	0.01	0.05	0.02	-0.16	0.08	-0.25
2Y Treasury Yield	-0.32	0.19	1.00	0.01	0.12	-0.16	-0.04	-0.06	-0.06
1Y Inflation Expectations	0.04	0.01	0.01	1.00	-0.06	0.03	-0.02	0.04	-0.04
Geopolitical Risk	0.05	0.05	0.12	-0.06	1.00	0.06	0.02	0.02	-0.04
Monetary Policy Uncertainty	0.16	0.02	-0.16	0.03	0.06	1.00	0.06	0.04	-0.00
ETF Flows	0.20	-0.16	-0.04	-0.02	0.02	0.06	1.00	-0.28	0.08
Central Bank Flows	-0.07	0.08	-0.06	0.04	0.02	0.04	-0.28	1.00	-0.10
Futures Long Positions	0.42	-0.25	-0.06	-0.04	-0.04	-0.00	0.08	-0.10	1.00

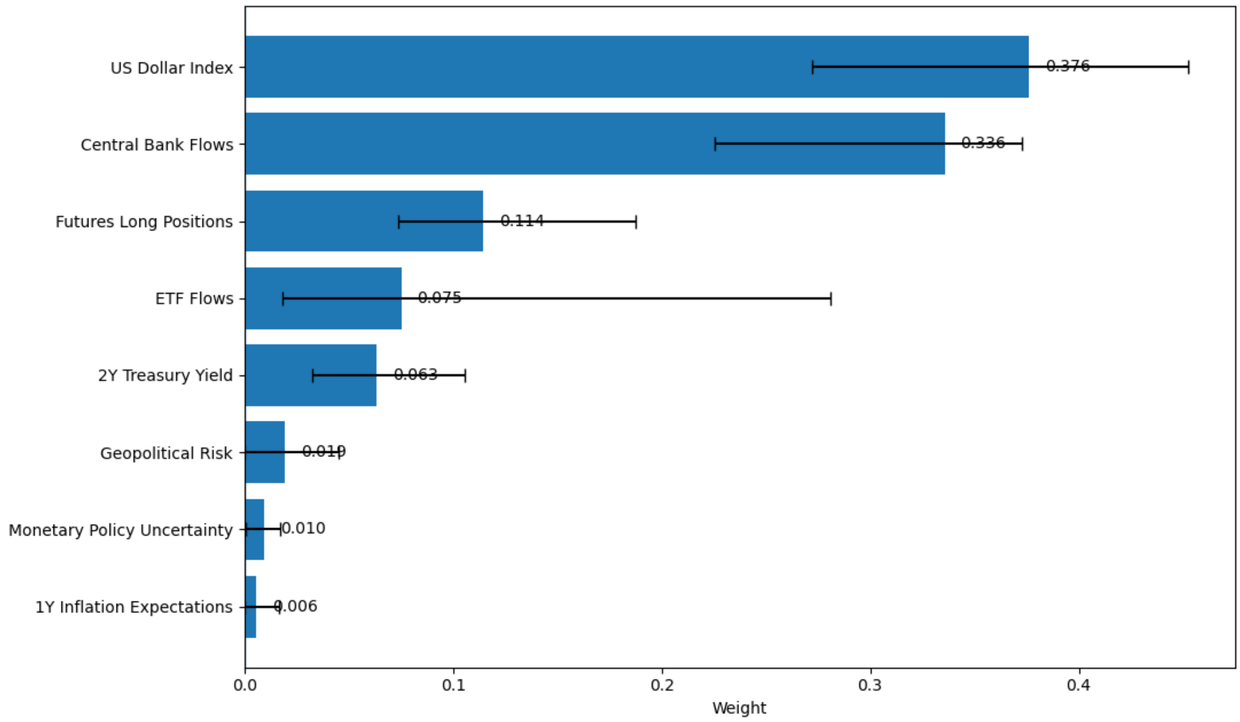
Notes: This table reports Pearson correlation coefficients between monthly gold returns and the macro-financial factors used in the style-analysis model. All variables are observed at the monthly frequency over the full sample period (April 2003 to August 2025).

Table 4 – Returns-Based Style Analysis: Estimated Factor Weights and Confidence Intervals

Factor	Estimate	CI Lower	CI Upper	Bootstrap Mean	Bootstrap Std. Err.	t-stat	CI Includes 0
US Dollar Index	0.376	0.272	0.452	0.369	0.046	8.10	No
Central Bank Flows	0.336	0.225	0.373	0.313	0.041	8.19	No
Futures Long Positions	0.114	0.074	0.187	0.129	0.028	4.08	No
ETF Flows	0.075	0.018	0.281	0.089	0.072	1.04	No
2-Year Treasury Yield	0.063	0.032	0.106	0.065	0.019	3.36	No
Geopolitical Risk	0.019	0.000	0.045	0.021	0.012	1.59	Yes
Monetary Policy Uncertainty	0.010	0.001	0.017	0.009	0.004	2.33	No
1-Year Inflation Expectations	0.006	0.000	0.017	0.006	0.005	1.22	Yes

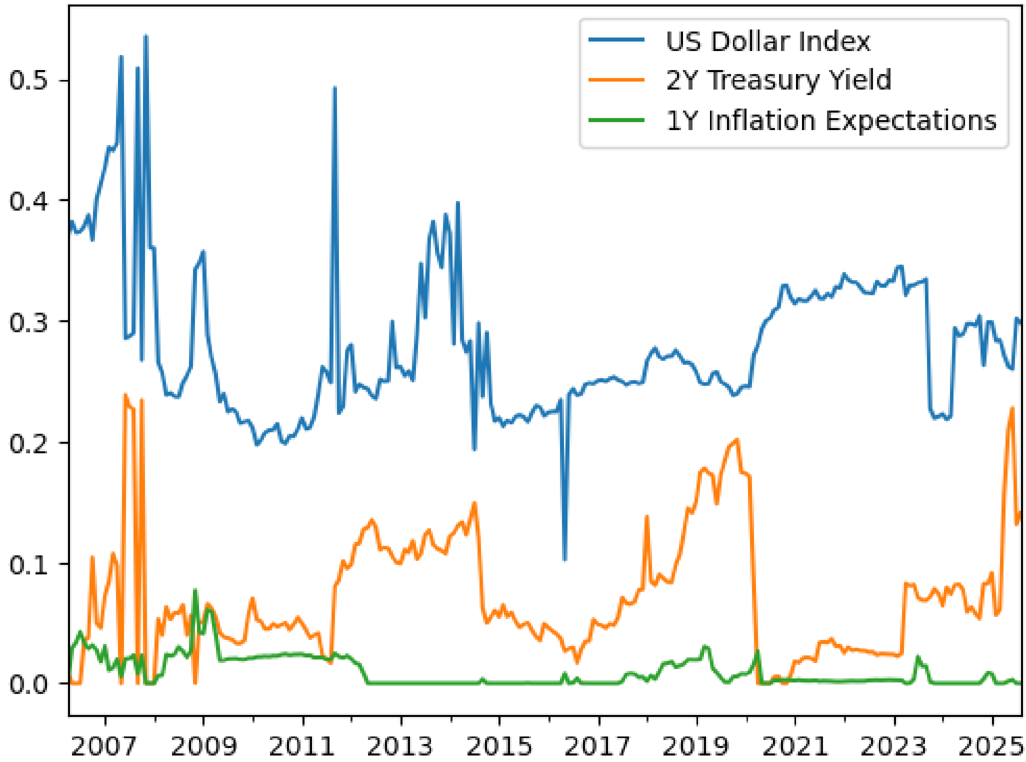
Notes: This table reports block bootstrap estimates of factor weights from the returns-based style analysis (RBSA). Confidence intervals are computed using a moving block bootstrap to account for time-series dependence. Bootstrap Std. Err. denotes the standard deviation of the bootstrap distribution of the estimated weights. The t-statistic is computed as the ratio of the point estimate to the bootstrap standard error. Zero in CI indicates whether the bootstrap confidence interval contains zero, implying that the estimated factor exposure may not be statistically distinguishable from zero.

Figure 1 – Estimated Style-Factor Exposures and Confidence Intervals



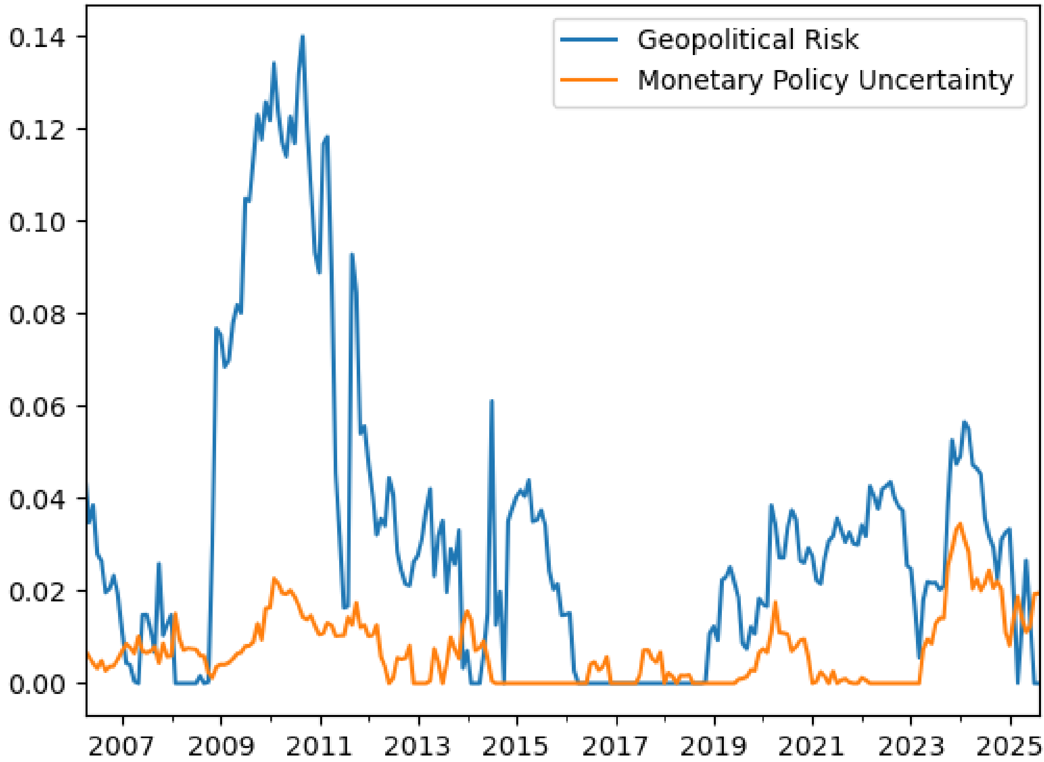
Notes: This figure reports the estimated RBSA factor weights explaining monthly gold returns together with their 95% bootstrap confidence intervals. The bars represent the point estimates of factor exposures, while the horizontal lines denote the bootstrap confidence intervals.

Figure 2 – Time-Varying Contributions of Gold Style Factors – Macro variables



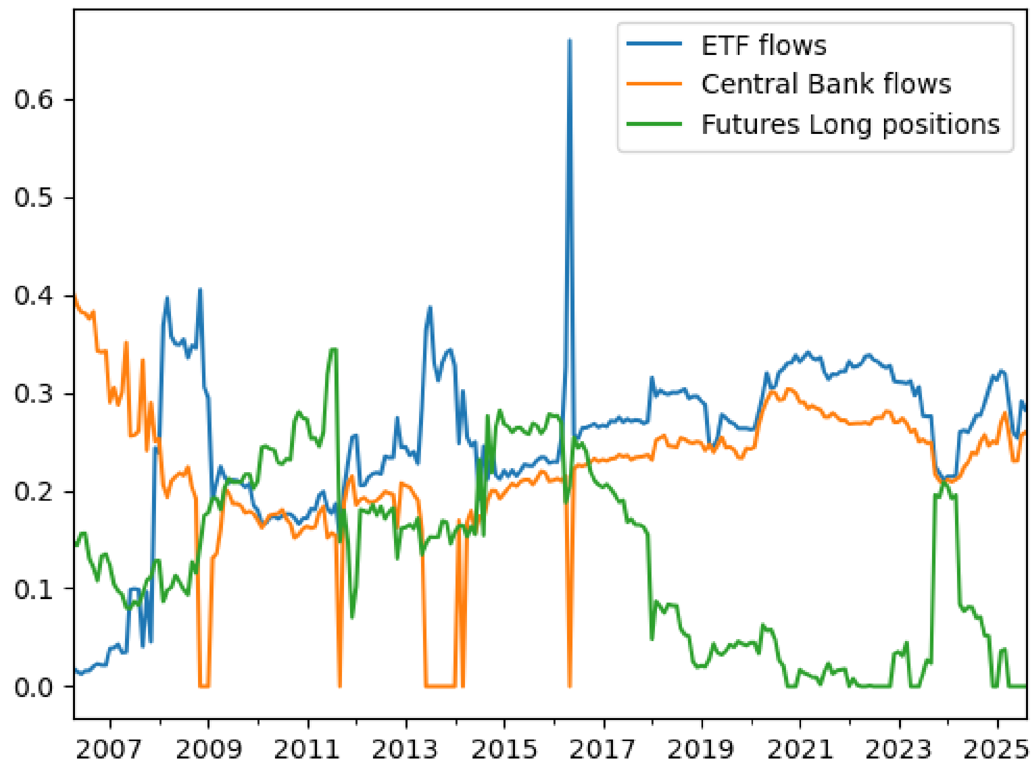
Notes: This figure displays the rolling RBSA factor weights associated with the three macroeconomic variables (inverted U.S. Dollar Index returns, inverted 2-year U.S. Treasury yield changes, and one-year expected inflation changes). The estimates are obtained using a 36-month rolling window, with the window advancing one month at a time over the period March 2003 to August 2025.

Figure 3 – Time-Varying Contributions of Gold Style Factors – Risk indicators



Notes: This figure displays the rolling RBSA factor weights associated with the two risk-related *variables (the Monetary Policy Uncertainty index and the Geopolitical Risk index). The estimates are obtained using a 36-month rolling window, with the window advancing one month at a time over the period March 2003 to August 2025.*

Figure 4 – Time-Varying Contributions of Gold Style Factors – Capital Flows



Notes: This figure displays the rolling RBSA factor weights associated with the three flow-based *variables (central bank gold flows, gold ETF flows, and COMEX speculative positioning). The estimates are obtained using a 36-month rolling window, with the window advancing one month at a time over the period March 2003 to August 2025.*