

Mining Gold for Regimes: The Case for Holding Gold in a Strategic Asset Allocation

May 30, 2024

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Abstract

After 2022, a year in which holding gold as part of a diversifying portfolio failed to produce material benefits for investors, we believe it is important to revisit the reasons for including gold in a long-term asset allocation plan. Our view is that its importance can be neatly summarized by appealing to a novel regime-based framework that has implications not just for investors' gold allocation specifically, but also potentially for strategic asset allocation more generally at a time when the likelihood of a material shift in the drivers of cross-asset returns is perhaps abnormally high.

Highlights

- We develop a novel procedure that automatically identifies regimes based on a transparent, flexible, and nonarbitrary methodology. The regimes we discover and the long-run historical behavior of gold reveal that it can serve, depending on the macroeconomic environment, either as a real asset proxy, a commodity, and/or a stable currency. These are three desirable properties which make gold compelling to include in a portfolio otherwise composed mostly of traditional equity and fixed income risk, especially during a period of higher-than-normal inflation.
- A diversified approach to diversification provides the best chance at improving both short- and long-term portfolio returns and characteristics, especially when one cannot rely on hindsight or data-mining to build robust forward-looking portfolios. Gold's three regimes offer this diversification opportunity.
- Our thesis is that investors in gold fundamentally underperformed what they would have expected to experience during the last few years, primarily because of an unfavorable change in valuation brought about by rising real yields. However, we could be entering a new investing environment in which gold could provide substantial benefits to traditional asset allocations.

Over the last four decades and counting, beginning with papers such as Merton 1980, academics and practitioners alike have devoted considerable energy to estimating time-varying risk premia both in the time series and in the cross-section. Another way of phrasing the “time-varying” part of that exercise is to suggest that there exist regimes that impact assets across financial markets. Clearly, identification of such regimes would provide investors with, at minimum, the ability to account for the performance and characteristics of global markets. In this paper, we develop a novel regime estimation procedure based on the transparent, flexible, and nonarbitrary methodology pioneered by Czaronis, Kritzman, and Turkington 2022. We apply our new framework to mine for regimes in the distribution of gold returns since the 1970s, and in doing so identify three distinct regimes that account for its behavior.

Like the three-faced Greek goddess Hecate, or the Hindu triad (“Trimurti”) of Brahma, Vishnu, and Shiva, gold’s three regime “faces” provide insights into the performance of an asset that has been around for centuries in investment portfolios. Gold’s “faces” reveal that it can behave, depending on the macroeconomic environment, either as a real asset proxy, a commodity, and/or a stable currency. These are three desirable properties which make gold compelling to include in a portfolio otherwise composed mostly of traditional equity and fixed income risk, especially during a period of higher-than-normal inflation. This time-varying behavior underscores a key takeaway from Bhansali and Holdom 2021 that we emphasize here: that a diversified approach to diversification provides the best chance at improving both short- and long-term portfolio returns and characteristics, especially when one cannot rely on hindsight or data-mining to build robust forward-looking portfolios.

This paper is organized into three sections: 1) a dissection of the regimes that gold has experienced historically using a new approach we have developed, building on the work of Kinlaw et al. 2023, as well as a note on the importance of valuation in explaining returns; 2) an accounting of gold’s lackluster performance and diversifying characteristics during 2022, a year in which traditional equity and bond exposures experienced one of their worst joint real drawdowns in history; and 3) an argument for holding gold going forward. Our thesis is that investors in gold fundamentally underperformed what they would have expected to experience during the last few years, primarily because of an unfavorable change in valuation brought about by rising real yields. But given the three faces of gold and the current state of governments’ fiscal positions², our new regime-based framework suggests that we could be entering a new investing environment in which gold could provide substantial benefits to traditional asset allocations.

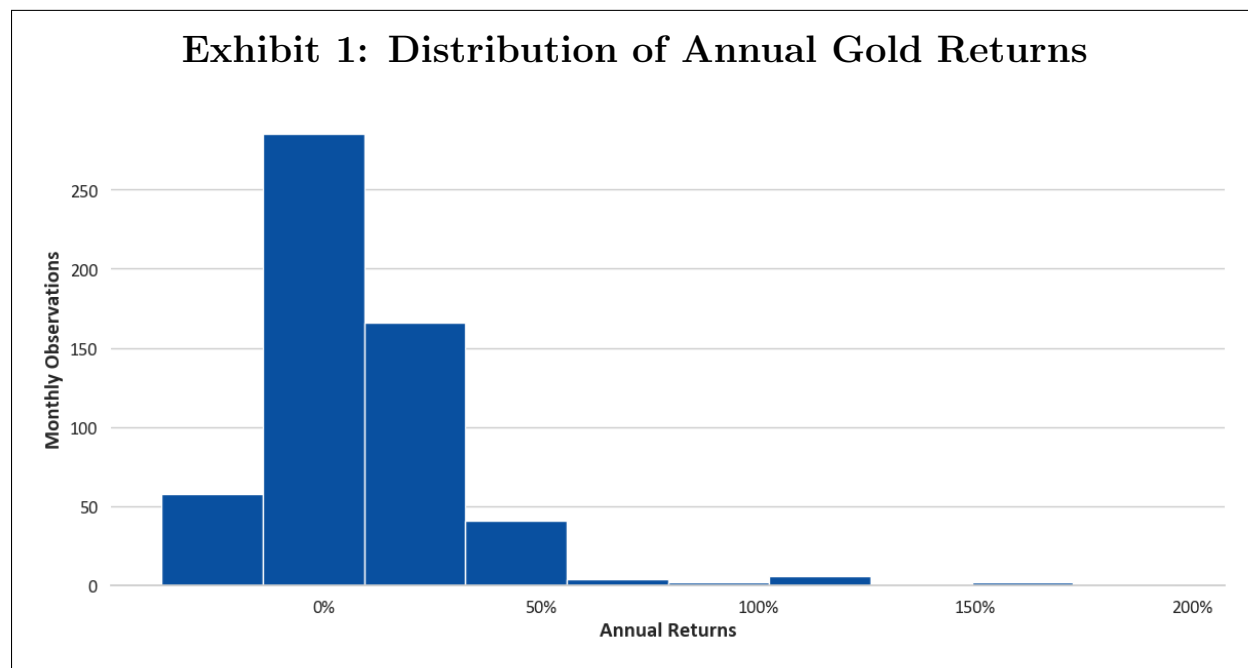
GOLD’S REGIMES AND VALUATION

Historically, gold has acted as one of the most potent stores of value. Indeed, Erb and Harvey 2013 show that when put in terms of units of gold, the pay of a modern U.S. Army Captain and Private are about equivalent to the similar Emperor Augustus-era ranks of Roman Centurion and Legionary, respectively, despite being separated by over 2,000 years. The “store of value” argument about gold has been one of the most-cited reasons for holding it in a strategic asset allocation, precisely because it is expected to hedge against inflation over the long-run. A similar argument has been made about Bitcoin as a “digital” substitute

2. The looming threat of fiscal crises. <https://www.ft.com/content/dcc702cb-0eec-4ac8-a0b8-c911a0b4f180>

for gold, however cryptocurrencies are outside the scope of this paper and are left for future research. Regardless, we rely on this long-run real zero return property as our primary valuation measure for gold, which we will discuss in more detail later in this section.

Though we believe this argument about the value of gold as an inflationary diversifier to be mostly correct, we also believe that it lacks additional context crucial to understanding gold’s performance over the medium- to long-term. In particular, the “store of value” argument can ultimately be decomposed into three primary regimes through which gold tends to move; it can behave as a real asset proxy, a commodity, and/or a stable currency. Before discussing our regime-based framework, however, we first emphasize that changing regimes often lead to observations in the tails of an asset’s return distribution. The most obvious example of this is equities in bad times such as recessions and financial crises, during which returns tend to be negative in greater magnitude than that suggested by a normal distribution. For gold the situation is reversed; its returns are highly positively skewed, as shown in Exhibit 1, which reveals that gold can provide the explosive convexity or tail risk protection needed to hedge portfolios during years such as 1979, when it was up over 150% and strongly outpaced even a very high rate of U.S. CPI inflation of 13.3%. Importantly, gold is expected to provide this tail hedging property³ not only when inflation runs hotter than expected, but also during recessionary environments as well, making it attractive in a period like today when the risk of either overheating or falling interest rates due to weak growth, respectively, are perhaps both higher than normal.



Source: Bloomberg. April 30, 2024

With this distribution in mind, we move to our novel regime estimation procedure. Our approach, though we recognize there are many methodologies to estimate and identify states,

³ Falling inflation might not dent gold’s rally. <https://www.ft.com/content/cd953f8f-38b9-4eda-8cfd-5964cd6d25f7>

is primarily based on the concept of relevance proposed by Czasonis, Kritzman, and Turkington 2022 and Czasonis, Kritzman, and Turkington 2023. Relevance suggests that, when it comes to the task of prediction at a particular point in time, maintaining a focus on periods similar to the one of interest but unlike the historical average is paramount. Such observations are more likely to represent useful information for the prediction task relative to data that is either not similar to the current period - thereby potentially indicative of a different regime - or close to the average - potentially representing noise. Mathematically, relevance is defined as shown in equation 1.

$$r_{it} = sim(x_i, x_t) + \frac{1}{2}(info(x_i, \bar{x}) + info(x_t, \bar{x})) \quad (1)$$

In equation 1, similarity is the Mahalanobis 1936 distance between the current period of interest, x_t , a vector representing the variables selected, and a prior observation of those variables, x_i . Informativeness is defined similarly as the multivariate distance between each individual observation and the average of the independent variables, \bar{x} . Similarity is defined in equation 2, while informativeness is given in equation 3. Note that Σ represents the covariance matrix of the \mathbf{x} variables.

$$sim(x_i, x_t) = -\frac{1}{2}(x_i - x_t)\Sigma^{-1}(x_i - x_t)' \quad (2)$$

$$info(x_i, \bar{x}) = (x_i - \bar{x})\Sigma^{-1}(x_i - \bar{x})' \quad (3)$$

Using the definition of relevance in equation 1, we proceed to our regime methodology. In Czasonis, Kritzman, and Turkington 2023, the authors first implement a hidden Markov model to identify regime states, and later apply the concept of relevance to find the Mahalanobis likelihood of each regime at each point in time based on the independent variables they have selected. The result is a remarkably good fit of the regime probabilities to the hidden states despite a completely distinct methodology initially defining those states from that accounting for them. Our approach is different; we maintain an emphasis on the transparency, flexibility, and nonarbitrariness of relevance and solely use it to identify our regimes. Using our own selected variables that are important to gold's performance and characteristics, we calculate the relevance of each point in time with all other points in time to recover a $t \times t$ encoding matrix somewhat representative of a covariance matrix between each time period. From here, we sort the relevance matrix into regimes using k -means clustering, a process that results in an unsurprisingly much tighter fit of the Mahalanobis likelihood of each regime to those identified by the procedure. This goodness of fit indicates that our regimes are determined directly using relevance, and not externally defined prior to our accounting of them.

To illustrate the process, we first select eight variables important to gold's performance and characteristics. These include two measures of gold valuation, various relevant macroeconomic and financial market indicators, as well as the trailing performance of gold itself. The variables specifically are the:

1. 1-year lagged carry implied by the front two months of gold futures contracts;
2. 1-year lagged level of real gold prices (gold price scaled by the level of headline U.S.

Exhibit 2: Sample of Relevance-Based Encoding Matrix							
Date	Mar. 1977	Apr. 1977	May 1977	...	Feb. 2024	Mar. 2024	Apr. 2024
Mar. 1977	5.52	5.97	6.47	...	-3.26	-2.60	-3.03
Apr. 1977	5.97	6.50	7.05	...	-3.51	-2.88	-3.32
May 1977	6.47	7.05	7.84	...	-4.06	-3.40	-4.08
...
Feb. 2024	-3.26	-3.51	-4.06	...	4.35	4.32	4.55
Mar. 2024	-2.60	-2.88	-3.40	...	4.32	5.74	6.33
Apr. 2024	-3.03	-3.32	-4.08	...	4.55	6.33	7.90

Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

CPI, a ratio which, as mentioned previously, can act as a kind of valuation monitor for gold along with the level of negative carry in the futures);

3. annual change in federal government debt-to-GDP;
4. annual change in the federal government's budget deficit-to-GDP;
5. annual returns to spot gold;
6. annual returns to the S&P GSCI Commodities ex-Precious Metals Index;
7. annual returns to equities, represented by the S&P 500 Index;
8. annual headline U.S. CPI inflation rate.

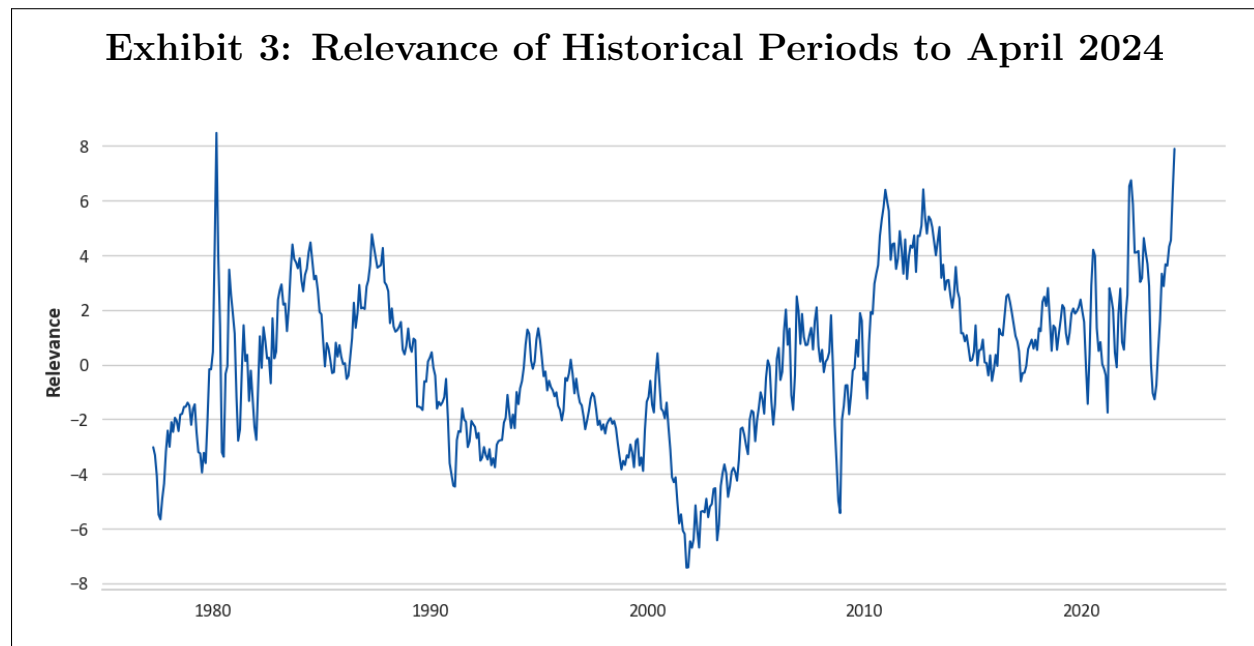
All data are constructed on a monthly basis and available from March 1977 to April 2024 using data from Bloomberg, Federal Reserve Economic Data (“FRED”), Robert Shiller⁴, and MeasuringWorth⁵. Where necessary, the data are lagged to account for the announcement delay, and are thus point-in-time. Next, we use equation 1 to calculate each time period's relevance to all other dates and construct the $t \times t$ encoding matrix; a portion of our encoding matrix is shown in Exhibit 2. Note that the encoding matrix is specific to the variables selected, but not gold itself; thus, no endogeneity issues exist by including gold as a variable itself.

Recall that higher positive values indicate greater relevance of the column date to the row date, while lower negative values suggest little relevance. The sample portion of the relevance-based encoding matrix presented in Exhibit 2 suggests that, perhaps unsurprisingly, dates closer to each current observation are more relevant than those farther away, for the primary reason that our variables are relatively slow-moving/overlapping. Three additional observations are in order. Firstly, a series of relevance to a particular data point, such as today (April 2024), naturally suggests regimes latent in the variables selected, even before applying k -means clustering to discover them. Exhibit 3 plots the relevance of each time period to today, showing that data in the early 1980s and after 2010 are most relevant to

4. Online Data Robert Shiller. <http://www.econ.yale.edu/~shiller/data.htm>

5. Lawrence H. Officer and Samuel H. Williamson, “The Price of Gold, 1257 - Present.” <https://www.measuringworth.com/datasets/gold/>

the current observations, while data from parts of the 1990s and 2000s are not particularly relevant. Secondly, although somewhat similar to a covariance matrix between each date, the encoding matrix, while symmetrical, does not have the property that the largest elements are those on the diagonal. The implication is that the most relevant observation to a particular date may not be that date itself, a perhaps surprising result. This is possible because relevance depends not only on similarity - which is zero (most relevant) for an observation relative to itself - but also on informativeness, which from equation 3 shows that how far a set of observations are from their average is important; more noisy observations close to the center of the distribution are less relevant. Lastly, to the extent that the sample average and covariance matrix are unbiased and consistent estimates of the population (or at least held fixed), adding new data as time progresses does not change the historical relevance between past data points. This makes our approach not only suitable for an historical accounting of regimes, as we use it for in this paper, but also for an out-of-sample forecasting methodology.



Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

We finally present the regimes identified from the relevance-based encoding matrix in Exhibit 2 using first a dimensionality reduction exercise with PCA and then k -means clustering⁶. We impose the condition of three regimes, representing a common sense balance between parsimony and complexity in the presence of inconclusive/conflicting in-sample cross-validation tests of identifying the optimal k using the silhouette⁷, Calinski and Harabasz⁸, and Davies-Bouldin scores⁹. Since k -means clustering is not deterministic, in the sense that it is sensitive to the initialization, we fit 1,000 iterations of the algorithm with different starting points using a k value of 3 and identify the one for which the average L2 norm score between each

6. We find similar results simply applying k -means clustering directly to the relevance-based encoding matrix.

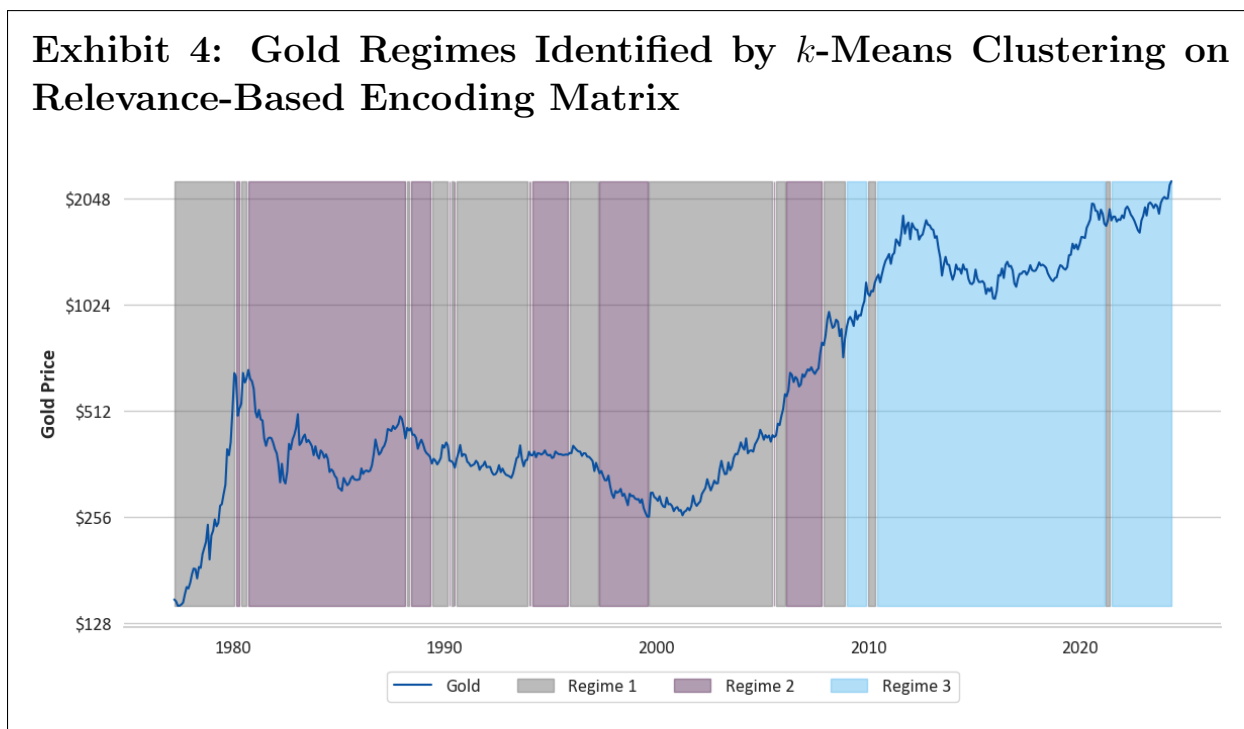
7. Please see Rousseeuw 1987 for more details.

8. Please see Caliński and Harabasz 1974 for more details.

9. Please see Davies and Bouldin 1979 for more details.

PCA data point and its respective cluster center is minimized. We take the resulting regimes from this minimum to be the "global" best fit for $k = 3$; though our approach is explanatory in nature and therefore uses the full sample, such an approach lends itself naturally to out-of-sample regime forecasting using cross-validation. The three regimes we identify using this procedure are shown in Exhibit 4. Note again that although we are applying the regimes to account for gold's performance and characteristics, they are not specific to gold but rather the totality of the variables selected in Mahalanobis distance space.

Exhibit 4: Gold Regimes Identified by k -Means Clustering on Relevance-Based Encoding Matrix



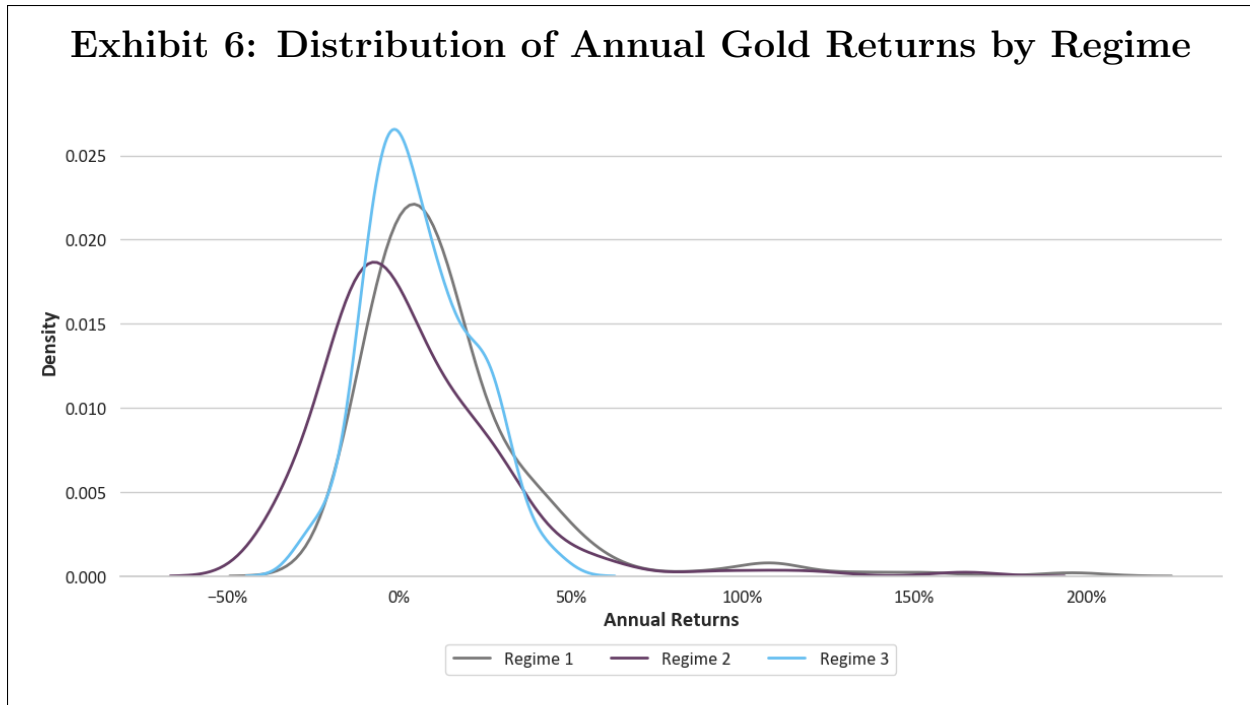
Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

Three aspects of the identified regimes immediately stand out. Firstly, they are mostly continuous and persistent, with monthly Markov transition probabilities of remaining in the same regime ranging from 93.8% for regime 1 to 98.9% for regime 3. Secondly, the third regime is very distinct from the other two, in that it only occurs for the first time in December 2008 after the start of the Global Financial Crisis ("GFC") and Great Recession, when the period of low interest rates began, pausing only briefly to revert back to the first regime from March to May 2021, during the peak of fiscal expansion following the COVID-19 pandemic. Since May 2021, the variables used in the analysis imply that gold has been in the third regime. Thirdly, although not shown, the fit of the Mahalanobis likelihood of each regime to the regimes themselves, as calculated by Kinlaw et al. 2023 in their Exhibit 8, is very tight. Although circular, since we are using the same variables employed in the regime identification to make a statement about how likely that regime is at a particular point in time, the result emphasizes that the regimes are indeed primarily based on the concept of relevance. Compared with Kinlaw et al. 2023, our Mahalanobis likelihood fits are much tighter and nearly binary in nature, indicating that we have successfully used relevance to define regimes directly, the intended goal of our novel approach.

Exhibit 5: Average of Select Variables by Regime								
Regime	Gold Returns	Real Gold Valuation	Debt/GDP Change	Budget/GDP Change	Equity Returns	Real Rate Beta	Inflation	Inflation Importance
1	14.5%	2.8x	1.3%	-0.4%	6.5%	-0.01	4.6%	21.3%
2	3.4%	3.4x	1.1%	0.2%	14.8%	0.08	4.5%	14.9%
3	6.1%	5.9x	3.2%	0.0%	8.7%	-0.32	2.4%	18.8%

Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

Using the detailed methodology of Kinlaw et al. 2023, we can determine the importance of each underlying variable to a given point in time on a scale of 0-100% by first calculating the Mahalanobis likelihood of each regime at each point in time, and later taking the derivative of this probability measure to changes in the \mathbf{x} variables. This analysis, along with examining the characteristics of each variable and that of gold during each state, reveals that the three regimes we have identified correspond to gold behaving as, respectively: 1) a real asset; 2) a commodity; and 3) a stable currency (hereafter, regimes one to three are used interchangeably with these names). The real asset regime is characterized as being primarily influenced by inflation, hence its name. The importance of this variable during the first regime is on average highest relative to inflation’s importance during the other regimes, at nearly a quarter of the total sensitivity. Gold returns are highest in this regime, at 14.5% per year on average, a welcome level of diversification from traditional equity and bond investments during a period in which average yearly returns were only 6.5% and 4.5%, respectively, all while inflation averaged 4.6%, the most compared with the other regimes. The commodities regime is slightly more subtle, but is so named primarily because of: 1) the negative real compounded return that gold experienced on an annualized basis during this period, typical of commodities in contango based on the findings of Levine et al. 2018; 2) its high monthly correlation in both absolute and relative to other regimes terms to commodities of nearly 65%; and 3) its unusually positive (albeit small) average beta to both equities and real rates (here defined as the 3-month Treasury bill yield minus trailing YoY U.S. CPI inflation, in order to extend the data back farther), both of which indicate a more growth-oriented asset in line with commodities’ long-run exposures. The stable currency regime, which has only prevailed after the Great Recession, is characterized by the lowest volatility and most normal distribution of gold returns across any regime, as well as the richest average valuation of gold in real terms. Indeed, the volatility of its annual returns during this third regime is 15.2%, almost less than half that during the other two regimes, while gold’s beta to real rates in the U.S. is most negative in this regime, suggesting protection against especially loose monetary policy. Exhibit 5 presents select variable averages across regimes, while Exhibit 6 depicts the monthly distributions of annual gold returns by regime, highlighting the regime summaries. Of note, the two-sample Cramér–von Mises, Kolmogorov-Smirnov, and Anderson-Darling tests all indicate that the distributions of gold returns are statistically different from one another across regimes.



Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

Viewed in these regime contexts, we can now parse historical episodes to decompose and explain gold’s performance, an exercise that will offer insights into its possible future performance as a diversifier. Take the example of the end of the second quarter of 1977 to August 16th, 1983, a nearly six-year period during which U.S. real rates rose dramatically (albeit not monotonically) from -2.3% to an all-time high of 7.2% (again when defined as nominal rates minus trailing one-year U.S. CPI inflation). Given the experience of 2022, it might be assumed that gold’s return would have been significantly negative. However, nominal gold prices actually rose 20.1% on an annualized basis compared with an 8.9% inflation rate. One of the primary drivers of this return was a valuation return of 10.3% annualized, from a starting ratio of gold price/CPI of 2.4x to an ending value of 4.2x, indicating a richening of the asset. While important, this full-sample view of valuation obscures the underlying dynamics throughout the period. In particular, up until September 1980 during the primarily real asset regime, real gold valuation rose to 8.2x, above its 99th percentile of all time, briefly touching 11.2x in January 1980 (well above the long-run median of 3.5x). Inflation during this period was 10.9% annualized and reached 15.7% YoY at its peak, and gold, true to its behavior as a real asset, delivered a 63.6% annualized return, driven in large part by a 47.5% valuation return as investors sought to protect the real value of their portfolios. Indeed, inflation was very important to determining this regime in Mahalanobis likelihood space based on the variable importance of Kinlaw et al. 2023, with an average importance of over 27%, higher than at nearly any other time in history. Subsequently, after September 1980, the commodities regime prevailed through to the end of the sub-sample. Along with inflation and other commodities, gold retreated back to a more modest valuation level, with inflation falling to a mere 2.5% YoY by the end of the period as the Volcker FOMC held nominal rates high to slow economy-wide price increases. The identified regimes, solely determined by relevance, were able to account nicely for gold’s

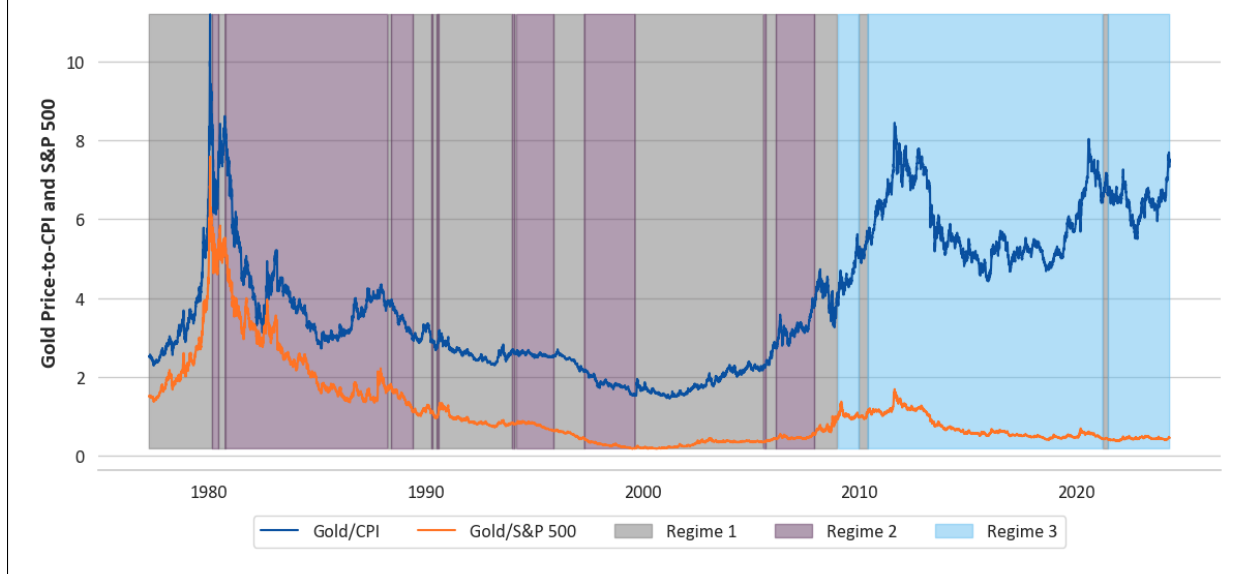
performance during a very volatile inflation period.

Another important era in gold's history is from August 25th, 1999, to August 22nd, 2011, a long 12-year period during which gold went through one of its strongest bull markets ever (with the exception of the inflationary 1970s, when gold generated its highest returns by decade of about 30% annualized). During this period, gold delivered annualized returns of 18.3%, composed of a significant increase in valuation from approximately 1.5x to 8.4x which contributed 15.4% toward that return. Importantly, such strong returns came during an era when equities generated a negative price return and only a slightly positive total return, as the period spans from the height of the Dot-Com Bubble to the post-Great Recession recovery. During this period the predominant regime was the real assets regime, which prevailed for nearly two-thirds of the time. In the commodities regime during this period, which occurred between 2005 and 2007 immediately prior to the GFC, gold was very correlated to a broad basket of commodities, as mentioned previously. Despite this, and the fact that commodities fell over -72% during the Great Recession¹⁰, gold's drawdown was a much more modest -29.0%, and over the whole recession it actually gained 16.6% cumulatively on the back of a 14.5% valuation return as investors fled to safety, with both commodities and equities down over a third. Part of the reason for this is that the stable currency regime began in December 2008 and saw an acceleration of gold's returns as its valuation increased from 4.1x to 8.4x amid a backdrop of the FOMC's first two rounds of quantitative easing along with Operation Twist¹¹. Two measures of gold's valuation over the long run are shown in Exhibit 7; the first is our preferred measure of gold price/CPI, discussed previously, while the second is gold price/S&P 500, which highlights gold's current relative cheapness to equities compared with the late 1970s/early 1980s period. In the exhibit, the substantial increase in valuation during the 2000s is clearly visible as the transition to the stable currency regime occurred, with investors bidding up the value of gold amid unprecedentedly low global interest rates.

10. National Bureau of Economic Research: "US Business Cycle Expansions and Contractions". <https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions>

11. Federal Reserve Bank of New York: "Large-Scale Asset Purchases". <https://www.newyorkfed.org/markets/programs-archive/large-scale-asset-purchases>

Exhibit 7: Gold's Valuation Relative to U.S. CPI and the S&P 500 Index



Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth. April 30, 2024

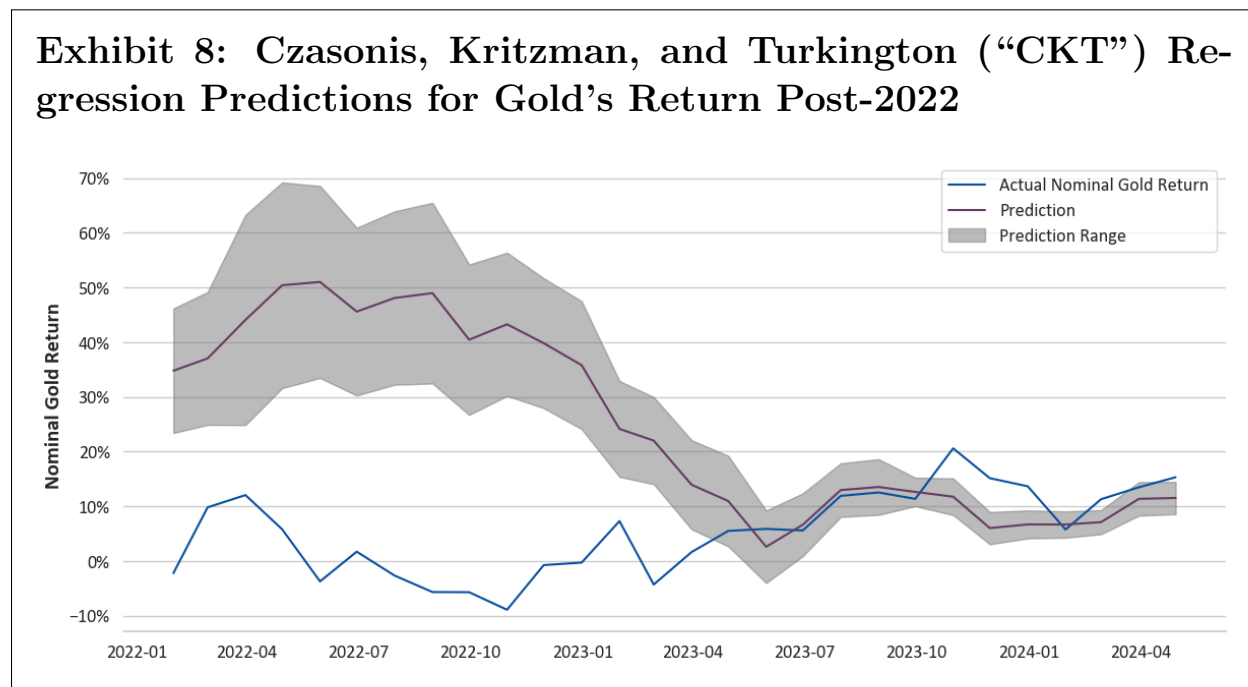
ACCOUNTING FOR GOLD'S PERFORMANCE IN 2022 AND THE ROLE OF FISCAL CONDITIONS

While the prior two select periods illustrate the power of adding gold as a diversification instrument, it is of course important to consider a year like 2022, the motivation for this paper, during which gold disappointed investors seeking diversification from traditional stock and bond risk. During 2022, despite gold delivering a close to zero nominal return, in real terms it fell -4.9% due to a change in our preferred measure of valuation from approximately 6.4x to 6.1x. Even though gold was indeed serving partially as a stable, flight-to-safety currency with, for example, a more negative than average 1-year beta to the S&P 500 and a rolling 1-month correlation of more than -70% in March, through which the equity drawdown during the year first began, the valuation shift overcame this desirable hedging property.

In order to better account for gold's dismal performance during 2022, we can extend our regime methodology, as described previously on U.S.-only data, to additional countries in an even more flexible way. In particular, we make use of the Jordà-Schularick-Taylor ("JST") Macrohistory Database, which includes data on 18 advanced economies from 1870 to 2020. To ensure outliers do not influence our results, we winsorize the data on an expanding panel basis at the 1% level for variables that involve changes on a YoY basis. We also limit our exploration to those countries and dates during which a country's exchange rate was not pegged to any other currency, leaving us with 337 observation years across 10 countries in the post-Bretton Woods era. Our goal in this exercise is to predict what gold returns should have been based on the starting (lagged) values of level variables and changes in change

variables throughout each year in the out-of-sample period from 2021 to the present. To align with our regime methodology, we use the same variables (all in local currency terms) as those described in the first section, only removing gold’s return itself and the level of carry in gold futures - since this is specific to an exchange and not available across countries - and adding in the lagged values of federal government debt-to-GDP and the federal government’s budget deficit-to-GDP to control for different levels of these variables in the cross-section. We make use of the related approach to our regime methodology in Czasonis, Kritzman, and Turkington 2023 to make transparent, flexible, and nonarbitrary forecasts of what gold’s returns should be from a fundamental perspective; additional tests using ordinary least squares found substantially similar results, lending robustness to the conclusions.

Despite a very good model fit in-sample of between 26-75% depending on how fit is measured (the adjusted R-squared is 26.0% but the reliability agreement exclusive of outliers is 75.4%), as discussed in Czasonis, Kritzman, and Turkington 2022, the out-of-sample prediction performance during 2022 was strongly biased. Our fundamental model of what gold’s performance should have been in 2022 reports expected returns of between 25-70% on a yearly basis, as shown in Exhibit 8. After 2022 our fundamental model goes back to accurately accounting for gold’s returns, implying that investors in gold in 2022 underperformed what they fundamentally would have expected to earn during the year due to a high starting valuation.



Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth, JST. April 30, 2024

It is therefore possible that the impact of increasingly high public debt-to-GDP and budget deficit-to-GDP ratios, for example, had yet to flow through to gold’s returns during 2022. Gold has a statistically significantly positive and negative relationship with those two variables, respectively, both of which suggested a very loose fiscal stance as inflation began to accelerate. At the beginning of 2022, for example, the percentile rank of these

two variables suggested the conditions were in the top 5% of fiscally profligate (see Mauro et al. 2015 for a detailed discussion) periods ever. The fundamental model of expected gold returns from Exhibit 8 in part captures the importance of these variables in their extremes, suggesting that gold's fundamental performance should have been better. But because the prevailing regime during this period was the stable currency regime, in which gold's beta to real rates was particularly negative, the negative valuation return - driven by rising real rates - overwhelmed the expected positive fundamental return. Indeed, real rates rose from -7.0% to -2.8% throughout the year, using the 3-month Treasury bill yield minus trailing YoY U.S. CPI inflation measure, among its largest increases ever. An alternative measure of real rates derived from the 10-year TIPS market rose 2.3%, also among the largest yearly increases ever. As a result, investors hoping for diversification during an inflation episode were ultimately disappointed in gold's performance.

WHY SHOULD INVESTORS HOLD GOLD NOW?

The above accounting of gold's performance during 2022 is a nice narrative, but unfortunately narratives don't provide diversification support to portfolios during the years that they need it the most. Thus, a natural question to ask in the context of the previous two sections is what expectations for gold are for the medium- to long-term future, for example in the next five years. Since regime shifts are incredibly hard to forecast ex-ante, we first note that taking a multi-faceted approach to diversifying assets is a superior approach in the long run. With that said, we believe the current macroeconomic setup favors a strategic allocation to gold despite 2022's dismal diversifying performance for two primary reasons: 1) prospective returns are strong in the event that inflation continues to run hotter than its long-term average, in a scenario both similar to the experience of the 1970s and that would represent a major shift from the conditions since then that have favored financial assets like stocks and bonds; and 2) there is an increasing question about the U.S. government's fiscal sustainability, a scenario that would favor a real asset/commodity/stable currency thematic investment like gold. We believe that gold can provide outsized returns if these dual tail events materialize, a conclusion that also has implications for strategic asset allocation generally. While the last 15 years since the Great Recession have strongly favored financial assets such as stocks and bonds, the current macroeconomic setup, marked by fiscal imprudence, possibly portends a shift away from this paradigm toward assets like gold that can hedge traditional asset allocation risks in multiple extreme environments.

Firstly, following Erb and Harvey 2013, we can construct scenarios of prospective 5-year annualized gold returns depending on assumptions about future inflation and ending gold valuation. Exhibit 9 documents these scenarios. The current valuation is approximately 7.3x which, despite being somewhat high by long-run historical standards, is only about 1.0-1.5 turns above the average/median relative to the last 5-15 years of valuation, during which the stable currency regime has prevailed. We believe this view of valuation in the post-GFC era is appropriate given our regime identification previously discussed, as the decade of low-to-negative real rates around the world during the 2010s materially shifted up average valuation when short-term nominal rates went to zero during the Great Recession. If valuation remains the same, we expect gold to generate a positive return in nearly all inflation environments,

and it may generate a positive return in many inflation scenarios even if valuation falls over a full turn to 6x. Furthermore, relative to the S&P 500's price, gold's valuation is below the 27th percentile relative to history, having retreated from the 80th percentile in the early 2010s somewhat consistently, providing a small cross-asset margin of safety.

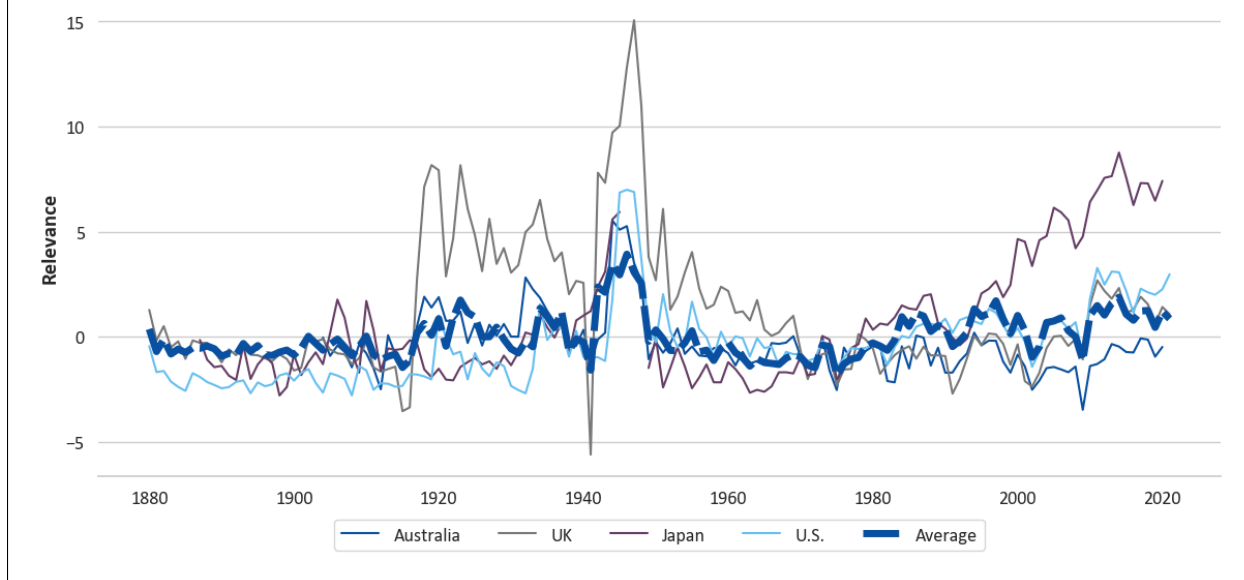
Exhibit 9: Scenario Table for 5-Year Annualized Gold Returns by Inflation and Valuation Assumptions

	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
2x	-22.9%	-22.1%	-21.3%	-20.5%	-19.8%	-19.0%	-18.2%	-17.5%	-16.7%	-15.9%	-15.1%
3x	-16.3%	-15.5%	-14.7%	-13.8%	-13.0%	-12.2%	-11.3%	-10.5%	-9.7%	-8.8%	-8.0%
4x	-11.4%	-10.5%	-9.6%	-8.7%	-7.8%	-7.0%	-6.1%	-5.2%	-4.3%	-3.4%	-2.5%
5x	-7.3%	-6.4%	-5.5%	-4.6%	-3.6%	-2.7%	-1.8%	-0.9%	0.1%	1.0%	1.9%
6x	-3.9%	-2.9%	-2.0%	-1.0%	-0.1%	0.9%	1.9%	2.8%	3.8%	4.7%	5.7%
7x	-0.9%	0.1%	1.1%	2.1%	3.1%	4.1%	5.0%	6.0%	7.0%	8.0%	9.0%
8x	1.8%	2.8%	3.8%	4.8%	5.9%	6.9%	7.9%	8.9%	9.9%	10.9%	12.0%
9x	4.2%	5.3%	6.3%	7.3%	8.4%	9.4%	10.5%	11.5%	12.5%	13.6%	14.6%
10x	6.4%	7.5%	8.6%	9.6%	10.7%	11.8%	12.8%	13.9%	14.9%	16.0%	17.1%
11x	8.5%	9.6%	10.6%	11.7%	12.8%	13.9%	15.0%	16.1%	17.2%	18.2%	19.3%

Source: Bloomberg. April 30, 2024.

Secondly, amid an increasingly unsustainable fiscal path for the U.S. government in both public debt-to-GDP and government budget deficit-to-GDP, gold's function as a real asset, in line with our regime discussion previously, sets it up well as a potentially powerful diversifier. Indeed, the recent paper Calomiris 2023 documents this trajectory and lays out a scenario of fiscal dominance in which the deteriorating fiscal position overwhelms monetary policy's ability to keep inflation low, a scenario in which gold would undoubtedly perform well given the regime-based analysis in this paper. We confirm this finding by using the concept of relevance from Czaronis, Kritzman, and Turkington 2022, as shown in equation 1. Specifically, we use the JST dataset and search across 18 advanced economies over 150 years to identify periods most relevant to the current macroeconomic setup in the U.S. along the variables used in the Exhibit 8 regressions. Exhibit 10 shows the average relevance across these economies and highlights a subset of countries for illustration, including Australia, the UK, Japan, and the U.S.; note that the units themselves are unimportant in this context, only their relative magnitudes, but that as a reminder one can intuitively consider more relevant observations to the present to be those that are similar to today (i.e., most likely to represent the same regime) and unlike the long-run average (i.e., least likely to represent noise).

Exhibit 10: Relevant Periods across 10 Advanced Economies to April 2024 in the U.S.



Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth, JST. April 30, 2024

Over this very long 150-year dataset, we find that the most mathematically relevant periods to today in the U.S. are the periods between and following WWI and WWII, as well as Japan over the last two decades. This finding is quite troubling in that the primary drivers of this relevance are inflation, public debt-to-GDP, and the government’s deficit-to-GDP, all of which tended to be elevated during these historical analogs. In the case of inflation, this is the same variable that, as discussed previously, is most important to the real asset regime discovered in our methodology, implying a high chance of regime shift in the short-term to this real asset regime. In the case of the latter two variables, although their averages are not necessarily significantly different from one another across regimes, the nature of their distributions suggests a significant skewness towards fiscal profligacy in the real assets regime (i.e., expanding debt-to-GDP and the government’s deficit-to-GDP). Indeed, we already saw a small shift to this regime from March to May 2021, during the peak of fiscal expansion following the COVID-19 pandemic, in large part because of these variables; for example, the importance of the government’s budget deficit-to-GDP increased from just 3.2% at the beginning of 2020 and 12.8% at the beginning of 2021 to 22.2% in March 2021, when the shift to the real assets regime occurred. That level of importance is the highest it has been in the post-2020 world.

It is therefore evident that the current fiscal path in the U.S. mirrors many of the extreme instances of the past, including two world wars and the “lost decades”, highly indebted experience of Japan following the bursting of its asset price bubble in the late 1980s. Our analysis also confirms data from the IMF, reported on recently by the Financial Times¹², that shows both advanced and emerging economies’ government debt loads as a percent of

12. The looming threat of fiscal crises. <https://www.ft.com/content/dcc702cb-0eec-4ac8-a0b8-c911a0b4f180>

Exhibit 11: Suggested Allocation to Stocks, Bonds, and Gold by Regime in MVOs as of April 2024					
Regime	Regime Probability	Equity Allocation	Bond Allocation	Gold Allocation	Expected Sharpe Ratio
Real Asset	1.1%	31.0%	55.2%	13.8%	0.54
Commodity	0.0%	57.8%	41.3%	0.9%	0.84
Stable Currency	98.9%	57.4%	37.4%	5.3%	0.29
Weighted Average		57.1%	37.6%	5.4%	0.29

Source: Bloomberg, FRED, Robert Shiller, MeasuringWorth, SBBI from the CFA Institute. April 30, 2024

GDP are at all-time highs, mirroring the experience of the Second World War. Given this finding, we believe it is important for investors to hold gold as a diversifying asset that can behave as a real asset, should such a regime shift occur.

One way to quantify this view in terms of how it might manifest itself in a strategic asset allocation is a weighted-average expectation based on the current probabilities of each regime. We use the latest data as of April 2024 to calculate the Mahalanobis likelihood of each regime, adjusting them for the long-run Markov transition probabilities. At present, this approach suggests the stable currency regime is very likely, though as mentioned the fact that the current circumstances in the U.S. are so similar to prior periods of extreme government largesse implies a heightened chance of a shift to the real asset regime; the small Mahalanobis-likelihood of the real asset regime prevailing at present confirms that view. Furthermore, the widely-reported breakdown in some of the usual relationships between gold and other variables, such as real rates¹³ and ETF/central bank gold holdings¹⁴, may exacerbate the probability of such a regime shift, as the recently-positive relationship of gold with real rates is inconsistent with the significantly negative average beta of gold to real yields in the stable currency regime.

For simplicity, we consider a three-asset portfolio composed of U.S. equities, long duration U.S. Treasuries, and gold. Data for the former two comes from Ibbotson’s Stocks, Bonds, Bills, and Inflation (“SBBI”) dataset¹⁵. We calculate the historical average returns, volatilities, and correlations between these three assets during each regime and use these as our inputs for a mean-variance optimization (“MVO”) exercise¹⁶. Due to issues with MVO caused primarily by errors in means raised by Chopra and Ziemba 1993, we employ a re-sampling methodology in which we perturb the expected returns in each state proportional to their expected volatilities and optimize 1,000 times, taking the average of the results to arrive at the final recommended allocation between the three asset classes in each state. The suggested allocation to each asset class based on this resampled MVO approach is given in Exhibit 11 for not only each regime, but also on a weighted average basis based on the current probabilities (which matches the stable currency regime given its nearly 100% Mahalanobis likelihood at present, as noted).

Although the stable currency regime is currently considered to be most likely by far, Exhibit 11 highlights two things. Firstly, even in this stable currency regime, despite gold’s underwhelming performance relative to fundamental expectations in 2022, the suggested allocation to the metal is approximately 5%. Secondly, should the stable currency regime

13. Please see Peety et al. 2024 and Wang 2024 for more details.

14. Please see Yardeni 2024 and Erb and Harvey 2024 for more details.

15. CFA Institute. ”Stocks, Bonds, Bills, and Inflation (SBBI) Data” <https://rpc.cfainstitute.org/en/research-foundation/sbbi>

16. We force the allocation to each asset class to be between 0% and 100% (i.e., no shorting or leverage) and aim to maximize Sharpe ratio in the MVO resamples.

shift to either the real asset or commodity regime, the optimal portfolio would change dramatically. In the commodity regime, the optimal portfolio resembles something close to the traditional 60-40 approach to asset allocation between stocks and bonds, with only a small allocation to gold of less than 1% recommended. In the real asset regime, which we believe is more likely in the short- to medium-term given the current state of inflation, government debt, and the government's budget deficit in the U.S., as shown in Exhibit 10 and discussed in relation to the regimes presented in Exhibit 4, the optimal portfolio shifts materially toward gold and bonds and away from equities. Should such a shift occur, the investing paradigm of the post-Great Recession world would be completely turned on its head, suggesting that our novel regime-based approach not only has implications for investors' gold allocation, but also strategic asset allocation more generally at a time when the likelihood of a material shift in the drivers of cross-asset returns is perhaps abnormally high.

CONCLUSION

Following the experience of 2022, many investors have rightly questioned the belief that gold is an effective diversifying asset to traditional equity and fixed income risk. After all, a zero real-return asset over the long-run that didn't hedge against one of the worst inflation experiences since the 1970s-1980s isn't exactly the most compelling proposition, especially now that U.S. short-duration fixed income yields over 5% for the first time since the pre-GFC period. Nonetheless, and given that this could be the result of one of the many regime "faces" of gold not yet having revealed themselves, we have laid out the case for continuing to hold gold in a strategic asset allocation. Our view is that gold can behave as a real asset, commodity, and/or a stable currency, properties highly desirable when investors most want them, and that it can provide tremendous convexity when there are unanticipated regime shifts between these three "faces". We showed that while investors underperformed what they would have fundamentally expected to receive from gold during the year 2022 using the same variables as our model of gold's regimes, there is still a place for a healthy allocation to gold in a strategic asset allocation plan based on evolving inflation dynamics, as well as the more recent trajectory of governments' fiscal positions. Should the conditions over the last 15 years since the Great Recession that favored financial assets like stocks and bonds – declining interest rates and low economic volatility, among others – shift onto a more unstable path, the probability that gold will exhibit its trademark tail risk hedging property increases. In such a scenario, the implications for investors' gold allocations, as well as their strategic asset allocations more broadly, would be tremendous.

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