Understanding Gold*

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ABSTRACT

Gold has a reputation as a safe-haven asset – useful in times of economic turmoil or inflation. However, perceptions can differ from reality. We examine gold's investment characteristics and assess its reliability as a hedging asset. We also explore why the gold price is so high today by detailing the financialization of gold as well as efforts by many countries to de-dollarize their economies. We theorize that new demand shocks, perhaps on the same scale as the introduction of gold ETFs, may loom on the horizon, driven by further de-dollarization or potential changes to Basel III regulations, which could allow commercial banks to hold gold for regulatory purposes as a high-quality liquid asset. While central banks hold gold as a major reserve asset, commercial banks currently cannot. This is a major inconsistency and may be due for correction. Finally, by applying the framework of Erb and Harvey (2013), we show that after reaching all-time highs, gold has historically had low or negative multi-year returns, an outcome that investors must weigh against gold's hedging ability, i.e., hedging assets have low expected returns, and the possibility of increased demand from institutional investors, commercial banks, and de-dollarizing countries.

Keywords: *Gold, golden constant, golden dilemma, real gold, overshoot, inflation, de-dollarization, ETF flows hedging, risk management, central banks, emerging markets, safe-haven asset.*

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- "The Golden Dilemma" *Financial Analysts Journal*, 2013:69:4, July-August, 10-42.
- "Gold and Bitcoin", SSRN

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Table of Contents

Introduction

Gold is the world's oldest financial asset. More than 2,500 years ago, in King Nebuchadnezzar's Babylon, an ounce of gold bought 350 loaves of bread. Based on gold's average price over the last year, that adds up to almost $8 per loaf, or about what an artisanal bakery would charge today.

In the Bible, Matthew 2:1–12 describe how the Three Wise Men bring gold, frankincense, and myrrh to the infant Jesus in Bethlehem. More than two millennia later, these gifts of the Magi have diverged in value. Frankincense and myrrh cost about $4.50 per ounce, while gold's price has climbed to more than $3,700.

Why did gold's nominal value soar relative to that of the other gifts? Was gold just lucky? Why is it so valuable?

Six characteristics help explain gold's unique position.

1. It is a soft metal that craftspeople can easily shape into jewelry and other adornments, and unlike silver or copper, it does not lose its luster.

2. Gold solved a trading problem. Original market exchange was decentralized and relied on the barter method. This was remarkably inefficient: It required an exact match of buyer and seller. If we had two pigs and wanted a cow, we would need to find someone who wanted two pigs and had a cow they were willing to trade away. By the time of Nebuchadnezzar, gold was a medium of exchange, and goods were bought with units of gold.

3. Gold provides a store of value. It does not spoil and is relatively durable.

4. Gold has other applications. Nearly half of gold production is used for jewelry, 7% or so for electronic equipment, among other industrial uses, and most of the remaining for investment purposes, which include central bank and individual holdings, in the form of bars, bullion, and coins, as well as exchange-traded funds (ETFs).

5. Gold is scarce and non-inflationary. While scarcity does not guarantee value, it is helpful given gold's other uses. How rare is gold? Melted down, the world's entire above-ground supply would fit in a cube 73-feet wide, by 73-feet long, by 73-feet deep. The roughly 216,000 metric tons mined to date are equivalent in volume to an Olympic-sized swimming pool.[1] New production is nominal – about 3,300 metric tons in 2024 – and augments the total supply by less than 2%.[2]

[1] See "Above-Ground Stock." World Gold Council, February 11, 2025. https://www.gold.org/goldhub/data/how-much-gold

[2] A metric ton equals 1,000 kilograms or 32,150.7 troy ounces. At 1.09714 ounces, a troy ounce is slightly heavier than a standard ounce. See U.S. Geological Survey. 2025. "Mineral Commodity Summaries 2025 (ver.1.2)." https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf

6. No single authority controls gold. It is a rare "global" unit of value. While individual governments can ban its export or make it illegal to hold, one country's actions may not impact gold's value and utility elsewhere.

Gold is especially valuable today. On March 17, 2025, its price exceeded $3,000-per ounce for the first time in history. Even adjusting for inflation, this represented an all-time high. Over the past 12 months, gold has soared by 35%.

How can we understand gold's recent price dynamics and develop a foundation for anticipating the future of gold? We will explore these questions in four parts. The first details the investment case for gold and introduces the concept of the golden constant. The next focuses on six potential drivers of gold's recent price increase. The third applies the golden constant framework to anticipate future price paths. Some concluding remarks are offered in the last section.

1. Why Invest in Gold?

A. Gold's Relationship with Inflation

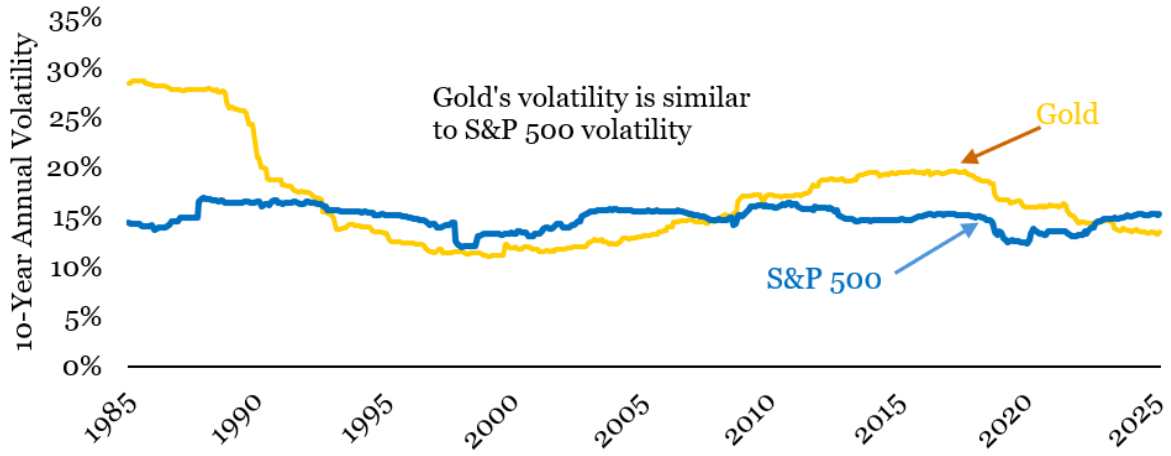
Gold has held its value over the last 2,500 years. Its purchasing power has not changed much. Erb and Harvey (2013) shared a historical example from Roman military payrolls. The annual salary of a Roman centurion in the reign of Augustus was 38.58 ounces of gold.[3] Based on gold's average price over the past year, that is about what a U.S. Army captain, major, or lieutenant colonel earns today.[4]

Gold's consistent purchasing power over the millennia led Roy Jastram (1977) to propose the "golden constant." For almost all assets, return has two components: compensation for inflation and real return. If gold has held its value, its price has moved with inflation. That implies that gold's real return has been zero and that gold has been a successful inflation hedge for the past 2,000-plus years.

Of course, no real-world investor has a 2,000-year horizon. Over shorter periods, gold can be an unreliable hedge for one simple reason: It is a volatile asset. **Exhibit 1** shows gold has about the same volatility as the S&P 500.

[3] See Erb and Harvey (2013). Centurions earned 3,750 denarii. One gold aureus equals 25 denarii. Based on historical coins, an aureus contains 7.85 grams of gold at 24-karat purity; a troy ounce contains 31.101 grams.
[4] See "U.S. Army: List of Ranks, Insignia, and Pay Range." FederalPay.org. https://www.federalpay.org/military/army/ranks

Exhibit 1
10-Year Volatility of Gold and the S&P 500
1985–2025



Notes: The S&P 500 is represented by a continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997; and Gold by Generic 1st Gold Futures (GC1 Comdty).
Sources: Research Affiliates and Bloomberg.

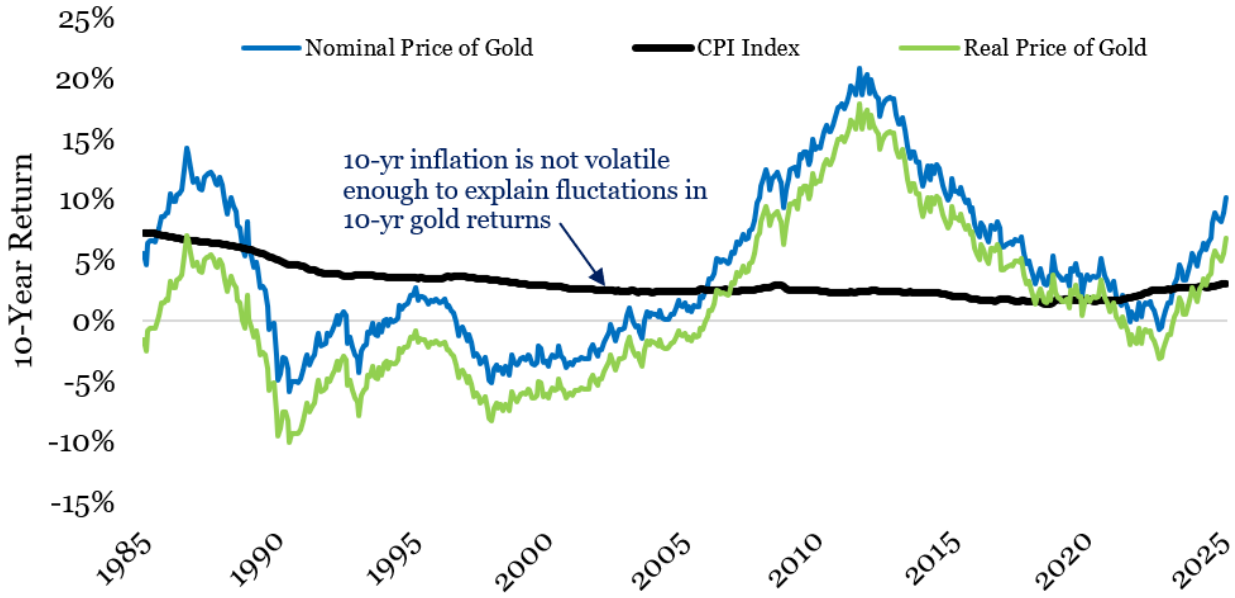
But inflation has far lower volatility than gold returns. According to our research, inflation has approximately 2% annualized volatility, while gold's is closer to 15%. **Exhibit 2** shows 10-year inflation as well as gold's 10-year nominal and real returns. The solid black line represents the Consumer Price Index (CPI) change over 10 years. The CPI has very low volatility in contrast to the wide swings in the price of gold. In the first 20 years of the sample, gold underperformed inflation – its price lagged the inflation rate – leading to negative real returns. Over the second 20 years, gold generally outperformed inflation.

This volatility mismatch essentially guarantees that gold will be an unreliable inflation hedge over short time spans. Yet since gold has held its value over the very long term, many expect it to retain its value over the short term. Our evidence suggests this extrapolation is a mistake.

Exhibit 2

10-Year Inflation Does Not Drive the 10-Year Real or Nominal Return on Gold

January 1975–March 2025

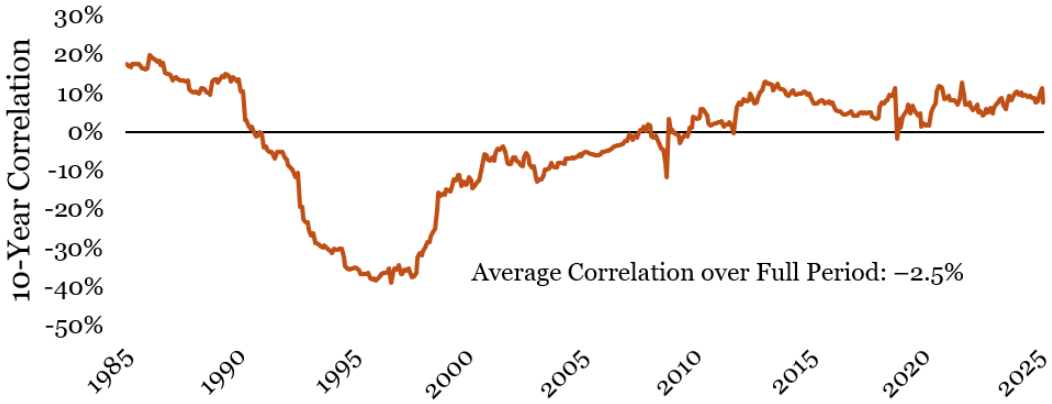


Notes: Exhibit 2 depicts the "real price of gold". More specifically it represents the "spot" price of gold adjusted for inflation. The exhibit shows the ratio of the month-end COMEX nearby gold futures contract divided by the month-end US CPI (GC1/CPI). Alternatively, the ratio could be derived by taking another measure of the month-end spot price of gold, represented by the spot gold price ticker XAU, and dividing XAU by the US CPI. There is usually little or no difference between XAU and GC1 prices as well as their respective real price of gold ratios. What slight differences that exist are usually driven by the time of day when the last daily GC1 and XAU prices are posted. Gold futures trading started in January 1975. Bloomberg provides an XAU time series stretching back to January 1921. Starting the depiction of the real price of gold in 1975 is a convenient way to focus on observing the real price of gold in an economic regime in which it has been legal for US citizens to own gold. From January 1975 to August 2025 the annualized geometric return of XAU was 6.28% and the annualized geometric return of GC1 was 6.29%. For many years the Goldman Sachs Commodity Index (GSCI) was the most referenced long-only commodity index. The GSCI was sold to Standard & Poor's in 2007. The Dow AIG commodity index was an alternative to the GSCI, and the Dow AIG commodity index became the Bloomberg Commodity Index in 2014. Gold is a constituent of the Bloomberg Commodity Index. The Bloomberg Commodity Index offers two different gold indices, two different ways of looking at the return of gold. Investment banks offer swaps to clients accessing these indices. First, there is BCOMGC. This provides a measure of price appreciation when rolling the nearby gold futures contract into the next nearby gold futures contract (as the expiration of the nearby gold futures contract approaches). From January 1975 to August 2025 the annualized geometric return of BCOMGC was 1.30%. Second, there is BCOMGCTR. This represents the total return from owning gold when accessed through this index. From January 1975 to August 2025 the annualized geometric return for BCOMGCTR was 5.86%. The difference between GCOMGC and GCOMGCTR, 5.86% - 1.30% = 4.56%, reflects a "collateral return". Think of BCOMGC as the return from "rolling" gold contracts from one period to another and BCOMGCTR as the return from "rolling" gold contracts from one period to another plus an interest rate return on the collateral that is needed to back the gold exposure gained through gold futures or swaps. XAU represents the spot price of gold and, if you can find someone to buy or sell gold at XAU, it is tradable. GC1 represents the spot price of gold because it is the nearby gold futures contract but GC1 itself is not tradable (both BCOMGC and BCOMGCTR are tradeable but not GC1). Years ago, when it was popular to market "portable alpha" strategies, the return from BCOMGC would be paired with a fixed income manager's short-term fixed income strategy so that it provided, hopefully, a return greater than BCOMGCTR.

B. Gold does have diversifying qualities.

While gold is roughly as volatile as the S&P 500, its volatility is not the same as risk. As just one asset in a broad portfolio, gold interacts with the other assets in that portfolio. **Exhibit 3** shows the correlation between monthly gold and S&P 500 returns.

Exhibit 3
10-Year Rolling Correlation of Monthly Gold and S&P 500 Returns
January 1975–March 2025



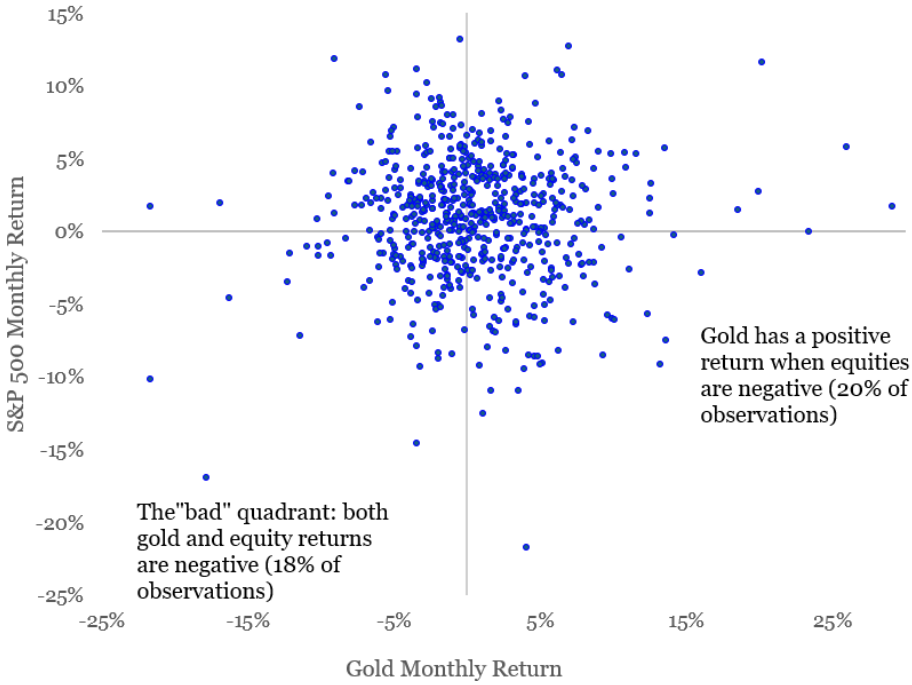
Notes: The S&P 500 is represented by continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997; and Gold by Generic 1st Gold Futures (GC1 Comdty).
Sources: Research Affiliates and Bloomberg.

For equity portfolios, gold has been a reliable diversifier, with a reasonably stable negative 0.025 correlation and a maximum correlation of 0.20. In the last 10 years, the correlation has fallen below 0.10. Adding gold to an equity portfolio reduces portfolio volatility.

Exhibit 4 shows gold's diversification capabilities in a different way and over a shorter, one-month horizon. The scatter of annual gold and S&P 500 returns has no upward or downward slope, so gold and the S&P 500 have about zero correlation.

As for gold's hedging ability, 18% of the observations fall into the "bad" quadrant, Quadrant 3, on the lower left, where both gold and the S&P 500 decline.

Exhibit 4
Annual Gold and S&P 500 Returns
January 1975-March 2025



Notes: The S&P 500 is represented by a continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997; and Gold by Generic 1st Gold Futures (GC1 Comdty).
Sources: Research Affiliates and Bloomberg.

C. Can Gold Serve as a Crisis Hedge?

In 1992, Eric Lawes was searching for a lost hammer with a metal detector in a field near Hoxne in Suffolk, England. His metal detector activated. Rather than his hammer, Lawes found one of the largest hoards of Roman gold and silver ever discovered. Nearly 15,000 coins as well as tableware, gold jewelry and household items were contained in an oak chest dating back to CE 407, when Roman rule in Britain was coming to an end.[5] As the Romans fled increasing Saxon raids near Suffolk, a Roman family buried the chest for insurance.

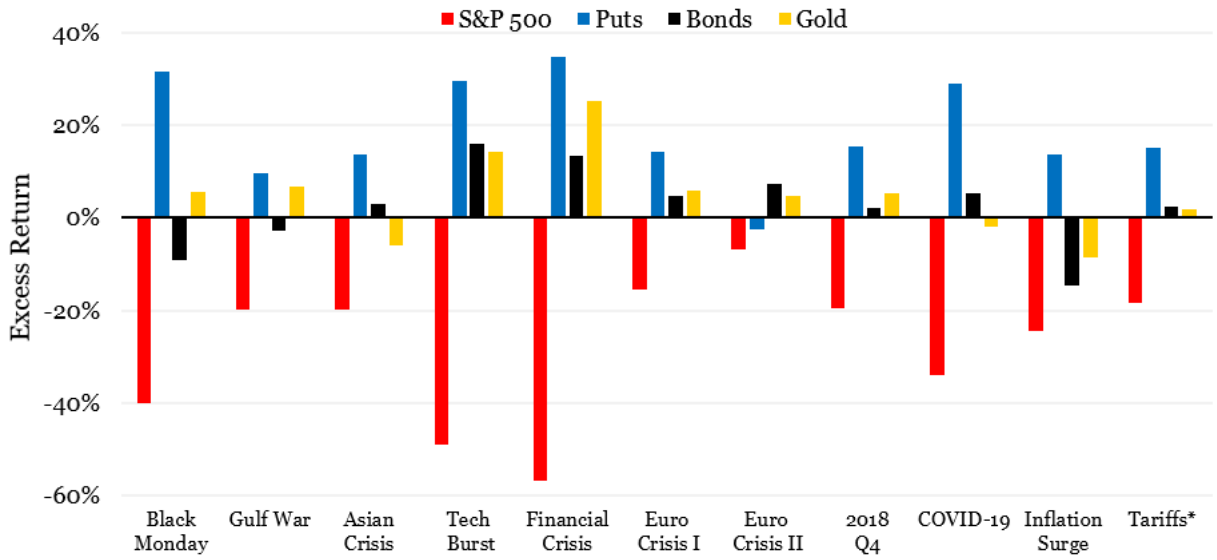
Unfortunately, the gold failed as a safe haven asset and remained buried for more than 1,500 years. As Marc Faber once said, "When Timur sacked Aleppo and Damascus in 1400, it didn't help to have your savings in gold. You lost your life and your gold."[6]

[5] See Grout, James. "Hoxne Hoard." *Encyclopaedia Romana*. https://penelope.uchicago.edu/encyclopaedia_romana/britannia/saxonadvent/hoxne.html
[6] See Ash, Adrian. "The Golden Constant." *BullionVault*, November 20, 2009. Also quoted from Faber's *Gloom, Boom & Doom Report*: "Gold has kept its purchasing power over the course of history . . . [but] the problem is that the owners of the gold changed over time." https://www.bullionvault.com/gold-news/gold_books/golden-constant-11202009

In the midst of a societal collapse or other systemic event, financial assets plunge in value and how the price of gold responds is not always clear.

But what about less severe crises, for example, equity market drawdowns? How does gold compare to long put options, long bonds, and other hedging strategies? We looked at gold's performance in 11 major stock market drawdowns relative to Treasury bonds and S&P 500 puts taken 5% out of the money. As **Exhibit 5** shows, the price of gold rose in eight of the 11 drawdowns and fell by less than the S&P 500 in the three others. Gold did provide some diversification benefit and could be a valuable hedge against current stock market volatility.

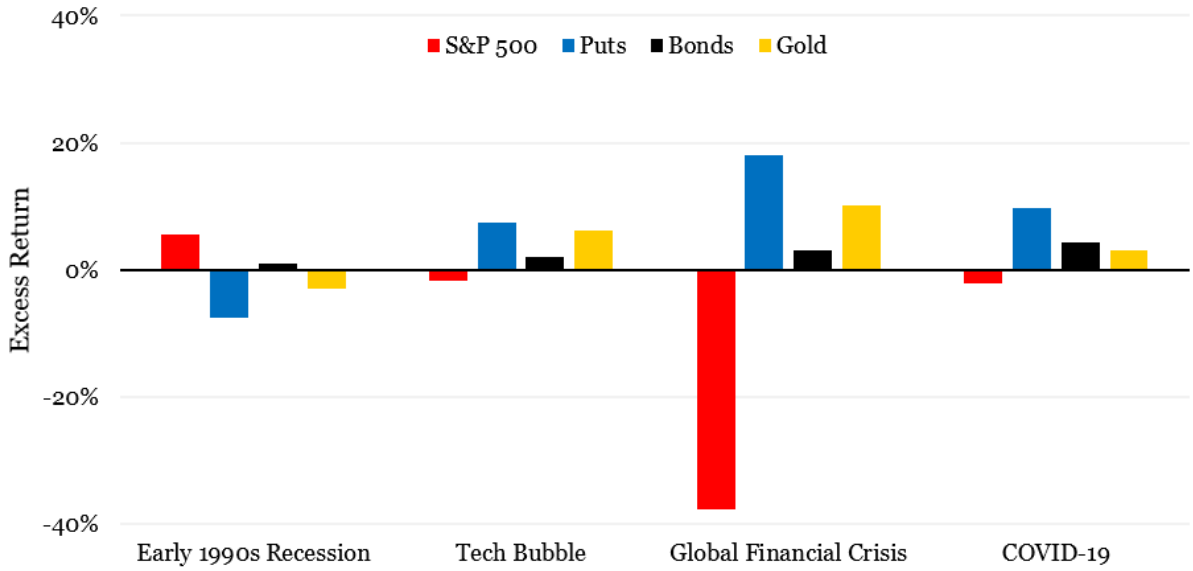
Exhibit 5
Gold's Total Performance in 11 Major Stock Market Drawdowns
January 1975–April 2025



Notes: Total return is presented for each drawdown's full duration. The S&P 500 is represented by continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997; Puts by the inverse of the CBOE S&P 500 PutWrite Index; Bonds by 10-Year U.S. Treasury Futures (TY1 Comdty); and Gold by Generic 1st Gold Futures (GC1 Comdty). Figures reflect market peaks to troughs. The dates for the first eight drawdowns follow Harvey et al. (2019). The last three drawdown dates are: COVID-19: February 19 to March 23, 2020; Inflation Surge: January 3 to October 12, 2022; and Tariffs: February 19 to April 8, 2025.
Sources: Research Affiliates and Bloomberg.

Recessions show a similar pattern. In three of the four recessions between 1975 and April 2025, when the S&P 500 declined, gold returns were positive. In the 1990-to-1991 recession, when the S&P 500 rose, gold registered a small decline. This is consistent with its low or negative correlation to stocks.

Exhibit 6
Gold's Total Performance in Recessions
January 1975–April 2025

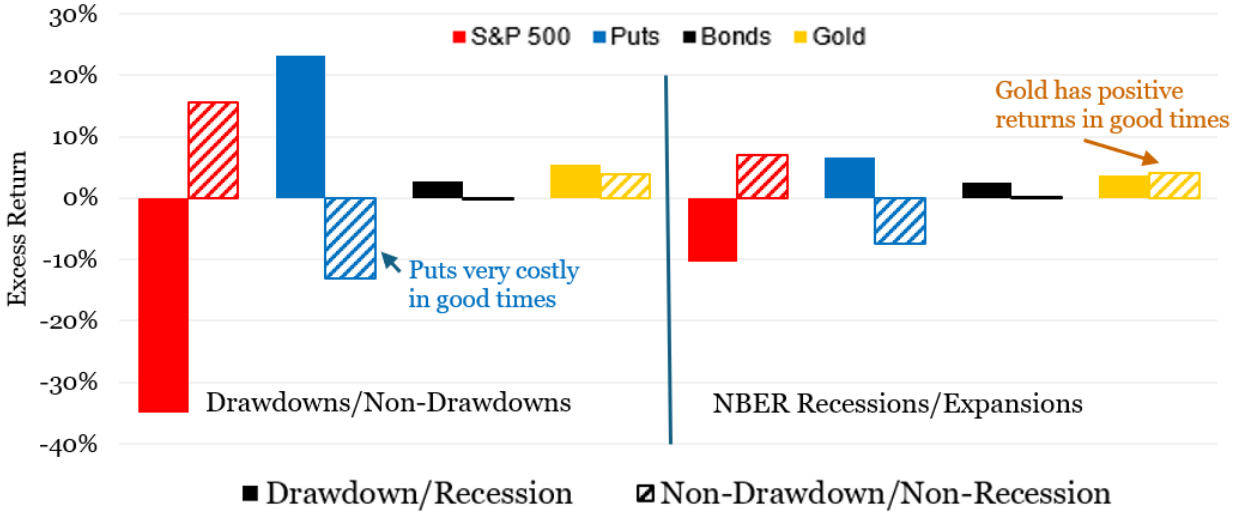


Notes: Total return is presented for each drawdown's full duration. The S&P 500 is represented by continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997, Puts are represented by the inverse of the CBOE S&P 500 PutWrite Index, Long Bonds by 10-Year U.S. Treasury Futures (TY1 Comdty), and Long Gold by Generic 1st Gold Futures (GC1 Comdty). Futures returns are in excess returns form. Recessions are as defined by NBER. Early 1990s Recession: July 1990 to March 1991; Tech Bubble: March 2021 to November 2021; Global Financial Crisis: December 2007 to June 2009; COVID-19: February 2020 to April 2020.
Sources: Research Affiliates and Bloomberg.

Of course, hedging isn't free. A security's value as a hedge must always be weighed against its price. As **Exhibit 5** and **Exhibit 6** show, long puts always work. But they always work for a reason – they are very costly to implement.

The hashed lines in **Exhibit 7** show the average annualized return in non-drawdowns and economic recoveries. The put option strategy is quite expensive and constitutes at least a 10% drag on performance when implemented monthly.

Exhibit 7
Annualized Performance in Good and Bad Times
January 1975–April 2025



Notes: The S&P 500 is represented by continuous full-sized S&P 500 futures contract (SP1 Comdty) switching to the more liquid S&P 500 E-mini futures (ES1 Index) as of September 1997, Puts are represented by the inverse of the CBOE S&P 500 PutWrite Index; Long Bonds by 10-Year U.S. Treasury Futures (TY1 Comdty); and Long Gold by Generic 1st Gold Futures (GC1 Comdty). Futures returns are in excess returns form. Major S&P 500 drawdowns are from peak to trough. Recessions are as defined by NBER. Dates for first eight drawdowns follow Harvey et al. (2019). The last three drawdown dates are: COVID-19: February 19 to March 23, 2020; Inflation: January 3 to October 12, 2022; and Tariffs: February 19 to April 8, 2025.
Sources: Research Affiliates and Bloomberg.

With its low and stable correlation with equity markets, gold has proven its value as a hedging asset. But the price of gold has surged recently to all-time highs. What forces are driving gold's current ascent? What are the implications for the future?

2.Why Is the Gold Price High?

A. Gold Supply and Demand Dynamics

The gold supply is very static. To produce more, we have to mine or recycle it. **Exhibit 8** shows, over the past 10 years, annual production has increased 12%. On a yearly basis, gold mining adds about 1% to the gold supply even as gold has doubled in value over those 10 years.

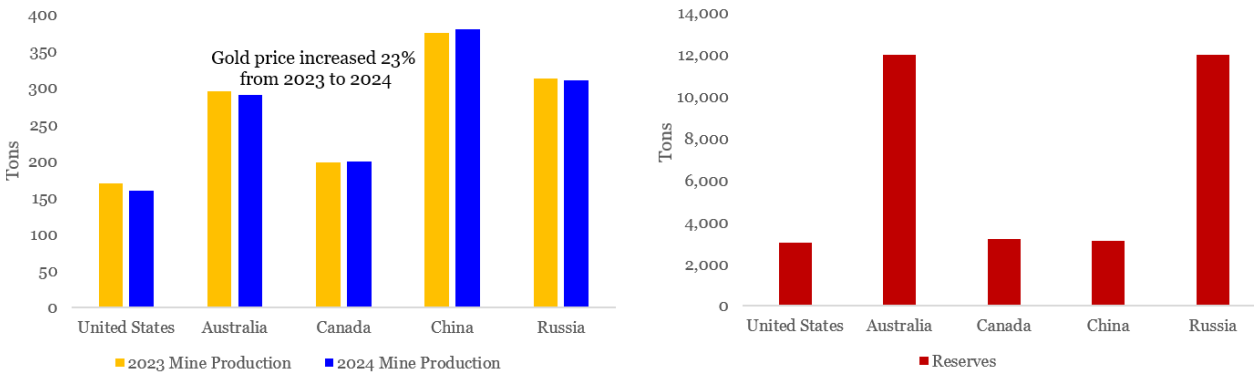
This supply stickiness is a function of how difficult gold is to mine, which also helps explain gold's volatility. For most other goods, production can be ramped up in response to rising demand. But gold production doesn't work like that. Opening a new mine or restarting an old one can take years. Recycling also doesn't move the supply needle by much. **Exhibit 8** shows that the amount of recycled gold plays a much smaller role than mining. As such, changes in demand can have an oversized impact on prices.

Exhibit 8
Gold Supply
2010–2024

Source: World Gold Council.

Many countries mine gold. **Exhibit 9** shows the world leaders and their production in 2023 and 2024. The big five – the U.S., Australia, Canada, China, and Russia – combined account for 41% of world gold mine production and 52% of global reserves. (China, the largest producer, represented only 11.5% of total gold mining production in 2024. In contrast, that same year, it produced 69.2% of rare earths.[7]) While the price of gold rose by 23% in 2024, big five production fell by 1%, and global production increased by less than 2%.

Exhibit 9
Gold Mine Production and Reserves
2023–2024



Source: U.S. Geological Survey. 2025. "Mineral Commodity Summaries 2025 (ver.1.2)."

[7] The U.S. Geological Survey footnotes that China's mine production of 270,000 tons of rare earths is based on "production quota: does not include undocumented production," and observes that China has close to 50% of the world's reserves.

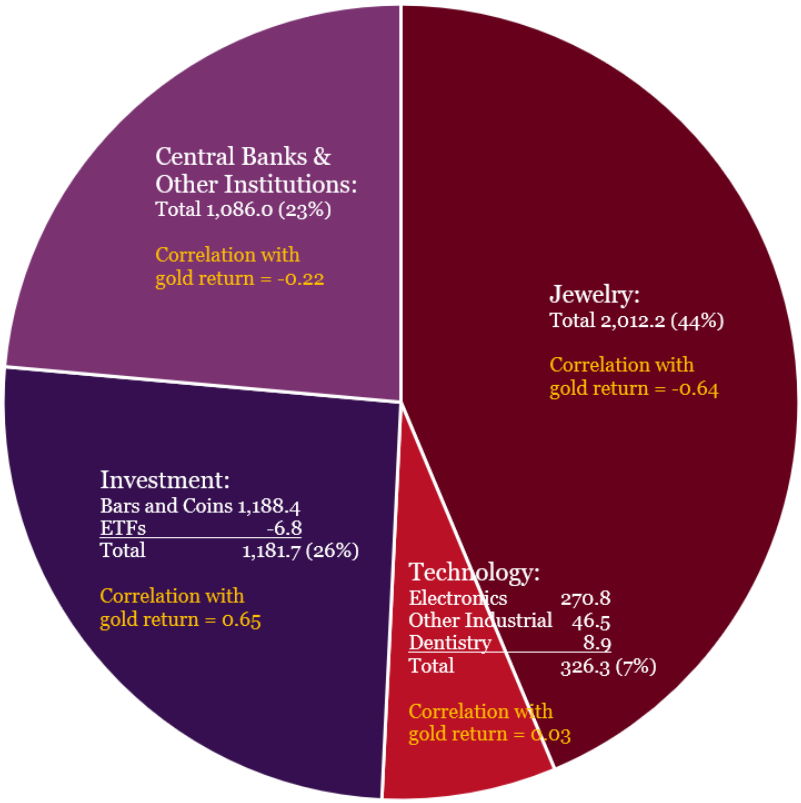
Outside the big five, mining production is globally diversified. The 12 next-largest gold producers account for over one-third of mining production. Seven of these mine more than 100 tons per year. All other countries account for about one quarter of gold production.

Demand for gold comes from four principal sources, as detailed in **Exhibit 10**. In 2024, jewelry accounted for 44%, investment for 26%, central banks and other institutional buyers for 23%, and technology for the remaining 7%.

Unlike gold supply, gold demand is not so fixed. Certain demand categories are very sensitive to price changes. For example, when gold prices surged in the first quarter of 2025, jewelry-related demand dropped to only 33%. Based on quarterly data from 2010 through the first quarter of 2025, jewelry demand has a strong negative correlation – 0.64 – with gold price changes. As gold becomes more expensive, consumers buy less gold jewelry.

The investment category, in contrast, shows a strong positive correlation. Investment contributed negatively to overall demand in 2024 but represented 17% of total demand in the first quarter of 2025. Gold has two investment categories: coins and gold bars and ETFs. The former has a negative 0.25 correlation with prices and thus behaves more like jewelry. However, ETF demand has a strong positive correlation with gold returns, about 0.71. This suggests that ETF investors are price chasers, buying more gold the more expensive it gets.

Exhibit 10
Gold Demand in 2024
Correlations Based on 2010–2024



Source: Correlations estimated with World Gold Council data.

Demand from central banks and other institutions has a negative 0.23 correlation with gold price changes. Such entities tend to buy less when prices go up. Technology-related demand, however, shows no sensitivity to price changes.

As gold prices increase, the two largest demand categories – jewelry and investment – offset each other. As jewelry demand falls, ETF demand rises. But correlations do not take the level of demand into account. For example, the gold ETF demand surge in the first quarter of 2025 was much larger than the decline in jewelry demand.

B. The Financialization of Gold

Gold is not an easy asset to hold for various reasons. It is much heavier and harder to transport than paper money. **Exhibit 11** shows that at current market prices, $5-million worth of gold weighs more than 100 pounds.

Exhibit 11

Weight of Gold

Price of Gold

Dollar Amount	$2,000	$2,200	$2,400	$2,600	$2,800	$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	Pounds of Gold
$1,000,000	34	31	29	26	25	23	21	20	19	18	17	
$2,000,000	69	62	57	53	49	46	43	40	38	36	34	
$3,000,000	103	94	86	79	74	69	64	61	57	54	51	
$4,000,000	137	125	114	106	98	92	86	81	76	72	69	
$5,000,000	172	156	143	132	123	114	107	101	95	90	86	
$6,000,000	206	187	172	158	147	137	129	121	114	108	103	
$7,000,000	240	218	200	185	172	160	150	141	134	126	120	
$8,000,000	275	250	229	211	196	183	172	162	153	145	137	
$9,000,000	309	281	257	238	221	206	193	182	172	163	154	
$10,000,000	343	312	286	264	245	229	215	202	191	181	172	

More seriously, given its value, physical gold must be kept secured. That can be costly. Moving and storing it carries risks.

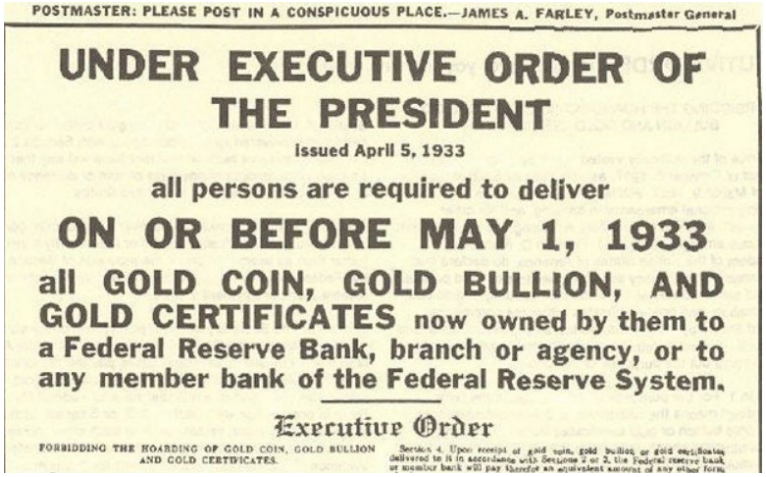
Physical gold has another liability: market illiquidity. Anyone with the money can buy a gold bar at Costco. But selling that gold bar requires finding a buyer. Gold dealers may be plentiful online, but their typical spread on buying and selling is 5% to 8%.[8] With a spot price of $3,000 for an ounce of gold, an 8% haircut trims it to $2,760.

Financial Exposure

For more than 40 years, from 1933 to 1975, U.S. citizens could not legally hold physical gold. On April 5, 1933, President Franklin Roosevelt signed Executive Order 6102 (see **Exhibit 12**), which banned the possession of gold coin, bullion, and gold certificates and gave those who had any four weeks to turn it in.

Exhibit 12

Executive Order 6102



POSTMASTER: PLEASE POST IN A CONSPICUOUS PLACE.—JAMES A. FARLEY, Postmaster General

UNDER EXECUTIVE ORDER OF THE PRESIDENT

Issued April 5, 1933

all persons are required to deliver

ON OR BEFORE MAY 1, 1933

all GOLD COIN, GOLD BULLION, AND GOLD CERTIFICATES now owned by them to a Federal Reserve Bank, branch or agency, or to any member bank of the Federal Reserve System.

Executive Order

FORBIDDING THE HOARDING OF GOLD COIN, GOLD BULLION AND GOLD CERTIFICATES.

[8] See Chussler, Jordan. "Buyer Beware: Costco Gold Is Easier to Purchase Than Sell." *Money*, May 7, 2024. The range is 2%–20% with typical spreads in the 5%–8% range. Some cities have physical gold retailers that may offer lower spreads. https://money.com/how-to-sell-gold-costco-bars/

This executive order was extraordinary. Treasury Secretary William H. Woodin, an avid coin collector, had language inserted to exclude "gold coins having recognized special value to collectors of rare and unusual coins." People caught holding gold after the deadline could be subject to a $10,000 fine, or $250,000 in today's dollars, up to 10 years in prison, or both.

For the next 40 years or so, the only way for U.S. investors to gain exposure to gold was through the stock market, specifically gold mining companies. These stocks generally move with the gold price, albeit imperfectly. For example, mining firms tend to rely on leverage, so if gold prices fall far enough, they could go bankrupt. Exploration projects are also expensive and prone to failure. Investors in gold mining firms not only gain exposure to gold but also to all the associated risks of mining it, from bad management to bad luck. Physical gold is a much more effective investment than gold mining stocks.

FDR's executive order was repealed in the 1970s. On January 1, 1975, Americans could once again hold physical gold. The day before, the New York Commodity Exchange (COMEX) opened the first futures contract (for 100 troy ounces). Today, COMEX is owned by the Chicago Mercantile Exchange or CME, the dominant futures trading hub, and trades an average 840 tons of gold daily. At $85 billion, this represents close to 58% of global volume.[9] The Shanghai Futures Exchange (SHFE), the second largest trading hub, has 1-kilogram contracts and an average daily trading volume of $12 billion. Exchanges in India, Japan, and Dubai account for about $10 billion in average daily volume (see **Exhibit 13**).

Exhibit 13
Leading Gold Futures Exchanges

Rank	Exchange	Contract size	ADV (contracts)	ADV (ounces equiv.)	ADV (US $ bn)	Share of global futures turnover*
1	CME Group-COMEX (GC, MGC)	100 oz; 10 oz	≈ 275,000	≈ 27 million oz	≈ 85 bn	~58 %
2	Shanghai Futures Ex.	1 kg	≈ 120,000	≈ 3.9 million oz	≈ 12 bn	~8 %
3	MCX India	1 kg; 100 g	≈ 55,000	≈ 1.8 million oz	≈ 5.5 bn	~4 %
4	JPX-Osaka/TOCOM	1 kg; 100 g	≈ 17,000	≈ 0.55 million oz	≈ 1.7 bn	~1 %
5	Dubai Gold & Commodities Ex.	100 oz; 1 kg	≈ 9,000	≈ 0.9 million oz	≈ 2.9 bn	< 1 %
6	ICE Futures US	100 oz	≈ 1,000	≈ 0.1 million oz	≈ 0.3 bn	negligible
7	SGX	1 kg (physical)	< 200	< 0.01 million oz	≈ 0.03 bn	negligible
8	Bursa Malaysia (BMD)	100 g	< 100	< 0.003 million oz	≈ 0.01 bn	negligible
—	Other listed venues (Borsa Istanbul, Thailand FEX, KRX, etc.)	various	—	—	—	< 1 % combined

*Global share is calculated against total exchange-traded gold futures ADV of ≈ US $147 bn; OTC forwards/swaps and ETF shares are excluded.

While gold was first financialized through futures contracts, this approach had some disadvantages. The contracts needed to be continually rolled over. Also, futures trading was not widely available to retail investors, and even among institutional investors, many mandates prohibited the use of futures contracts and other derivatives.

Introduction of ETFs

On November 18, 2004, the first gold-backed ETF, SPDR Gold Shares, or GLD, was launched and gold became completely financialized. A joint venture between State Street Global Advisors and the World Gold Council, GLD crossed $1 billion in assets after three days, making it the

[9] See CME Group, "Gold: Futures and Options."
https://www.cmegroup.com/markets/metals/precious/gold.html

fastest-growing ETF in history at the time.[10] Structured as a trust, GLD holds physical gold bullion in bank vaults, with shares representing fractional ownership of that gold. Each GLD share equals about one-tenth of an ounce of gold held in trust. The fund's custodian – HSBC in London – secures the gold bars, while a trustee, the Bank of New York Mellon, oversees the trust's assets. GLD's annual fee is 40 basis points (bps).

Competitors quickly followed GLD's debut. BlackRock's iShares Gold Trust, IAU, launched in January 2005 with a slightly smaller share size and eventually a lower 25-basis point fee. State Street itself introduced SPDR Gold MiniShares, GLDM, in 2018 with 10 bps in annual fees. GLD's current has about $100 billion in assets under management (AUM). IAU has approximately $50 billion.[11] Total North American gold ETFs have almost $200 billion, and ETFs outside the U.S. account for another $175 billion in gold. In total, global ETFs hold close to 3,560 tons, which is more than a year's worth of total world production.[12]

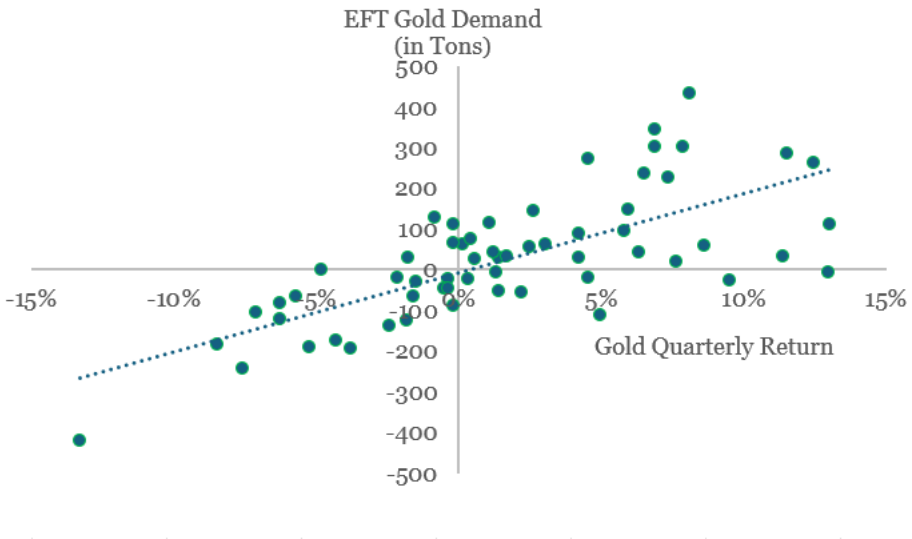
The rapid growth of gold ETFs reflects the market's long-suppressed demand. There was always a pre-existing appetite for gold, but institutional constraints prevented investors from owning it. The ETFs provided a new conduit between the financial and physical markets that transformed gold into a highly liquid asset and appealed to a wide array of investors. Pension funds, endowments, and retail investors now buy an ETF ticket rather than lease vault space. Gold ETFs also helped expand the broader commodity-ETF complex. Silver ETFs launched in 2006, and platinum, palladium, and other precious metal ETFs soon followed. Gold ETFs also inspired "asset-wrapped" products like bitcoin ETFs.

The demand curve for gold ETFs slopes upward, indicating higher price and higher demand. **Exhibit 14** shows that the return on gold accounts for more than half of the variation in ETF flows. In economics, positively sloped demand curves are associated with Giffen goods and Veblen goods. A Giffen good is often a staple, like bread or rice. When prices rise on Giffen goods, consumers cut back on luxury goods to continue buying the staple. Gold is not a Giffen good. Veblen goods are status goods, luxury items, like expensive handbags or watches. Demand for them increases as the price rises. Gold is not a Veblen good.

The variation in ETF demand likely has two causes. One is momentum investing. Investors see the price going up and assume it will maintain that trajectory, or they simply suffer from fear of missing out (FOMO) on the price rally. Gold has another appeal to investors, as a security of last resort. The price of gold often rises in uncertain times. Investors are not buying gold because the price is high but because their portfolio needs a hedging asset. In stressful periods, hedging costs increase and gold's price reflects that.

[10] Remarkably, in 2011, GLD briefly overtook the popular SPDR S&P 500 (SPY) ETF.
[11] See ETF.com. "GLD vs. IAU." https://www.etf.com/tools/etf-comparison/GLD-vs-IAU
[12] Based on World Gold Council data as of April 30, 2025. https://www.gold.org/goldhub/data/global-gold-backed-etf-holdings-and-flows.

Exhibit 14
Gold ETF Demand Sensitivity
2010–2024



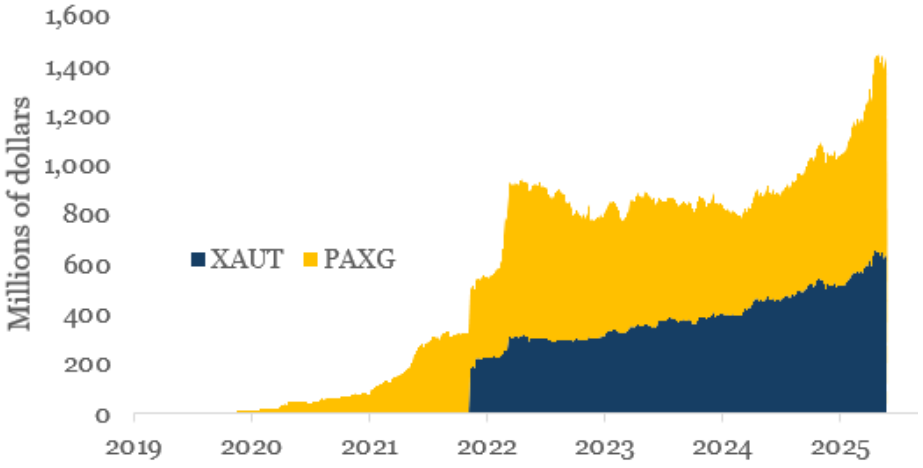
Source: Correlations estimated with data from World Gold Council.

Investors today can gain exposure to gold in other ways. Decentralized technologies, in particular, have opened up new avenues for gold financialization. Stablecoins, or tokens linked to specific collateral, are the most successful of these. Bypassing the traditional banking system, they can be transferred anywhere in the world in seconds for a fixed fee as low as one cent. The total stablecoin supply is $235 billion as of this writing, and most stablecoins are linked to the U.S. dollar. In 2024, stablecoin transactions exceeded $13 trillion – more than Visa.[13]

The two main gold-backed stablecoins are Paxo's PAXG and Tether's XAUt (see **Exhibit 15**). Relative to their fiat-backed peers, gold-backed stablecoins are only a small share of the total stablecoin supply, but the rate of growth in their trading volume is substantial. PAXG's dollar trading volume increased sevenfold and XAUt's threefold over the last year. Unlike gold ETF owners, holders can make actual purchases with their stablecoins.

[13] Hougan, Matt., et al. "Crypto Market Review (Q1 25)." Bitwise, April 16, 2025. https://s3.us-east-1.amazonaws.com/static.bitwiseinvestments.com/Research/Bitwise-Crypto-Market-Review-Q1-2025.pdf

Exhibit 15
Gold-Backed Stablecoins
2019–2025



Notes: Data through May 2025. Graphic features the two leading gold-backed stablecoins: Paxo's PAXG and Tether's XAUT.
Source: RWA.xyz.

Stablecoin owners can also participate in staking. In the staking process, an investor deposits a token in a protocol and then helps validate transactions. If the investor approves a valid transaction, they earn a fee. If they approve invalid transactions, their stake is "slashed." This helps ensure they are good actors.

With stablecoins, investors can pool their tokens and issue loans like a bank. At a typical bank, customers deposit their money, the bank makes commercial and personal loans, and the bank pays interest to the customers from the revenue generated. Stablecoin investors deposit their tokens in a protocol rather than a bank and collect their interest.

Investors can also earn some yield on gold ETF shares by lending them out to short sellers. The borrow rate fluctuates but is usually in the 0.5%-to-1% range, and the fee is split with the broker.[14]

There are a few caveats: GLD charges investors an annual fee of 0.4%. Stablecoins have no expense ratio. Unlike other equity ETFs, gold ETFs cannot lend out their gold to reduce the expense ratio.

Financialization and Gold Prices

Exhibit 14 shows a close relationship between gold ETF flows and gold returns and could be easily reversed: Do ETF flows impact the price of gold? Correlation may not imply causality, but it does warrant a closer look.

[14] See Fintel for GLD borrow rates. https://fintel.io/ss/us/gld

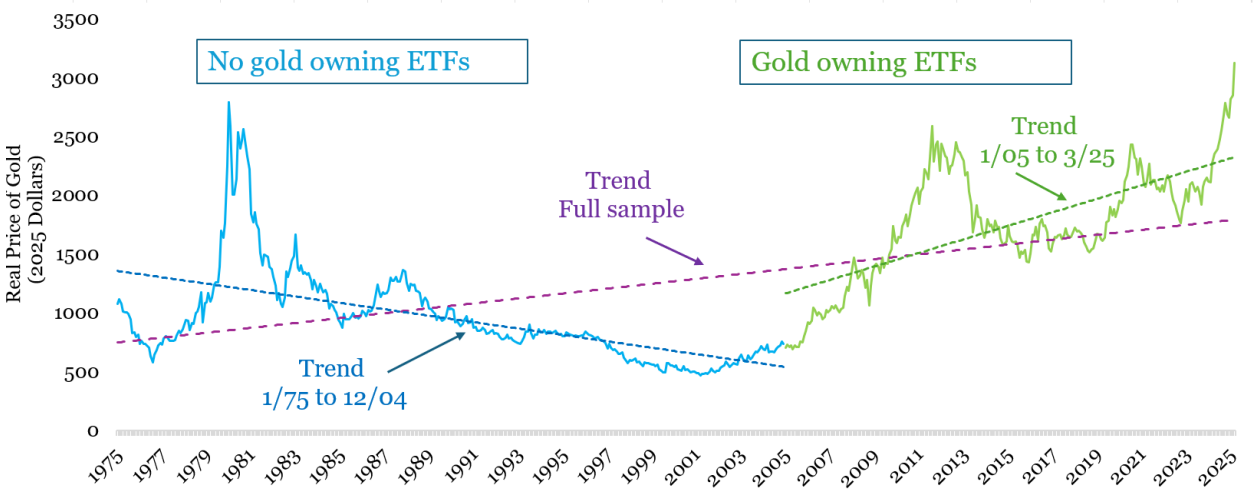
Exhibit 16 provides the "golden constant" framework. The real price of gold – the blue line – should be constant through time. When the price exceeds – or falls below – the average real price, we should expect mean reversion.

But could the introduction of gold ETFs in 2004 have led to a structural change? Did demand permanently increase as the institutional constraints on owning gold disappeared?

The reverse case is analogous to a short-selling ban on equities. Those with negative information about a company are prohibited from acting on it. The buyers are dominated by those with positive information and the asset's price therefore goes higher than in the unconstrained case. Eliminating the ban negatively impacts prices just as eliminating the frictions to owning gold for those who wanted but previously could not may positively impact prices.

Exhibit 16 performs a simple trend analysis on the pre- and post-gold-ETF era. The trend is flat or negative in the pre-gold-ETF era and positive in the post-gold-ETF era, even omitting the past two years.

Exhibit 16
Gold ETFs and Trends in the Real Gold Price
1975–2025



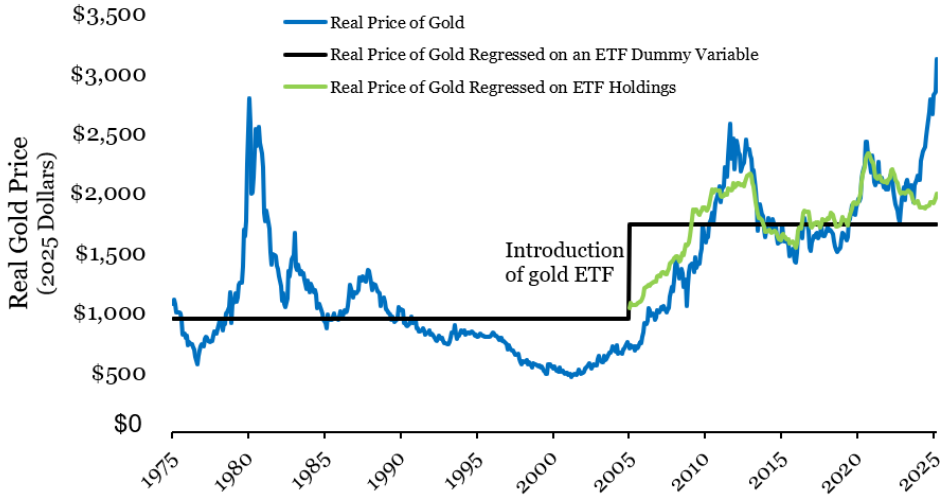
Notes: The real price of gold is the nominal price divided by the CPI's level.
Sources: Bloomberg. Gold (GC1) and CPI (CPI Index).

The analysis in **Exhibit 17** goes deeper. First, we regress the real gold price (in 2025 dollars) on an indicator variable that activates in 2004 when GLD was introduced. The variable is significant, suggesting that the mean real price of gold (in black) from 1975 to 2003 was lower than the mean real price in the post-gold-ETF era from 2004 to 2025.

The second exercise is more convincing. It regresses the real price of gold on ETF holdings, with the fitted values from that regression covering the 2004-to-2025 period. The green curve reflects the predicted gold price based on ETF holdings. The real and predicted price of gold have a very close correlation up to the last year of data and a divergence based on ETF holdings in 2024 and 2025. This analysis indicates that:

1. The financialization of gold led to a permanently higher price.
2. The story is more complex given the recent divergence.

Exhibit 17
Have Gold ETFs Increased the Real Gold Price?
1975–2025



Notes: The real price of gold is the nominal price divided by the CPI index level. ETFs are GLD and IAU.
Sources: Research Affiliates and Bloomberg. Gold (GC1) and CPI (CPI Index).

C. The Weaponization of the U.S. dollar

As **Exhibit 17** shows, ETF flows are an important part of the story but not the whole story. The correlation between the real price of gold and gold ETF flows is a remarkable 0.83 over the whole sample, but a divergence emerges since 2023. From 2004 to 2022, the correlation is 0.92. From 2023 to 2025, the correlation vanishes and, indeed, turns negative.[15]

For part of that period, gold ETFs were being redeemed while the price of gold was rising. One possible explanation relates to the weaponization of the U.S. dollar in geopolitical conflicts, which is part of a larger issue regarding the dollar's global reserve status.

Economic sanctions have long been a tool of U.S. foreign policy. Over the past 50 years, the U.S. has targeted Iran (1980, hostage crisis), South Africa (1986, Apartheid), Libya (1986, terrorism), Iraq (1990, Gulf War and Saddam Hussein); and North Korea, among others. Such sanctions mostly apply to companies and people. However, in 2012, new sanctions cut Iran off from the SWIFT messaging system, which enables bank-to-bank transfers. This effectively eliminated Iran's ability to conduct international transactions in almost every currency.

Iran is a sizeable country, but it is not a world power. Russia is both a huge country and a world power. After Russia invaded the Crimea in 2014, the U.S. imposed sanctions on various Russian and Crimean officials, oligarchs, banks, and oil companies. The U.S. also made it illegal to do

[15] The regression R^2 drops from 88% in the early period to a statistically insignificant 7% in the later period with a negative coefficient.

business with Crimean companies, though not all Russian firms, and targeted Russian banks and oil companies by limiting long-term financing.[16]

After Russia invaded Ukraine in 2022, the U.S. imposed even further sanctions, removing Russia from the SWIFT system and freezing the assets of Russia's central bank, the CBR, in the U.S. and the EU (see **Exhibit 18**). Russia's access to dollars through its gold holdings was also cut off, which effectively trapped $130 billion in gold reserves. This forced a default on Russian bonds denominated in U.S. dollars. Russia had the money to pay the interest, but the U.S. Treasury made it illegal to receive those payments.

Russian equities were also affected. Most investment funds wrote down the value of their Russian equity holdings to zero since they could not receive proceeds from the sale of those assets.

These sanctions had an impact beyond their dollar value. The U.S. was not targeting an isolated rogue nation but a great power. Of course, with one-fourteenth the GDP of the U.S., Russia may not quite have qualified as an economic giant, but China does meet the criteria and its leaders took note. If Russia was vulnerable to such dollar weaponization, China was too.[17]

[16] See Executive Orders 13660, 13661, and 13662.

[17] According to the IMF's *World Economic Outlook* (April 2025), the U.S. has a GDP of $30.5 trillion , while China has $19.2 trillion, Canada $2.2 trillion, and Russia $2.1 trillion. On a purchasing power parity basis, China has $40.7 trillion, the U.S. $30.5 trillion, Russia $7.1 trillion, and Canada $2.7 trillion.

Exhibit 18
Post-2022 Invasion Sanctions on Russia

Date	Sanction Action	Targeted Entities	Impact on USD	Source
Feb 24 2022	Correspondent banking cutoff for Sberbank; Specially Designated National (SDN) asset freeze on VTB, Otkritie, Sovcombank, Novikombank	Sberbank; VTB; other major banks	Disrupted ~80 % of Russia's daily FX (mostly USD); froze U.S. assets	Treasury Press Release, Feb 24 2022, "Treasury Sanctions Russia's Two Largest Banks and Imposes Severe Limitations on the Russian Economy."
Feb 26 – 28 2022	Removal of key banks from SWIFT; Central Bank asset freeze (Directive 4)	Selected banks; Central Bank of Russia	Blocked cross-border USD transfers; immobilized ~$300 bn in reserves	Joint Statement, Feb 26 2022, announcing SWIFT removal; OFAC Directive 4, Feb 28 2022, targeting the Central Bank of Russia.
Mar 11 2022	EO 14068: Ban on export of U.S. dollar banknotes to Russia	Russian govt; persons in Russia	Prevented replenishment of dollar cash holdings	Executive Order 14068, Mar 11 2022, "Prohibiting Certain Imports, Exports, and New Investment with Respect to Continued Russian Federation Aggression."
Mar 24 2022	OFAC FAQ 1029: Sanctioning gold transactions with CBR	Central Bank of Russia's gold holdings	Stopped gold-for-dollar swaps; trapped ~$130 bn in gold reserves	OFAC FAQ 1029, Mar 24 2022, clarifying sanctions on transactions involving the Central Bank of Russia's gold reserves.
Apr 6 2022	Full SDN block on Sberbank & Alfa-Bank	Sberbank; Alfa-Bank	Eliminated residual U.S. dollar clearing for >50 % of banking assets	Treasury Press Release, Apr 6 2022, "Treasury Escalates Sanctions on Russia's Financial Sector by Targeting Sberbank and Alfa-Bank."
May 25 2022	Expiration of debt-payment license (Russia sovereign bonds)	Russia sovereign bond payments	Forced historic default on USD bonds	Treasury Statement, May 25 2022, on the expiration of the Russia sovereign bond payment license (General License 9C).
Jun 28 2022	Ban on imports of Russian gold	Russian gold exporters	Cut off major non-energy dollar revenue stream	Treasury Press Release, Jun 28 2022, implementing the G7 ban on imports of Russian-origin gold.
2022 – 2023	Secondary & follow-up sanctions; REPO asset seizures	Remaining banks; oligarch proxies	Closed final loopholes; maintained dollar isolation	U.S. Treasury & DOJ REPO Task Force statements (2022–2023) on seizure of sanctioned Russian assets.

The U.S. dollar is the global reserve currency and gives the U.S. the ability to take punitive action against any country – for any reason. China has geopolitical ambitions and should China act on them, the U.S. could impose sanctions similar to those imposed on Russia.

But the stakes for China are much higher than they are for Russia. More than one-fifth of China's GDP is driven by exports. Thus, as a matter of sovereign risk management, China should consider easing its dependence on the U.S. dollar. The Chinese renminbi cannot yet replace the dollar as a reserve currency, but China can reduce its risk exposure to the U.S. dollar by increasing confidence in the yuan.[18]

[18] Renminbi refers to the currency in general as Sterling does in the UK. The unit of account is the yuan (like the pound).

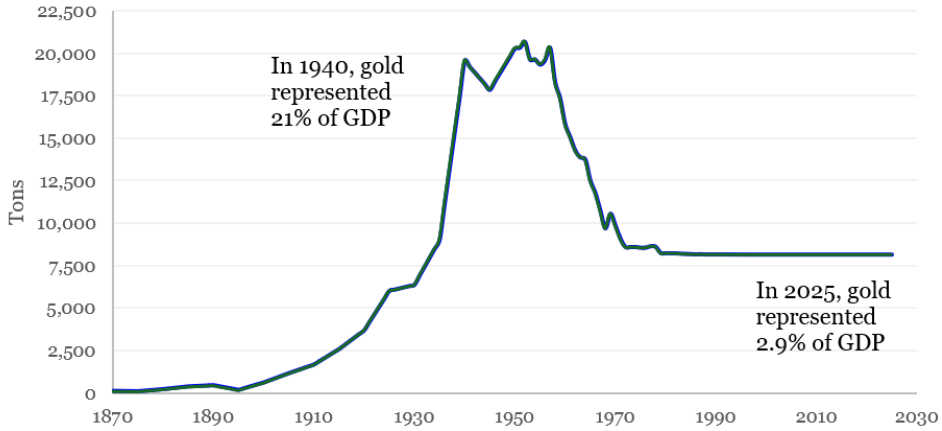
One way to do that is to add safe assets to its official reserves. As the global reserve currency, the dollar tends to be the standard safe asset, but in China's case, if the goal is to de-dollarize, gold is the logical alternative.

D. Central Bank and China Accumulation

The U.S. holds the most gold in the world. **Exhibit 19** shows the U.S. gold reserves from 1870 to the present. U.S. gold holdings soared in the mid-1930s with Executive Order 6102 and represented almost 21% of U.S. GDP by the 1940s. In the 1960s, however, they began to rapidly decline.

During this Bretton Woods era, leading currencies were pegged to the dollar. In turn, the dollar was convertible to gold at a fixed price of $35 per ounce. Given expansive post-war U.S. spending, there were more dollars abroad than gold collateral. Fearing a run on U.S. gold, many countries, France in particular, actively exchanged dollars and other U.S. assets for gold. By 1971, U.S. gold reserves had fallen 53% from their 1940 level.

Exhibit 19
U.S. Gold Reserves



Source: World Gold Council

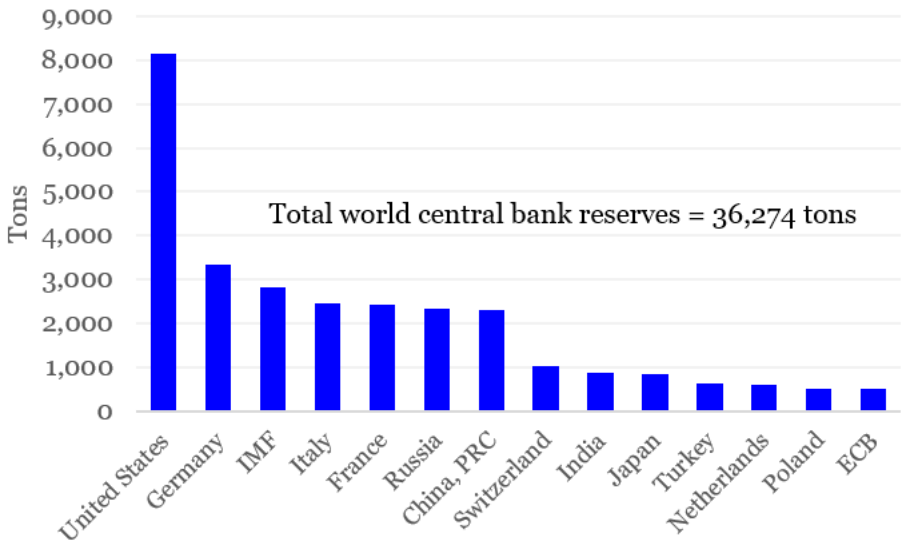
The Bretton Woods system effectively ended on August 15, 1971, when President Richard Nixon issued Executive Order 11615 suspending the dollar's convertibility to gold. Known today as the "Nixon shock," the order came as something of a surprise.

Gold traded between $42 and $43 per ounce before and shortly after Nixon's announcement. Since convertibility was set at $35, the switch from the gold standard to a fiat currency led to an effective "default." Since bond holders received U.S. dollars, this was not an official default, but they did take a haircut because they could no longer convert gold at $35 and then sell at $42.

The value of U.S. gold today is approximately $900 billion, and official bullion reserves have held steady for decades. As a result, gold's value relative to GDP has dropped to less than 3% even as U.S. gold reserves remain the largest in the world.

Exhibit 20 shows that the U.S. holds 22.4% of world reserves, almost 2.5 times as much as second-place Germany. All euro-area countries and the European Central Bank (ECB), combined hold 29.7%. While reserve levels are interesting, changes in reserves are what potentially moves prices.

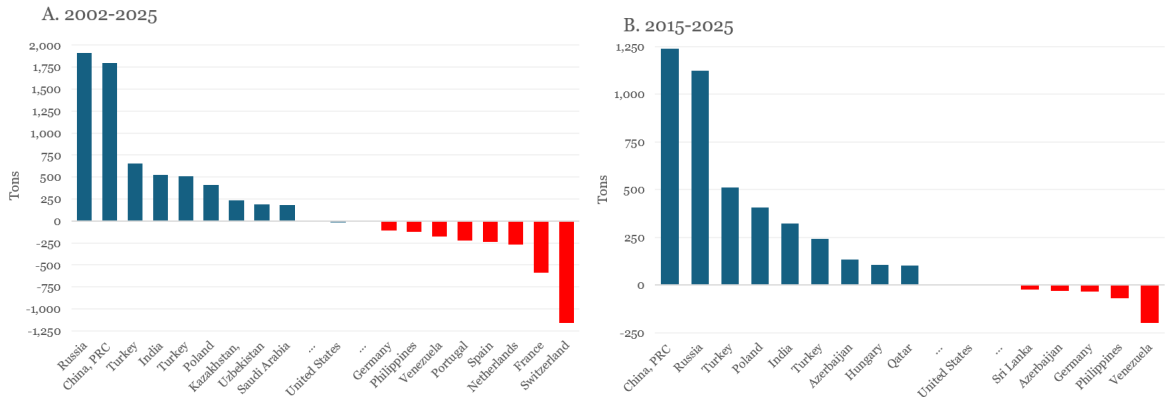
Exhibit 20
World Gold Reserves in June 2025



Sources: World Gold Council, based on country reports that vary between March and April 2025.

Exhibit 21 shows the largest changes in gold holdings. **Panel A** covers 2002 to 2025 and **Panel B** looks at the last 10 years. There is a large overlap in purchasers, with China and Russia the key buyers. Over the last 10 years, they have added approximately 2,500 tons between them. India and Poland are also active buyers, but nowhere near China and Russia.

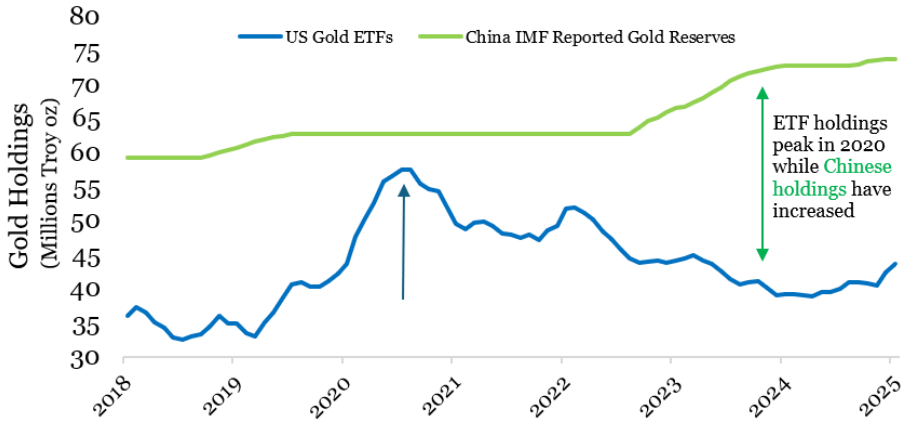
Exhibit 21
Changes in Gold Reserves



Sources: World Gold Council, based on country reports that vary between March and April 2025.

How do China's gold reserves compare to the leading gold ETF holdings? **Exhibit 22** shows that gold ETF holdings peaked during the COVID-19 crisis and have retreated since. While these ETF holdings have increased in value, rising gold prices are the culprit rather than holding additional bullion. China's official reserves have spiked in the last few years.

Exhibit 22
China vs. Gold ETFs



Sources: World Gold Council, based on country reports that vary between March and April 2025.

How much gold does China need to achieve per-capita parity with the U.S.? As **Exhibit 23** shows, U.S. reserves total three-quarters of an ounce and China's one twentieth of an ounce per capita. The U.S. has almost 15 times as much gold per capita as China. To reach per-capita parity

with the U.S., China will need to accumulate over one-billion ounces of gold, or more than 31,000 tons.

Over the past 10 years, China has acquired 1,240 metric tons. At that rate, parity with the U.S. will take centuries. But China is also the world's largest gold producer, mining 380 tons in 2024. If China put 100% of its production into official reserves and matched its 2024 numbers on an annual basis, it could achieve parity in 82 years. But with only 3,100 tons of proven gold reserves, or a little more than eight years' worth of current production, that seems unlikely.

Exhibit 23
Required Gold for China to Achieve Gold Parity

	Stated Gold Holdings (ounces)	Population	Per Capita Ounces
U.S.	261,500,000	342,000,000	0.765
China	72,740,000	1,410,000,000	0.052
China parity	1,078,114,035	1,410,000,000	0.765

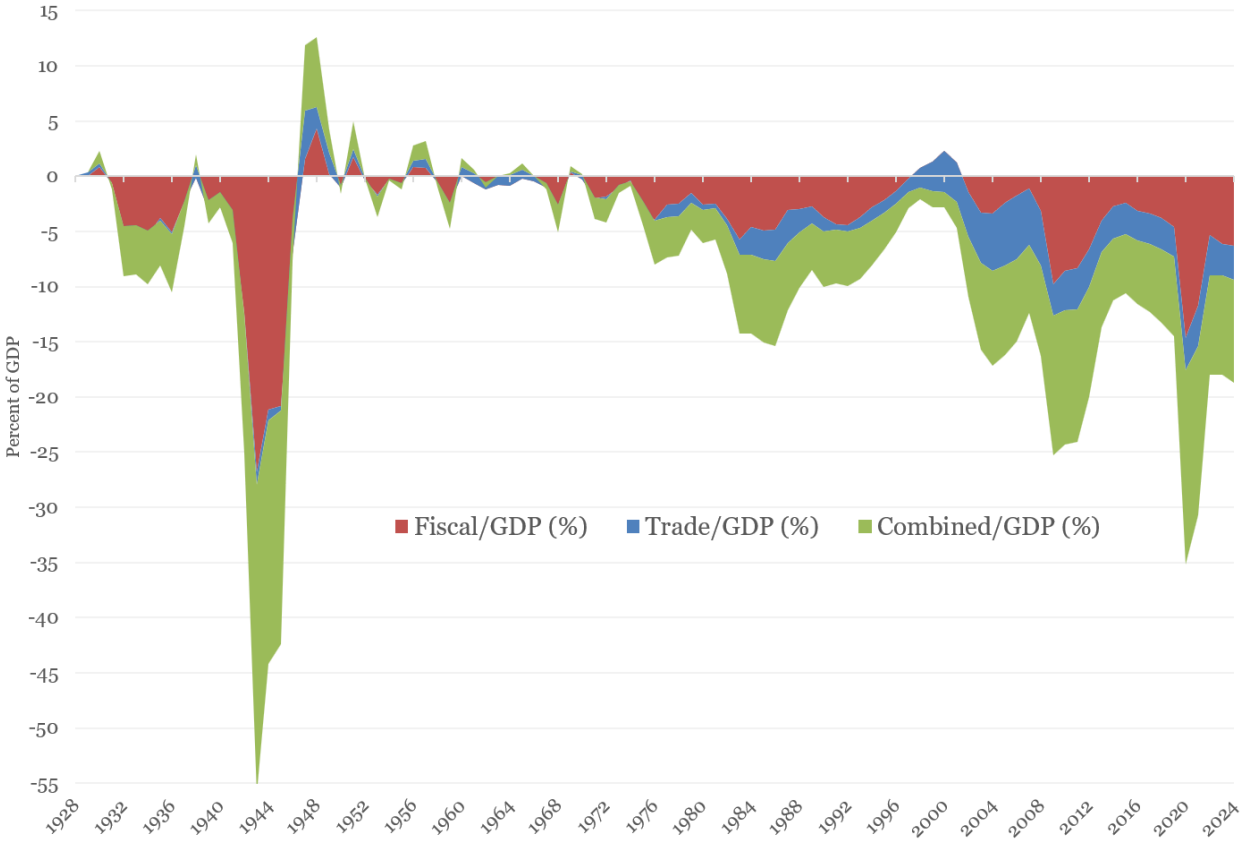
Sources: https://www.census.gov/popclock/population_widget_310x200.php and World Gold Council

While parity with the U.S. may be a distant prospect, China's efforts to close the gap could increase demand for gold.

E. The Dollar as Reserve Asset

For years, the U.S. has run fiscal and trade deficits that total nearly 10% of GDP. The U.S. dollar's reserve currency status enables this. Many countries hold U.S. dollar assets – even if they do not trade with the U.S. – because they need those dollars to trade with other international partners. Crude oil, for example, tends to be priced in dollars, so most international trade in crude oil must be conducted in dollars.

Exhibit 24
The U.S. Twin Deficits



Sources: FRED GDPA, A019RC1A027NBEA, FYFSD

Reserve currency status comes with privileges and costs. On the privilege side of the ledger, it allows the U.S. to run trade deficits because other countries will hold dollars. But rather than hold cash, they buy U.S. assets like Treasury bonds with their dollars. Roughly half of all U.S. Treasuries are held by non-U.S. entities. This creates a convenience premium: Buying the bonds drives the price higher and the yield lower, so the interest rate on Treasuries is probably less than it would be if the U.S. dollar was not the reserve currency. Indeed, the U.S. obtains "leverage" with this borrowing.

But there are downsides to reserve currency status. Demand for the currency enhances the dollar's value. As it grows more valuable, U.S. exports become less competitive. Moreover, persistent trade deficits are unlikely to continue forever. Leverage will eventually reach such excessive levels that foreign holders of U.S. dollars will diversify their reserves.

Could that threaten the dollar's reserve status? Or can the dollar hold on indefinitely? Recent U.S. macroeconomic events have led many to raise these questions. U.S. debt service costs more than $1 trillion per year and constitutes the second largest government spending category. The U.S. runs a nearly $2-trillion fiscal deficit even amid solid economic growth, low inflation, miniscule unemployment, and record-high stock markets. A deficit this large might be understandable in a deep recession, a war, or some other crisis, but not amid such relative

prosperity. Technically, a structural deficit is defined as the deficit excluding debt service. The U.S. has a serious structural deficit.

These uncertainties create risk, which may motivate foreign entities to reduce their exposure to the U.S. dollar. Gold is an obvious candidate for diversification. A recent ECB report declared:[19]

> "Central banks purchased more than 1,000 tonnes of gold in 2024, which is double the average annual amount seen in the previous decade. Global holdings of gold by central banks now stand at 36,000 tonnes, close to the all-time high of 38,000 tonnes reached in 1965 during the Bretton Woods era. With the price of gold reaching new highs, the share of gold in global foreign reserves at market prices, at 20%, surpassed the share of the euro (16%). Survey data suggest that two-thirds of central banks invested in gold for purposes of diversification, while two-fifths did so as protection against geopolitical risk."

Despite such concerns, the U.S. dollar is likely to maintain its reserve currency status for one simple reason: There is no credible alternative.

Reserve currency status is associated with the following attributes:

1. A large and strong economy
2. Highly liquid capital markets
3. Stability and credibility, including a rational monetary policy, low inflation, and an independent central bank
4. The rule of law and strong institutions
5. A wide moat. Once in use, with goods denominated in it, the new reserve currency should not be easy to dislodge by a competitor seeking to gain market share.
6. Backing by a geopolitical and military power
7. Free convertibility without capital controls
8. Current account deficits to supply the world with the reserve currency

The U.S. dollar checks all eight boxes. The euro might be in second place, but euro markets lack the liquidity (2), the geopolitical influence (6), and the stability (3). In its short history, the euro has been through two crises.

The yuan is in a distant third place. It does not have an independent central bank (3) and falls short on Western norms for the rule of law and institutions (4). In contrast to the U.S., China runs a current account surplus (8). Most seriously, China does have capital controls (7).

The current account deficit criterion (8) reveals a major limitation of the reserve currency model that may be playing out today. To inspire confidence, the reserve currency must have ample liquidity. This liquidity is generated by a current account deficit. But a persistent current account deficit creates debt or leverage and eventually erodes confidence in the reserve currency. This is the so-called Triffin Dilemma, after Robert Triffin, who described this

[19] European Central Bank. 2025. "The International Role of the Euro." https://www.ecb.europa.eu/press/other-publications/ire/html/ecb.ire202506.en.html#toc4

phenomenon in 1960 and in his influential book *Gold and the Dollar Crisis: The Future of Convertibility*.

F. How Important Is It to Have a Reserve Currency?

Not as important as many believe. The key is to establish a bilateral swap facility that serves as a backstop in periods of stress. A hypothetical scenario involving China and Malaysia explain the dynamics.

China's goals are to decrease its reliance on the U.S. dollar and promote the renminbi as an alternative; increase domestic economic growth by promoting trade; and expand its influence by contributing to growth outside of China, through its Belt and Road initiative, for example. Swap lines are especially useful for the first objective.

Companies in Malaysia import Chinese goods that might be invoiced in U.S. dollars. But the Malaysian importers could bypass the dollar if they go to their local bank, borrow money, and tell the bank to exchange the borrowed Malaysian currency, Ringgit Malaysia (RM), for renminbi (RMB).[20]

Once the importers sell the goods locally, they pay back their loans to the commercial bank. Chinese banks would accumulate RM. Chinese companies could also demand liquified natural gas and other Malaysian goods and exchange the RMB for RM and pay for the LNG with the RM.

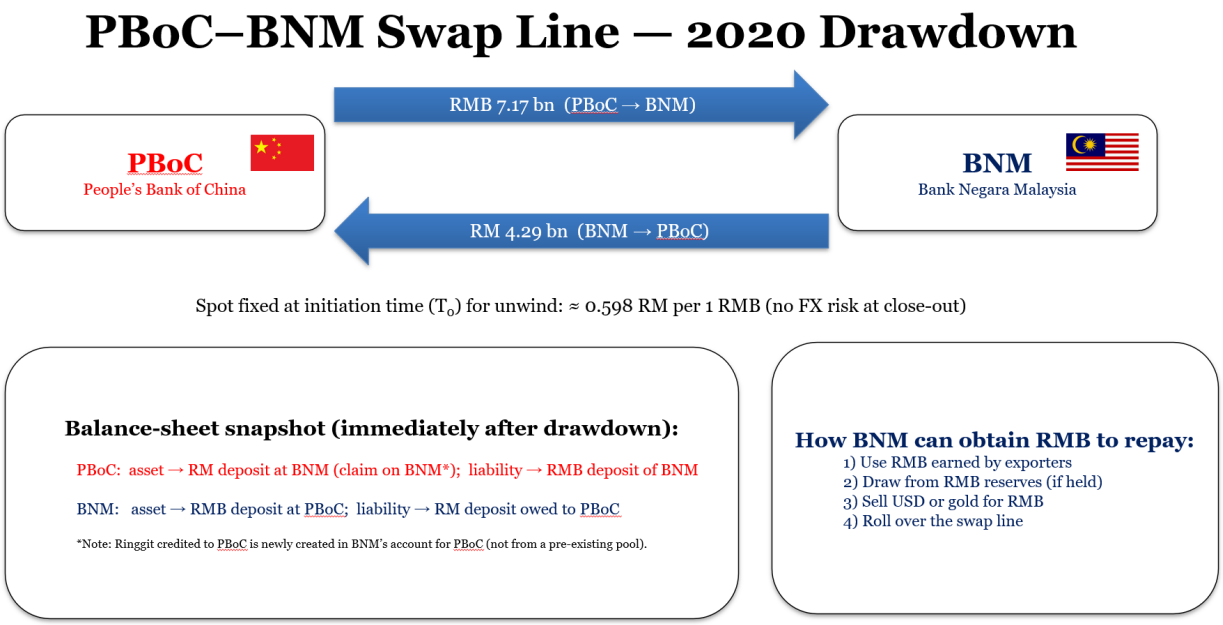
This usually works but not always. In a crisis, commercial banks may not have the liquidity, whether in RMB or RMs. Even absent a crisis, liquidity challenges could disrupt trade and persuade companies to bypass this risk and invoice in U.S. dollars. This is where bilateral swap lines are useful.

The People's Bank of China (PBoC) and Bank Negara Malaysia (BNM) initiated an outstanding swap line in 2009 that automatically rolls over every five years. The facility, which totals about $25 billion in size, ensures that parties in China can always obtain RM and their Malaysian counterparts can always obtain RMB. The facility acts as a type of insurance and bolsters confidence. Malaysia resorted to the facility in 2020, drawing about $1 billion-worth of RMB during the COVID-19 crisis, and again in 2021 when oil prices collapsed.

In its 2020 draw on the swap facility, Malaysia was the borrower. The PBoC credits BNM's account for the requested RMB 7.17 billion, and BNM credits a ringgit account it maintains for PBoC for RM 4.29b. The ringgit balance is now an asset for PBoC, or a claim on BNM, and a liability for BNM. To be clear, the ringgit does not come out of a pre-existing pool at PBoC – it is newly transmitted from BNM to a PBoC-owned account and is legally owned by the PBoC for the life of the swap. **Exhibit 25** shows the details.

[20] The RMB is also referred to as CNY, which is its three-digit ISO 4217 currency code, and by the ¥ symbol. The RM's ISO 4217 currency code is MYR.

Exhibit 25
The Mechanics of a Bilateral FX Swapline



At the end of the agreement, BNM sends back the RMB 7.17 billion principal (plus interest) to the PBoC. Simultaneously, the PBoC instructs BNM to debit its ringgit account by RM 4.29 billion to close the position. On both balance sheets, the swap-related asset/liability disappears. Importantly, there is no FX risk because the spot rate used when the swap was initiated is also used in the close out. No net change occurs on the balance sheet.

All loans entail credit risk. Malaysia has borrowed RMB and the PBoC holds the RM. If Malaysia defaults and its currency collapses, the PBoC still has the collateral, but the value of the collateral does not cover the value of the loan.

In paying back the swap, Malaysia needs to deliver RMB. It can do this in four ways. It may have accumulated RMB from companies exporting to China. It could tap RMB from its official reserves if it has them. Third, and most relevant, it could sell U.S. dollars or gold from its reserves for RMB. Lastly, it could roll over the swap line.

There are a few insights here. First, bilateral swap lines reduce the need for a reserve currency. Indeed, the PBoC has 31 active bilateral swap lines worth close to $600 billion, including with 12 Asia-Pacific countries, the Hong Kong Monetary Authority, and Macao.

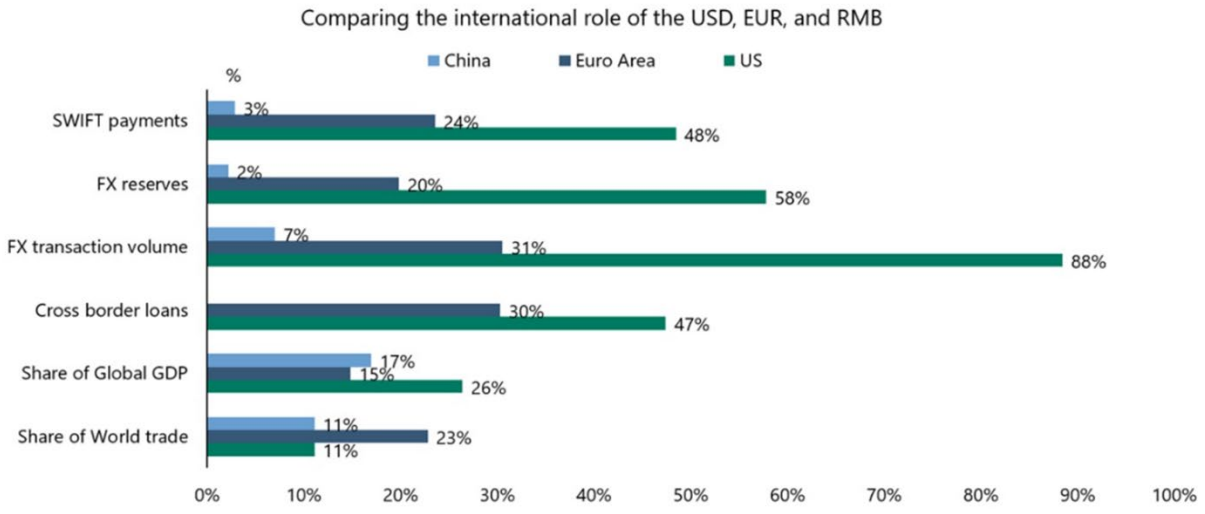
Second, the credit risk of these bilateral swaps decreases if a country has other reserves to draw upon. In the past, these reserves would be heavily weighted to the U.S. dollar because invoices tended to be denominated in U.S. dollars. Given a network of bilateral swaps, many central banks may diversify into other collateral – including gold.

Third, this network of bilateral swaps challenges the U.S. dollar's reserve currency status by offering a credible alternative. With an alternative model, countries can reduce their reliance on

the U.S. dollar and potentially increase their reliance on gold. This is a type of central bank hedging. Instead of being solely dollar-dependent, portfolios diversify and gold benefits.

Nevertheless, today the dollar remains dominant, with over half of FX reserves in U.S. dollars, according to the **Exhibit 26**. Yet only 11% of world trade is denominated in dollars.

Exhibit 26
The Dollar, Euro, and Renminbi in World Trade



Source: Apollo

G. Basel III

Gold is not currently a Tier 1 High Quality Liquid Asset (HQLA) under Basel III.[21] But gold could meet the requirements for HQLA Tier 1 if the regulatory environment changes.

Currently banks need sufficient liquid capital to survive a stress-test set by regulators for 30 days. The Liquidity Coverage Ratio or LCR is the key regulator metric. The LCR has two components: The numerator is the stock of HQLAs and the denominator is the potential outflows in the 30-day stress test period. The LCR must be greater than one. So, the bank must have enough liquid assets to cover withdrawals, defaults, and a short-term funding breakdown.

HQLA has three categories. Tier 1, Level 1, the top tier, consists of only cash, central bank reserves, and the highest quality government bonds, such as U.S. Treasuries and German Bunds. Tier 2A and 2B are lower quality assets that are subject to a haircut when included in the stock of HQLA (numerator) as well as a maximum cap. As **Exhibit 27** shows, gold does not currently qualify for any tier.

[21] For current definitions of HQLA, see Basel Committee on Banking Supervision. "Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools." Bank for International Settlements, January 2013. https://www.bis.org/publ/bcbs238.pdf

Exhibit 27
High Quality Liquid Assets Under Basel III

Tier	Basel Term	Asset Type	Haircut	HQLA Cap	Gold Included?
1	Level 1	Cash, central bank reserves, top-rated gov't	0%	Unlimited	✗ Not included
2	Level 2A	High-grade gov't/PSE/covered bonds	15%	≤40%	✗ Not included
3	Level 2B	Corp bonds, RMBS, major index equities	25–50%	≤15%	✗ Not included
—	—	Gold bullion (held securely)	—	—	☑ For capital, ✗ for LCR

Source: Bank for International Settlements, BCBS-238 (2013).

To make the case for gold, we have to consider the four characteristics of HQ1As as detailed by the Bank for International Settlements (BIS). First, HQLAs must be low risk. This means high liquidity and a low degree of subordination. The assets may have low duration risk (sensitivity to interest rate changes), low legal risk, low inflation risk, and denomination in a convertible currency with low foreign exchange risk. For comparison, the U.S. 30-year Treasury is instructive as all Treasuries qualify as Level 1 HQLAs for the purposes of U.S. stress testing.[22]

U.S. Treasuries have relatively low risk despite their recent downgrade from AAA status. Under Basel III, AA– sovereign bonds are subject to a haircut. U.S. Treasuries are AA+, have no subordination, and do not have low duration risk. However, in crises, rates often go down, which would enhance the bond's value. Treasuries have low legal risk and, with their denomination in U.S. dollars, minimal FX risk. The bond does not have low inflation risk. Higher expected inflation usually leads to higher rates, which would negatively impact the bond.

As Neville et al. (2021) show, the inflation adjusted return on 30-year Treasuries is –8% annualized during inflation surges and 5% annualized in non-inflation periods (see **Exhibit 28**). In contrast, gold has delivered 12% real returns during inflation surges (see **Exhibit 29**). The spread between the return of gold and the 30-year bond is 20% during surges.

[22] See: https://www.ecfr.gov/current/title-12/chapter-II/subchapter-A/part-249

Exhibit 28
Bond Performance During Inflation Surges

Fixed Income in Inflationary Regimes

	Specific Inflation Regimes								Combined Regimes				
	US Enters WW2	End of WW2	Korean War	Ending of Bretton Woods	OPEC Oil Embargo	Iranian Revolution	Reagan's Boom	China Demand Boom	Inflation (19%)	Other (81%)	All (100%)	Hit Rate	*t*-Stat
Start Month	April 1941	March 1946	August 1950	February 1966	July 1972	February 1977	February 1987	September 2007					
End Month	May 1942	March 1947	February 1951	January 1970	December 1974	March 1980	November 1990	July 2008					
Total Price Level Change	15%	21%	7%	19%	24%	37%	20%	6%					
Strategy	**Real Return (total)**								**Real Return (ann.)**				
US Treasury 30 Yr.	–17%	–17%	–6%	–20%	–28%	–41%	13%	2%	–8%	5%	3%	25%	–5.0
US Treasury 10 Yr.	–11%	–17%	–6%	–13%	–12%	–31%	8%	5%	–5%	4%	2%	25%	–5.1
US Treasury 2 Yr.	–13%	–17%	–6%	–1%	–7%	–17%	11%	0%	–3%	2%	1%	13%	–5.8
USD Invest-Grd. Credit	–7%	–12%	–3%	–23%	–20%	–43%	–5%	1%	–7%	6%	3%	13%	–8.1
USD High-Yield Credit	–4%	–11%	0%	–18%	–21%	–38%	–10%	–8%	–7%	6%	4%	13%	–7.8
TIPS				–3%	13%	–2%	11%	6%	2%	3%	3%	60%	–0.6

Source: Neville et al. (2021)

Exhibit 29
Gold Performance During Inflation Surges

Commodities in Inflationary Regimes

	Specific Inflation Regimes								Combined Regimes				
	US Enters WW2	End of WW2	Korean War	Ending of Bretton Woods	OPEC Oil Embargo	Iranian Revolution	Reagan's Boom	China Demand Boom	Inflation (19%)	Other (81%)	All (100%)	Hit Rate	*t*-Stat
Start Month	April 1941	March 1946	August 1950	February 1966	July 1972	February 1977	February 1987	September 2007					
End Month	May 1942	March 1947	February 1951	January 1970	December 1974	March 1980	November 1990	July 2008					
Total Price Level Change	15%	21%	7%	19%	24%	37%	20%	6%					
Strategy	**Real Return (total)**								**Real Return (ann.)**				
Industrials				115%	38%	–6%	306%	3%	19%	4%	7%	80%	1.7
Precious				28%	29%	185%	–27%	33%	11%	–2%	1%	80%	1.7
Agris		–12%	6%	–23%	197%	–21%	6%	33%	7%	–3%	0%	71%	1.8
Softs				–41%	243%	15%	11%	15%	8%	–3%	–1%	80%	1.6
Livestock				69%	–21%	35%	97%	–23%	7%	1%	2%	60%	1.1
Energies	*–3%*	*2%*	*–6%*	*–16%*	*264%*	*57%*	201%	68%	41%	–1%	3%	100%	1.7
Gold					*166%*	154%	–18%	27%	13%	–1%	1%	67%	1.6
Silver				9%	99%	210%	–41%	36%	12%	–5%	0%	80%	1.8
Commods. Aggregate		12%	6%	26%	85%	38%	84%	21%	14%	1%	4%	100%	3.1

Source: Neville et al. (2021)

Gold fares well in this first fundamental category. It is highly liquid, not subordinated, and without obvious duration risk. Gold's correlation with interest rate changes is sometimes positive and sometimes negative. It has less duration risk than a 30-year Treasury and is convertible to almost any currency but to the U.S. dollar especially. It also has no hard-wired

inflation risk. Gold's value as an inflation hedge varies, but Treasuries perform poorly when inflation spikes.

The second HQLA characteristic according to the BIS is the ease and certainty of valuation. Both Treasuries and gold are highly liquid and trade in major markets. If there are price discrepancies across markets, they are generally minor.

Low correlation with risky assets is the third characteristic. In particular, a HQLA should not be subject to "wrong-way" risk. That is, in a crisis, the HQLA should retain or increase its value.

Exhibit 5 shows in periods of economic stress, as measured by major stock market drawdowns, Treasuries and gold both had negative returns in three of the 11 episodes. During the important 2009 drawdown, which provided the impetus for modern stress testing, both gold and Treasuries had positive returns, but gold's were much more positive.

A listing on a developed and recognized exchange is the final criterion. Why? Because a listing promotes transparency. Of course, the transparency motive is largely irrelevant for both Treasuries and gold. The former is public information and gold is gold – nothing about it is opaque.

The BIS also considers three market-related characteristics. First, the market must be active and sizable, with historical evidence of breadth, a diverse set of participants, and robust infrastructure. Both Treasuries and gold check this box.

Second, the assets should have low volatility. During stressed times, the markets should not break down amid forced sales. Both Treasuries and gold have long track records with no indication of haircuts during forced sales. The BIS specifically mentions price change volatility. Gold returns tend to be about as volatile as those of the 30-year Treasury. Of course, a lower duration bond, say a five-year note, would have lower volatility than gold. The point is simple: If the 30-year bond qualifies as Tier 1, it is hard to argue that gold doesn't.

Finally, the BIS looks to "flight to quality." During a crisis, market participants ideally shed their risky assets and purchase the HQLAs. Both Treasuries and gold appear more or less equal in this category.

Exhibit 30 summarizes the comparison between the 30-year Treasury bond and gold**.** At best, there is an insignificant difference between the bond and gold characteristics. Still, regulators do not seem to have gold on their agenda, though an internet hoax in early 2025 claimed that gold would become a Tier 1 HQLA as of July 1, 2025.[23]

[23] See, for example, LBMA. "Gold and HQLA: Correcting Misleading Online Information." May 14, 2025. https://www.lbma.org.uk/articles/gold-and-hqla-correcting-misleading-online-information

Exhibit 30

A Comparison of 30-Year Treasury Bond and Gold as High-Quality Liquid Assets

Fundamental characteristics		Bond	Gold
Low risk	High credit standing	✓	✓
	Low subbordination	✓	✓
	Low duration	✗	✓
	Low legal risk	✓	✓
	Low inflation risk	✗	✓
	Low FX conversion risk	✓	✓
Ease of valuation		✓	✓
Low correlation with risky assets		✓	✓
Listing on exchanges		–	–
Market-related characteristics			
Active and sizable market	Low bid-ask spreads	✓	✓
	High trading volume	✓	✓
	Large and diverse number of market participants	✓	✓
	Robust infrastructure	✓	✓
Low volatiliity		✗	✗
Flight to quality		✓	✓

List of characteristics drawn from BCBS-238. Bond is U.S. 30-year treasury.

What would happen if gold became a Tier 1 HQLA? Twenty-two financial institutions fall under the Enhanced Prudential Standards and are subject to stress tests under the Dodd-Frank Act. These include Global Systemically Important Banks (G-SIBs), large bank holding companies, and two banks that have opted in. Among these banks, the HQLA totals are approximately $4 trillion by our estimates. Some banks report their HQLA totals directly in their 10-Q. For example, JP Morgan reports $881 billion in their latest 10-Q.[24] Bank of America at $629 billion, Citigroup at $553.2 billion, Wells Fargo at $371.7 billion, Goldman Sachs at $371 billion, BNY Mellon at $123.4 billion, and State Street at $94.5 billion also report LCR disclosures, and combined all seven account for more than $3 trillion.

Exhibit 31 anticipates what will happen if in Basel 3.1, the so-called "Endgame," gold becomes a Tier 1 HQLA. According to our calculations, only 5% of the $4 trillion in HQLAs converts to gold. That translates to 1,885 tons of new gold demand, which is 57% of annual world mining production, five times more than China produces, and more than the 1,191 tons held by the two

[24] See JPMorgan Chase & Co. "Form 10-Q," for quarter ending March 31, 2025. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/investor-relations/documents/quarterly-earnings/2025/1st-quarter/corp-q1-2025.pdf

largest gold ETFs. The banks would be buying 43 times more gold than China purchased in 2024. We made the case that financialization likely influenced gold prices. Bank demand would be another shock, measuring about 1.6 times the size of the U.S. gold ETF complex. If banks only held 3% of HQLAs in gold, it would match the magnitude of the gold ETF demand shock.

Exhibit 31

Potential Bank Gold Demand If Gold Is Classified as Tier 1 HQLA

Troy ounces in metric ton		32,150.70
Price of gold	$	3,300.00
Value of a metric ton	$	106,097,310
HQLA	$	4,000,000,000,000
Percent in gold		5%
Total gold bank holdings	$	200,000,000,000
Potential bank demand (tons)		1,885.06
World mining production (2024, tons)		3,300
China total mining (2024, tons)		377.24
China buying (2024, tons)		44.17
China official holdings (2024, tons)		2,279.57
ETF holdings GLD+IAU (2024, tons)		1191.1

To put that 5% in perspective, stablecoin issuers are a type of largely unregulated bank that takes "deposits" and issues tokens.[25] Deposits can be redeemed in exchange for tokens at any time and are usually invested in safe collateral. There are no required reserves. To ensure confidence, the top stablecoin issuers are at least 100% collateralized.

The world's largest stablecoin issuer, Tether, recently reported assets totaling $149.3 billion in deposits or collateral, 81% of which was in U.S. Treasuries. [26] Another 4.5% was in 67 metric tons of gold bullion, more than the PBoC purchased in 2024.

Should gold be a Tier 1 HQLA? The case is compelling. Conservatively, it might create a demand shock similar in size to the one that followed the introduction of gold ETFs. A sense among investors that gold may take on a new role in future Basel III regulations could explain some of gold's recent price rise.

But this argument does not just apply to commercial banks. The insurance complex also holds safe liquid assets. Recently, China allowed its insurance companies to hold 1% of their reserves in gold. **Exhibit 32** details the impact. A 1% share of insurance assets is $27 billion, which

[25] Legislation that will provide a regulatory framework for centralized stablecoins (e.g., the GENIUS Act) has recently been established.

[26] See Tether. "Q1 2025 Attestation Report," May 1, 2025. https://tether.io/news/tether-approaching-120b-in-u-s-treasuries-confirms-quarterly-operating-profit-over-1b-and-strengthens-global-usdt-demand-in-q1-2025/

implies a demand of 226 metric tons, or 60% of China' 2024 mining output. Two other factors have to be considered. That 1% could be raised to 5% or higher, and the exhibit only focuses on a single country. If other countries follow the Chinese initiative, another demand shock on the same scale of a regulatory change for commercial banks could be forthcoming.

Exhibit 32
Impact of Chinese Insurance Demand

Price of gold ounce ($)	3,721
Ounces in metric ton	32,150.7
Price of ton ($ millions)	119.63275
Insurance demand at 1% ($ millions)	27,000
Insurance demand (tons)	225.6907
China gold mining production (tons)	377
Insurance as proportion of production	60%

Sources: World Gold Council and Bloomberg.

3. Where Will the Price of Gold Go?

A. The Golden Dilemma

In Erb and Harvey (2013), we explored what we called the "Golden Dilemma" framework. Our research documented that gold has held its value for over 2,000 years, that the nominal price of gold, over the very long term, moves with inflation, and that gold's real return over the very long term is zero, even if it is quite volatile in the short term. The real return on gold is sometimes positive and sometimes negative.

To achieve a long-term average real rate of return of zero, periods of positive real returns must be offset by periods of negative real returns. The real price of gold should mean revert. We noticed in 2012 that gold's real price was high. So, we anticipated future negative returns, and the real price of gold fell more than 12% over the next five years.

The notion that gold has a zero real rate of return has a parallel in equity valuation. If a stock's average price-to-earnings (P/E) ratio is 15 but then shoots up to 40, over the longer term, we would expect the valuation to mean revert. The valuation cannot increase indefinitely, though it could certainly go higher and stay elevated for a decade or more. Sometimes called revaluation, this is just another form of mean reversion.

The gold situation is analogous. Our Roman centurion was paid 38.58 ounces of gold, about a U.S. Army officer's wages today. But if gold's average real return was 0.5%, or 50 bps per year, instead of 0%, the equivalent salary today would be $2.5 billion and gold would trade at $66.6 million per ounce. Even at 0.1% annual appreciation, the soldier's salary would be $882,000.

Exhibit 33 explores the relationship between the real price of gold today and gold's expected real return for the next 10 years based on data from 1975 to the present. It shows a distinct negative slope, which means that high real prices (value) are associated with lower expected real returns.

The exhibit segments the data before and after the introduction of gold ETFs and finds a negative relationship in both regimes. For example, when gold is at $2,500, the expected real return in the pre- and post-gold-ETF eras is –7% and –2%, respectively.

Indeed, in the post-ETF era, the scatter has shifted upwards, accounting for the 5% difference, and also consistent with a structural shift in the real price of gold. Since today's prices are at or near all-time highs, no historical 10-year return matches them. The best that we can do is examine the closest comparables, such as $2,700 per ounce.

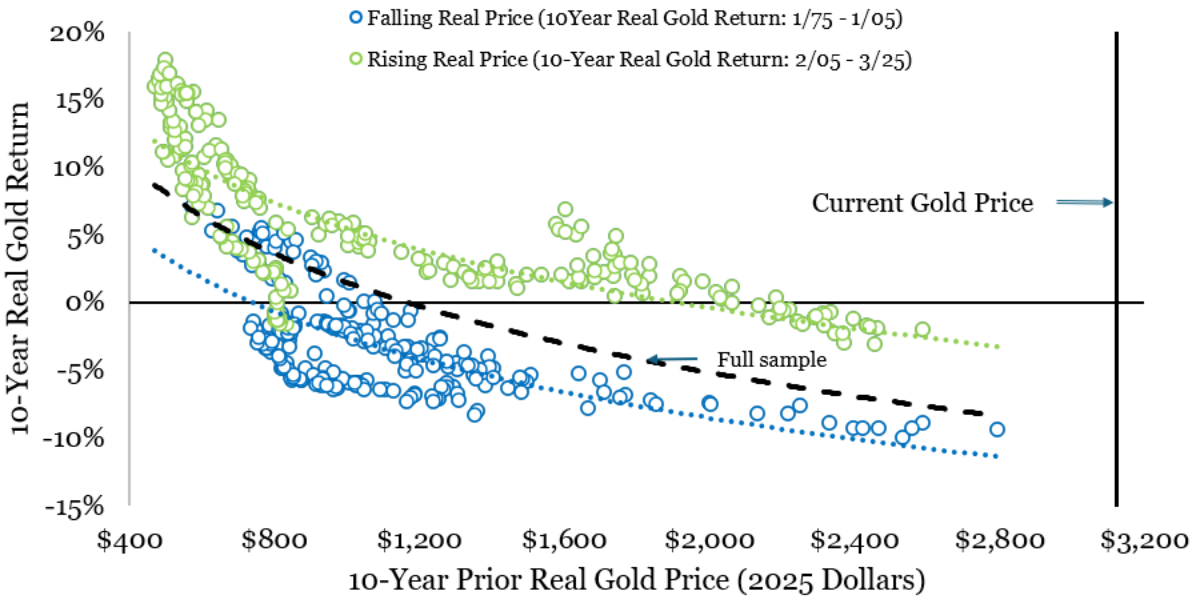
Suppose a company's average P/E ratio has hovered around 15. Then the company makes a discovery that will lead to a new business line and its P/E ratio skyrockets to 50. Some mean reversion can be expected, but maybe not all the way back to 15. The new discovery allows the company to enter a new sector and greatly reduce the risk in its existing one. The decrease in risk alone can shift the true P/E upwards. Maybe the mean reversion tapers out at 20. A structural shift pushes the P/E from 15 to 20 and reversion to the new mean pushes it from 40 down to 20.

Since gold financialization was a hard technological problem to solve, demand built up. Once financial innovation cleared the technological hurdle and market participants saw evidence of a permanent shift in demand, prices rose.

This places us right at the heart of the Golden Dilemma. Based on past performance, expected returns should be very low or negative over the next 10 years. But that may be pessimistic if demand for gold has, in fact, undergone a structural shift that has caused significant price appreciation. The baseline or average may have shifted upwards.

The dilemma for investors is how to weight the valuation perspective with the demand shock perspective since they move in opposite directions. Predictability will depend on what effect is strongest.

Exhibit 33
Valuation and Gold's Real Expected Return



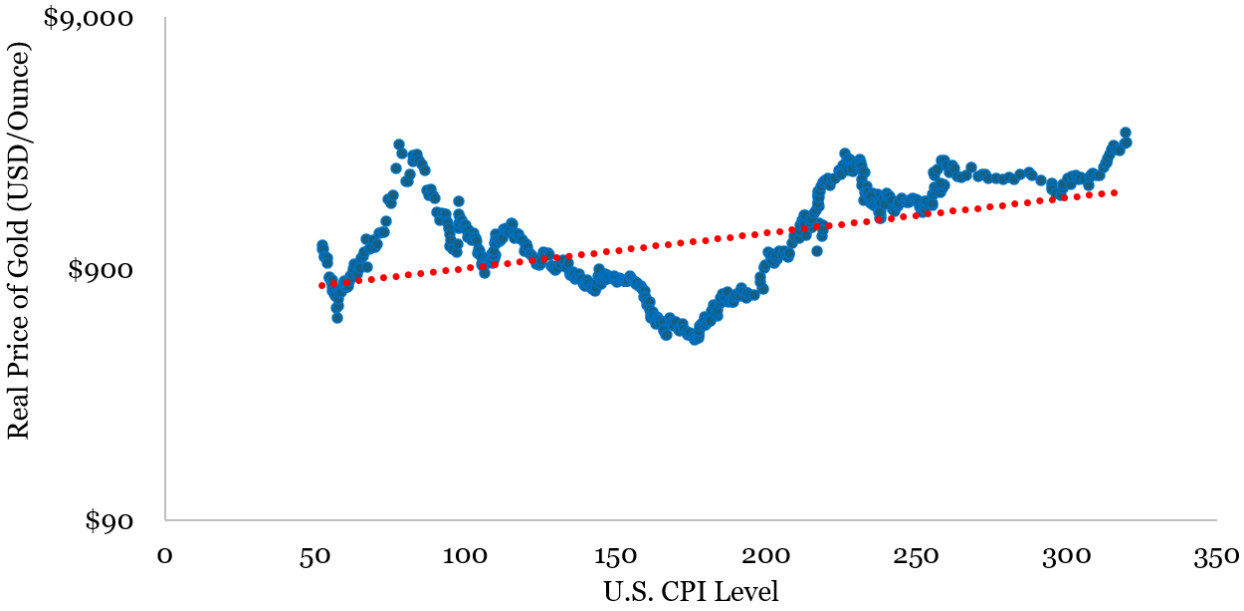
Sources: Bloomberg. Gold (GC1) and CPI (CPI Index).

The demand shock perspective hinges on whether "this time is different." Has a structural change rendered the old model obsolete? It is always tempting to believe so when times feel different. But, as we have said before, every time is different. The question is whether the circumstances are different enough. Can we make the case, through economic reasoning, that the model has changed? In **Exhibit 33**, the shift is reflected in a change of intercept. The slope of the two lines is nearly identical.

B. Other Comparables

Our focus has been gold and inflation. **Exhibit 34** presents a scatter of gold relative to inflation. If the real price of gold is constant and gold's real returns are zero, the dotted line should have a zero slope. The most recent observations cluster on the far right. The price of gold is high not only relative to inflation but also relative to the trend inflation.

Exhibit 34
Gold and Inflation



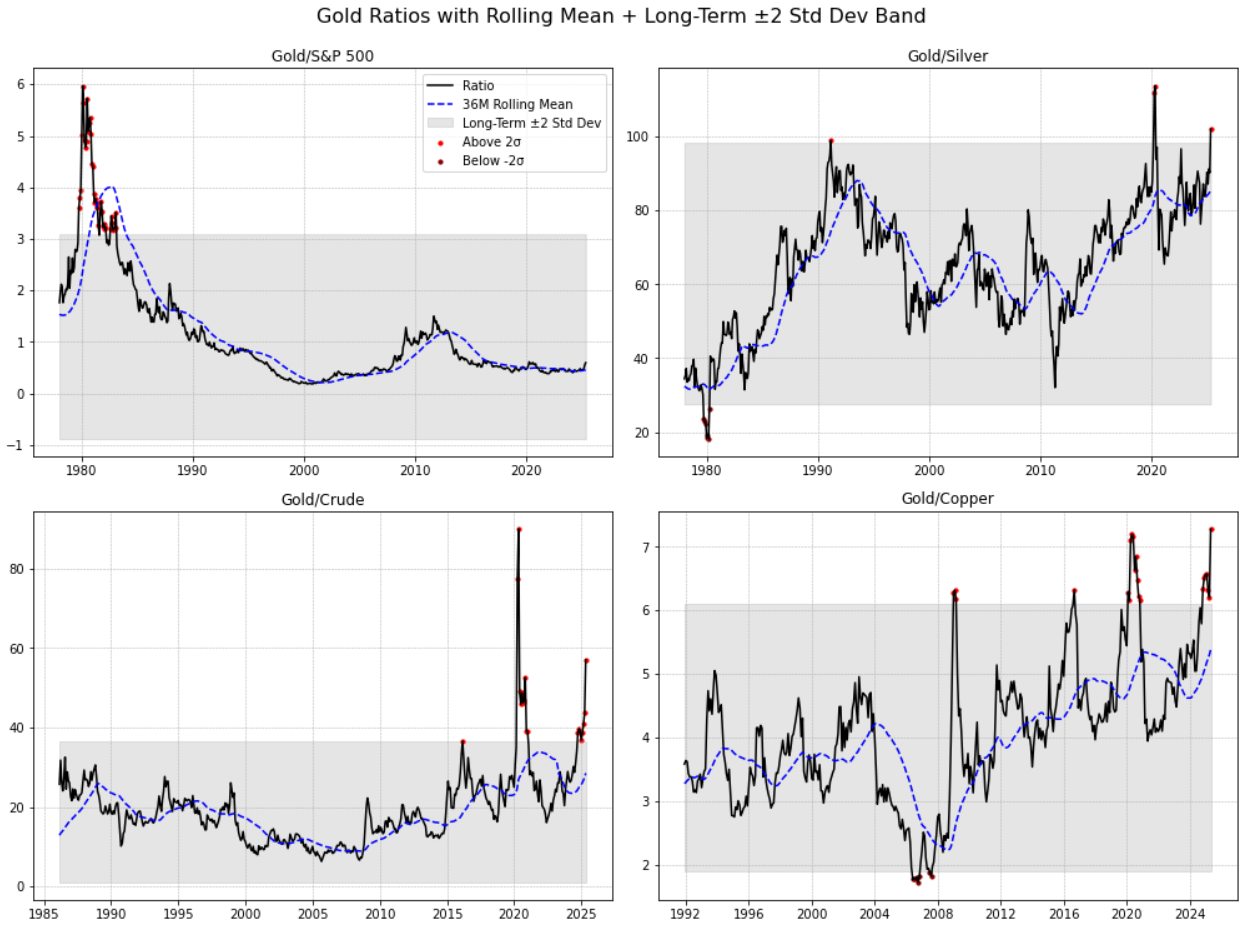
Sources: Bloomberg. Gold (GC1) and CPI (CPI Index).

Beyond the inflation rate, how does gold compare to other important variables? **Exhibit 35** looks at gold relative to the S&P 500, silver, crude oil, and copper. In the first panel, measured in units of the S&P 500, the price of gold looks unremarkable. The S&P 500 has had a tremendous run, so gold's recent performance doesn't stand out and the current ratio is well within the 95%-confidence range.

The next three panels tell a different story. The current gold price is well outside the confidence band to the upside for crude oil and copper and slightly outside the band for silver. This indicates that, relative to other commodities, gold's current price is high, and high prices are associated with lower expected returns. On the other hand, when gold's price is measured in units of the S&P 500, the price looks right.[27]

[27] The standard deviation bands are calculated over the whole sample. We also replicated with a rolling three-year sample. Given the current data, the ratio is outside the three-year confidence range for all three commodities.

Exhibit 35
Gold's Relative Valuation



4. Conclusions

"What motivates most gold purchasers is their belief that the ranks of the fearful will grow," Warren Buffett observed in 2011.[28] "During the past decade that belief has proved correct. Beyond that, the rising price has on its own generated additional buying enthusiasm, attracting purchasers who see the rise as validating an investment thesis. As 'bandwagon' investors join any party, they create their own truth – for a while."

The evidence shows that gold ETF flows are positively associated with gold price increases – investors buy more as the price goes up, just as Buffett said. This is the so-called "buy high/sell low" strategy.

[28] See Buffett, Warren. 2011. "Letter to Shareholders." Berkshire Hathaway. https://www.berkshirehathaway.com/letters/2011ltr.pdf

In the world market portfolio, equities represent about $100 trillion compared to the above-ground gold's $23 trillion. Most investors have little if any exposure to gold at a time when many anticipate a new currency regime.

Since 2011, gold's nominal price has more than doubled and its real price has risen by approximately 40%. In 2011, gold was at an all-time high. By the end of 2015, its real price had plunged 39%. This indicates that gold is a volatile asset. Small changes in demand can have an outsized influence on price because new mining supply is relatively unresponsive to price movements.

Historical analysis suggests that the expected returns on gold are low given the current valuation. Yet gold has been a very reliable hedge against equity drawdowns. In the last 11, gold had positive returns in eight and small negative returns in the other three. It is reasonable to add assets to a portfolio that have low or negative expected returns if they provide protection in tough times.

Of course, history may not repeat itself. Past performance is no guarantee of future results. Yet, there are many other intriguing possibilities. The introduction of gold ETFs may have driven gold prices higher. There was pent-up demand from consumers who wanted to hold gold but found physical possession awkward (and dangerous).

We explored two other potential demand shocks that could influence prices. Gold might qualify as a Tier 1 High Quality Liquid Asset under Basel III. The argument for excluding gold is unconvincing. But if gold does qualify, a demand shock at least on the order of the one that followed the introduction of gold ETFs may follow.

The second potential demand shock is related to de-dollarization. The U.S. dollar will likely remain the global reserve currency, but an increasing amount of trade will be conducted without it. As such, central banks will not need to hold as much in U.S. dollar assets. They will diversify, and gold is a potential diversifier.

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