



How to Value Gold

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Introduction

Gold is often dismissed by value investors who complain that, “gold is only worth as much as someone is willing to pay for it. It has no earnings; it pays no dividends; there is no way to value it.” While it is true that gold has no earnings and pays no dividends, it is incorrect to say there is no way to value it. In this letter we will provide a brief review of the history of gold, walk through the development of a model to value gold, and conclude with an analysis of the current and future prospects for gold.

Brief History of Gold

Around 550 BCE the first gold coins were used as currency in what is now Turkey. The use of gold coins spread as an efficient and durable medium of trade. Over hundreds of years, societies used many different metals to make coins, but gold’s rarity and positive physical properties helped it rise to the top as the most universally accepted store of value.

During the ascent of paper money, gold was viewed as the true store of value, for which paper could be exchanged. In the period known as the classical Gold Standard, from the 1870's to 1914, most countries fixed the value of their paper currencies to a specified amount of gold. While this system worked well most of the time, it was not flexible enough to handle extreme events, and ultimately it broke down at the start of World War I. There were attempts to return to the Gold Standard during the 1920's and 30's, but the political and economic turmoil were so great that all attempts failed.

Near the end of World War II, representatives from 44 nations met at the Bretton Woods Conference to design a new system to regulate international monetary policy. The work from this conference led to the establishment of the International Bank for Reconstruction and Development, the International Monetary Fund, and what came to be known as the Bretton Woods System of global monetary management. The Bretton Woods System was based on the US dollar, which in turn was pegged to gold. From 1945 until 1971, the price of gold was fixed at 35 USD per 1 ounce of gold. During this time, other currency exchange rates relative to the USD could be adjusted. For example, if a foreign currency were to weaken relative to the USD, it would take more of that currency to be equal to a USD, and hence it would take more of that currency to buy an ounce of gold. By the 1960's global inflation started to strain the system because the growth of M2 money supply (6.2%) was higher than the growth of gold supply (1.7%). Economically, the price of gold in USD needed to rise, but the system demanded that the exchange rate stay at \$35 per ounce. While the US and other countries worked to maintain the peg, ultimately it proved unsustainable. On August 15th, 1971, the US effectively ended the Bretton Woods System by terminating the convertibility of the USD to gold. At that point, most major currencies abandoned attempts to maintain a peg to gold.

During the last 50 years, most currencies have been allowed to float, with market participants determining their relative value. While gold is no longer the formal store of value backing any currency, it is worth noting that the value of all currencies has fallen relative to gold. Because it takes more units of a given currency to buy the same amount of gold, gold continues to demonstrate its historic ability to store value.

Gold Model Theory

It is currently estimated that 1.5% of the total above ground gold is newly mined each year. Because the total amount of gold is finite, it is possible that the market is already valuing gold based on the total amount that is estimated to eventually be mined, not just the total amount above ground. If so, the additional gold that will be mined might not dilute the price of gold. Evidence over the past 50 years suggests that newly mined gold has not been dilutive to the price of gold.

Given gold's historical precedent as a store of value, combined with its finite supply, it would be reasonable to conclude that it should maintain its value into the future. If we start with this assumption that gold should maintain its value starting on August 15th, 1971, we would predict

that the price of gold in USD would remain constant if the amount of USD stayed the same. But if the amount of USD supply was increased at 7% per year, then we would predict that it would take 7% more USD per year to buy the same constant amount of gold.

In the 50 years from September 1971 through August 2021, M2 USD money supply has grown at 7.07% annualized and the price of gold has grown at 7.87% annualized. This provides evidence that the growth of M2 is likely to be predictive for the rate of return of gold over the long term, as the above theory would suggest.

Why has the price of gold grown slightly faster than the growth of M2?

1.) During the few years before August 15, 1971, people started to expect that the Bretton Woods System would be terminated. Since the supply of money was growing, they reasonably thought that gold was undervalued in USD while it was held at \$35/ounce. Thus, when the gold peg was abandoned, the price of gold shot up to \$59.50/ounce by the end of May, 1972. At that time, inflation and real interest rates were very close to the average of the last 50 years, so this point serves as a good estimate of the “fair” value of gold. From the beginning of June, 1972 through August 2021, M2 grew at 7.00% and Gold grew at 7.19% bringing the differential to only 0.19% annualized.

2.) There is a second major variable that strongly influences the price of gold: current real interest rates. The change in real interest rates from June of 1972 to August of 2021 explains the remaining 0.19% return differential (explained below).

US Treasury bonds are generally considered to be one of the safest investments in the world, with nearly zero default risk. Similarly, gold has the historic record of being a store of value, and it has zero default risk because its value is intrinsic. Thus, it seems reasonable to think that gold should behave similarly to a US Treasury bond.

The price movement and total return of US Treasury bonds can be precisely calculated based on their duration, current yield, and the change in interest rates. Because gold pays no dividend, it can be thought of as a zero-coupon bond. Through an iterative modeling process, we found that gold behaves like a zero-coupon bond with a 12-year duration.

While gold pays no dividend, its value does go up at approximately the rate of M2 growth, so we accreted 1/12th of the annual M2 growth as a “dividend” added to the value of gold each month.

Finally, the value of gold should vary based on the relative value of its closest substitute: 12-year duration US Treasury bonds. The value of US Treasury bonds is their real interest rate which is approximately equal to their nominal yield minus inflation. When interest rates are high and inflation is low, the real interest rate is high. In this situation, Treasuries are very desirable because of their high real interest rate, while gold is less desirable because it pays no

real interest rate. Conversely, when inflation is higher than Treasury interest rates, the real interest rate is negative, so Treasuries are not desirable and gold is a more desirable substitute.

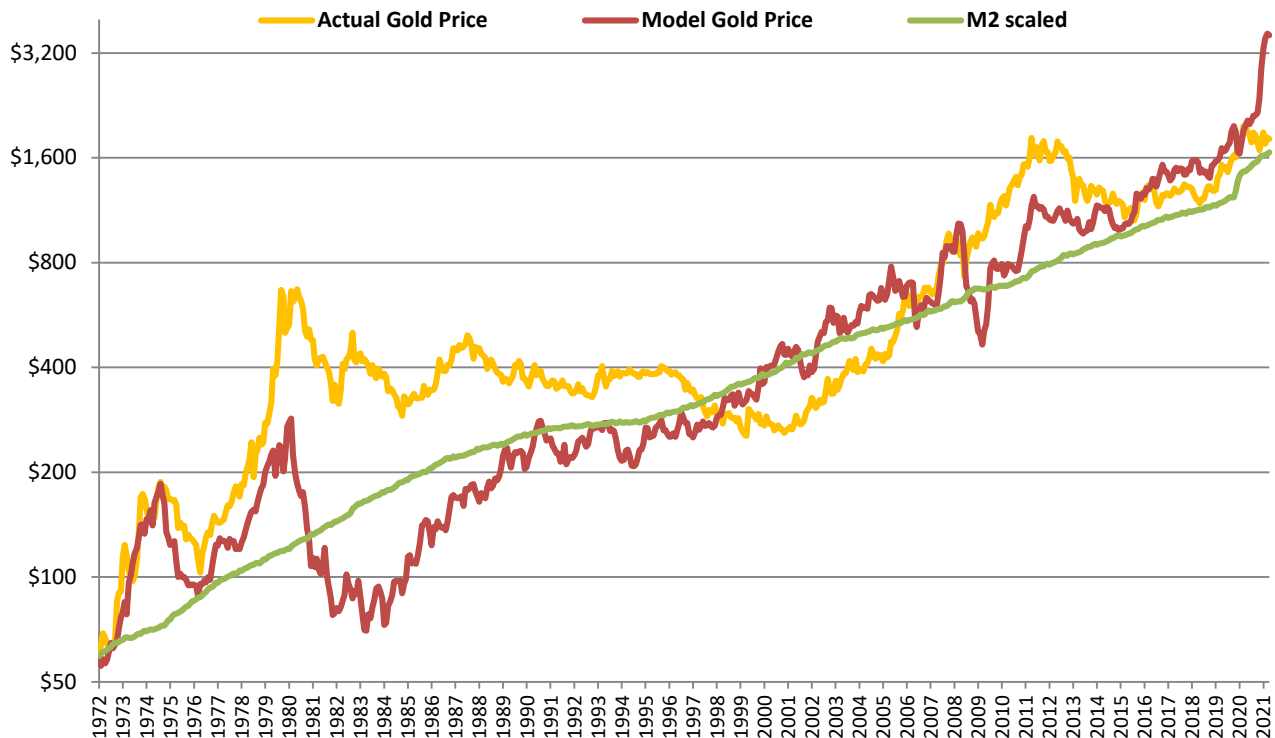
This theory explains a riddle that used to be inscrutable: why did gold hit its two relative highs in 1980 and 2011 when the 10-year Treasury rates were so dramatically different: 12% and 2% respectively? The answer is that the real interest rates during both time periods were deeply negative, which drove the price of gold higher (1980 real interest rate = -5%; 2011 real interest rate = -2%).

Putting this together, we were able to build a model to simulate the price of gold based on three variables:

- 1) Duration = 12 years
- 2) Current yield = Annualized growth of M2
- 3) Change in interest rate = Change in real interest rate

While reality always differs from a model, we find that our three-factor model has a 0.49 correlation with the actual monthly price of gold when analyzing 12 month rolling time periods since 1972. To visualize our model, we graphed the actual price of gold, our model's predicted price of gold, and the growth of M2 (Figure 1).

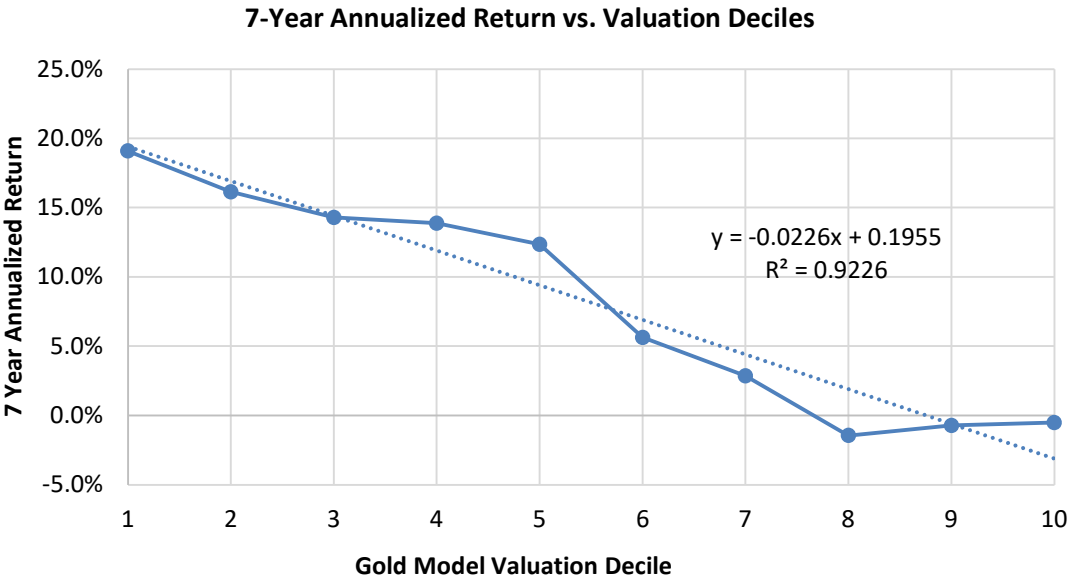
Figure 1. Gold, Gold Model, and M2 growth 1972-2021



Our model was very accurate during the 1970's, but by the peak in 1980, the gold bull market mania drove the price of gold well above the growth of M2 and our model's prediction of fundamental price. During the 1980's real interest rates went very high, sending our predicted price of gold very low, but the price of gold is "antifragile." As a safe haven asset, its sell-offs are usually more muted than its rises, so gold took nearly 20 years to work off its 1980 overvalued peak. By the early 2000's gold was deep in a bear market and was undervalued relative to our model and relative to the growth of M2. This set the stage for gold's bull market rise to its peak in 2011, when gold once again was overvalued relative to M2 growth and the fundamental value predicted by our model. (During the financial crisis of 2008-2009, gold demonstrated its antifragility by maintaining its value during a sharp temporary rise in real interest rates.) Today, gold is approximately at fair value relative to M2 growth, but it is significantly undervalued relative to our model because real interest rates are currently so negative.

In addition to visually inspecting how the gold model looks compared to the actual price of gold, it is important to test if gold's valuation relative to the model is predictive of future gold returns. To do this, we divided the 49-year time sample into 10 valuation decile groups from when gold was the most undervalued relative to our model (1st decile) to when gold was the most overvalued relative to our model (10th decile). We then calculated the returns of each decile group over the following 1, 2, 3, 5, 7, 10, and 12 year time periods. While our model was predictive of future returns over all time periods tested, we found that it produced the strongest results over a 7-year time frame (Figure 2).

Figure 2. 7-Year Annualized Return vs. Gold Model Valuation Deciles 1972-2021



With an R² of 0.9226, Figure 2 shows that our model is highly predictive of actual gold returns over the next 7 years. When gold is undervalued compared to our model, the future returns are strong with a nearly 20% annualized return from the 10% of the time when gold is most undervalued (1st decile). Conversely, when gold is significantly overvalued relative to our model (10th decile), 7-year future returns are just below 0%. The spread of 20% annualized return between the top and bottom valuation deciles is larger than most stock valuation return models, suggesting that gold's value may be more predictable than stock value, standing in stark contrast to the consensus belief that gold cannot be valued. As of today, gold is in the 1st decile of undervaluation relative to our model.¹

Current and Future Prospects for Gold

When gold was the medium of currency, or it directly backed currency, it maintained its purchasing power. From an investment perspective, this means that it had a zero real return which is good for maintaining wealth, but does not grow wealth.

Now that gold is priced in fiat currency which is diluted by the creation of more fiat currency, gold grows at the rate at which new currency is created (the growth of M2). Of great importance is the fact that technological advancements allow for the production of goods and services at a lower cost. This means that the cost to buy a similar basket of goods and services can grow more slowly than the growth of M2, or said more directly: the growth of the consumer price index (CPI) is lower than the growth of M2. This means that an investment which grows at the rate of M2 can be expected to produce a positive real rate of return above the growth of CPI (inflation).

From June of 1972 through August of 2021, we find that the growth of M2 (7.00%) minus the growth of CPI (3.90%) equals 3.10% real return for an asset that grows at the rate of M2.² Due to the fall in real interest rates over that time period, gold has grown slightly faster than M2, producing a real return of 3.29%.

¹Due to the rise of Bitcoin and other cryptocurrencies which share many of gold's desirable properties, we want to be cautious in our expectation of future gold returns. In fact, part of gold's current undervaluation may be due to a partial migration of dollars from gold to 'digital gold.' In terms of portfolio design, the issue of cryptocurrency taking some of gold's potential return can be solved by owning a market capitalization weight of cryptocurrency relative to our target gold allocation. In this way, we will own gold plus 'digital gold' so we will capture any returns that gold loses to cryptocurrency. Based on this logic, we are looking to build our cryptocurrency exposure to a market weight relative to our gold position.

² For you eagle-eyed financial nerds, yes, the actual equation to calculate real return is:

$$\text{Real Rate of Return} = [(1 + \text{Nominal Rate}) / (1 + \text{Inflation Rate})] - 1$$

The actual real return is 2.98%, but for ease of conceptual understanding, we simplified the equation to:

$$\text{Real Rate of Return} = \text{Nominal Rate} - \text{Inflation Rate}$$

Looking forward, it seems reasonable to predict that technological advancements will continue to enable CPI to grow more slowly than M2. Thus, at a starting point, we might guess that the long-term real return of gold should be about 3%, like it has been during the last 50 years.

From an asset allocation perspective, this prediction is extremely important. The historical real return of bonds has been about 2% and is currently near 0% due to extremely low interest rates. The historical real return of stocks has been about 6% and is currently near 3% due to significant overvaluation. In this context, gold becomes a highly desirable asset. In terms of portfolio risk management, gold has been a good hedge against stock corrections and bear markets (Table 1).

Table 1. Gold and Long Treasuries during S&P 500 drawdowns greater than 10%

Date of Top	Date of Bottom	Drawdown (Months)	S&P 500	Gold	Long Treasury	Annualized CPI
1/1/1973	9/30/1974	21	-42.6%	128.0%	-4.0%	10.5%
1/1/1977	2/28/1978	14	-14.1%	35.3%	-1.0%	6.9%
12/1/1980	7/31/1982	20	-16.9%	-44.9%	12.6%	8.2%
9/1/1987	11/30/1987	3	-29.5%	8.3%	2.5%	3.5%
6/1/1990	10/31/1990	5	-14.7%	4.3%	1.6%	8.0%
7/1/1998	8/31/1998	2	-15.4%	-7.6%	6.5%	1.5%
9/1/2000	9/30/2002	25	-44.7%	17.3%	31.4%	2.3%
11/1/2007	2/28/2009	16	-50.9%	20.5%	20.7%	1.2%
10/1/2018	12/31/2018	3	-13.5%	8.3%	5.5%	-1.9%
1/1/2020	3/31/2020	3	-19.6%	5.4%	38.2%	1.8%

	Average	11.2	-26.2%	17.5%	11.4%	4.2%
Average	when CPI > 4.2%	12.0	-17.7%	24.5%	1.8%	6.7%
Average	when CPI < 4.2%	8.7	-29.0%	8.7%	17.5%	1.4%

The monthly data in Table 1. shows that while both gold and long Treasuries go up on average during a stock market drop greater than 10%, gold is particularly helpful during high inflation periods, rising an average of 24.5%. Long Treasuries are not very helpful during high inflation stock market sell-offs, but they are a strong hedge against a deflation induced equity pullback.

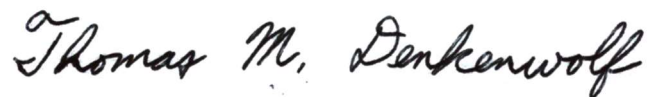
Looking forward over the next 1 to 5 years, there are reasons to believe that gold may experience above average price appreciation. Because inflation has consistently run below the Federal Reserve’s target for more than 10 years, it has become increasingly bold in its use of non-traditional measures that have grown M2 at a higher rate during the pandemic than we have seen at any other time in the last 50 years. This demonstrated willingness to grow M2, coupled with continued accommodative rhetoric, suggests that the growth of M2 is likely to remain higher than normal for the next few years which supports a higher-than-normal

expected return for gold. In the face of rising inflation, the Federal Reserve continues to delay raising interest rates. This is likely to maintain negative real interest rates which are also supportive of higher gold prices.

Conclusion

Even though gold pays no dividend and has no earnings, it can nonetheless be valued using the readily available data of M2 growth and the change in real interest rates. Using these variables, we developed a model which accurately shows when gold is overvalued and undervalued. Currently, this model suggests that gold is undervalued. The actions of the Federal Reserve, combined with its continued accommodative rhetoric, add additional evidence that the two supportive variables of gold price (M2 growth and negative real interest rates) are likely to remain in place which should push gold higher during the next few years. In a world where nearly every asset class is overvalued, it is exciting that gold is not only significantly undervalued relative to our model, but also has a strong record of hedging against equity pullback.

Best,



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