The Golden Constant

Claude B. Erb
Los Angeles, CA 90272

Campbell R. Harvey
Duke University, Durham, NC 27708
National Bureau of Economic Research, Cambridge, MA 02138

ABSTRACT

In *The Golden Dilemma*, Erb and Harvey (2012) explored the possible relation between the real, inflation adjusted, price of gold and future real gold returns. This update suggests that the real return of gold over the next 10 years could be about -4% per year if the real price of gold mean reverts or -12% per year if the real price of gold overshoots and declines to previous low real price levels. This view reflects a "golden constant" hypothesis that inflation is the fundamental driver of the price of gold. Of course it is possible to entertain other hypotheses. A "golden constant" perspective suggests a fair value price for gold of $840 an ounce and a possible overshoot price of $353 an ounce.

Keywords: Gold, golden constant, real gold, overshoot, inflation hedge.

See our two earlier papers on gold:
"The Golden Dilemma"
"An Impressionistic View of the 'Real' Price of Gold Around the World"

*First posted to SSRN: August 3, 2015. Current version, November 11, 2016

Erb and Harvey (2012, 2013) observed that a common argument made for investing in gold in that it is an inflation hedge, a "golden constant".[1] One way to think about the golden constant perspective is as a collection of statements that assert that: 1) over a long period of time the purchasing power of gold remains largely the same; 2) in the long run, inflation is a fundamental driver of the price of gold; 3) deviations in the nominal price of gold relative to its inflation-adjusted price will be corrected; and 4) in the long run, the real return from owning gold is zero. There are at least two ways to visually illustrate this view. The first is to look at the historical relationship between the price of gold and a common measure of inflation. The second is to look at the movement over time in the real price of gold, the price of gold adjusted for inflation. Do these perspectives suggest a favorable or a problematic outlook for an investment in gold? This update suggests that the next 10 years could be challenging for gold.

Exhibit 1 illustrates the relation between the price of gold in U.S. dollars and the U.S. Consumer Price Index since January 1975, when futures trading in gold commenced. Related to the idea that gold is an inflation hedge is the idea that the purchasing power of gold is constant, at least over a long period of time. The rust colored line in Exhibit 1 is a way of thinking about what the "golden constant" value of gold might look like, if it exists. First, we calculate the average real price of gold (average of the nominal price divided by the CPI level). Over our data the average real price of gold is 3.46. The line in Exhibit 1 is simply the average real price multiplied by the current level, each month, of the CPI index. For example, in June 2016, the CPI level is 239.9. Multiplying the average real price times the current CPI (3.49x239.9) delivers a price of approximately $840. This represents what the nominal price of gold should be today – if we assume the real price of gold is constant.

Importantly, the price of gold has fluctuated substantially over time as well as relative to the golden constant value estimate. Since there is no generally agreed upon definition of an inflation hedge, some might see in Exhibit 1 evidence that gold is a golden constant inflation hedge, at least in a long run sense, and others may look at the same data and suggest that perhaps an inflation hedge should track realized inflation more closely.

The golden constant is not a fact -- it is one hypothesis about the value of an asset that embeds the idea that gold is an inflation hedge. It is possible to enthusiastically believe in other hypotheses, such as a "golden" version of market efficiency (in which the observable price of gold is an unbiased estimate of the otherwise unobservable "value" of gold), the idea that the price of gold is ultimately driven by the actions of the Chinese government and Chinese consumers, or the idea that the price of gold is driven by the cost of production of gold mining companies. Of course, while there may be an efficient market explanation for gold, or the Chinese may be driving the price of gold, it is worth considering whether these possible drivers of the price of gold are consistent with the idea of gold being an inflation hedge.[2] Do Chinese purchases of gold proxy for what people, in the U.S. and everywhere else, really think inflation happens to be, is an assertion that price equals value a step forward in hedging inflation, or does the cost of production of the average or marginal gold miner really capture the story of inflation? All the golden constant hypothesis perspective suggests is that, if it is true, the price of gold ($1321 in June 2016) is much

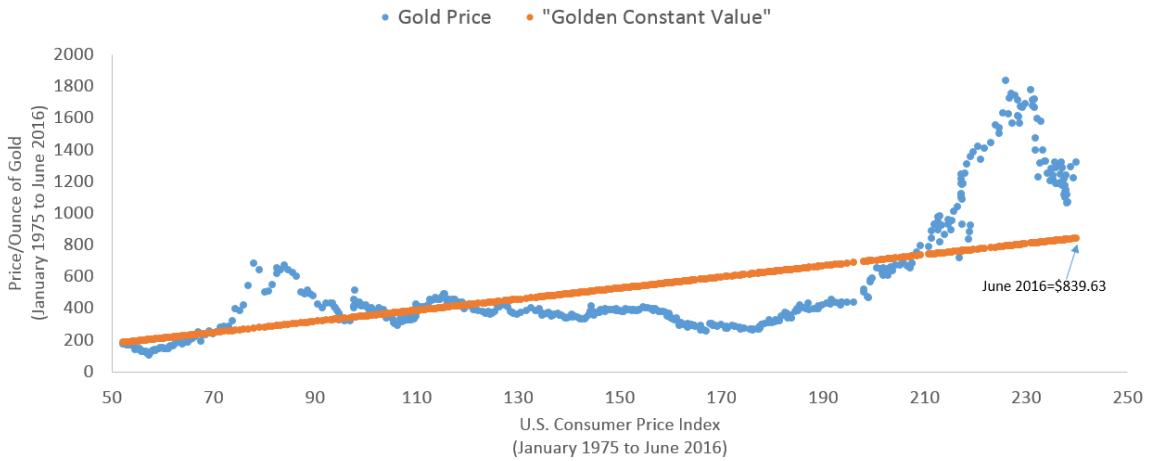
[1] The "golden constant" is also discussed in Erb and Harvey (2012) along with the work by Jastram (1978).

[2] Another way of thinking about this is: to some degree it is possible to point to some measure of inflation but it is probably hard to point to some measure of market efficiency or of Chinese "gold activity". Alternatively, because it is so hard to define either of these arguments, it is hard to disprove either of these assertions.

higher than its golden constant value ($840). An obvious question to ask is, if the golden constant provides a guide to the value of gold, what typically happens when the price of gold is above or below its golden constant value. Following the path of the real price of gold may be helpful.

Exhibit 1

The Price of Gold, the Level of Inflation and a "Golden Constant Value" of Gold



Source: Bloomberg The "golden constant value" of gold is derived by multiplying the value of the U.S. Consumer Price Index by the average "real price of gold", the average of the nominal price of gold divided by the U.S. Consumer Price Index.

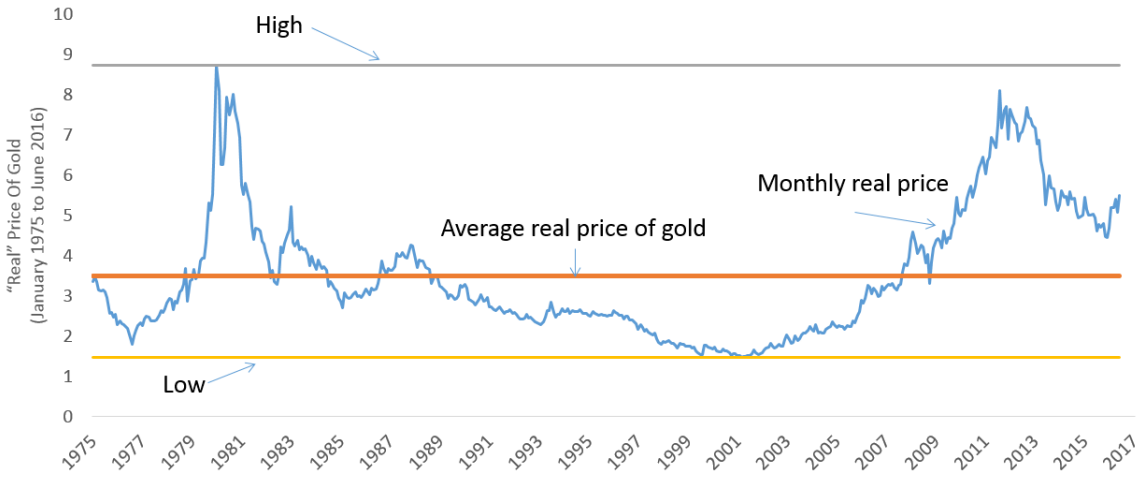
Exhibit 2 shows how the real price of gold has fluctuated since January 1975. As mentioned earlier, the ratio of the price of gold relative to the U.S. Consumer Price Index has averaged about 3.46 over this time period.[3] Of course the value of this ratio might be different using a different inflation index or a resetting of the base date of the U.S. CPI. The general idea of a golden constant only suggests that once an investor thoughtfully selects an inflation index, viewing inflation as a "fundamental" driver of the price of gold, there is no reason to expect that the real price of gold, relative to that index, will persistently trend up or down over a long period of time. Using the U.S. Consumer Price Index[4] as an arbitrary, though

[3] The long run future real price of gold, measured this way, may stay the same or change. If the average real price of gold rises over time then it does more than provide an inflation hedge (it is an asset that generates the return of inflation and an additional premium). If the average price of gold falls over time than it may not live up to investor expectations of what an inflation hedge should be (since it would provide the return of inflation minus some penalty). It is only if the real price of gold stays the same, over a long period of time, that it is possible to consider it an inflation hedge without a very lengthy list of qualifications about what one expects from an inflation hedge. In "The Golden Dilemma", Erb and Harvey (2012) examine the golden constant from 1792.

[4] Erb and Harvey (2013) go beyond a United States-centric view (gold priced in US dollars and real gold prices calculated using the US CPI) and explore the fluctuations of the real price of gold from the perspective of 22 other countries. However, the perspective gleaned from these extra counties did not alter the real gold price analysis message. There are at least two reasons. Unlike stocks or bonds, which to some degree are different from one country to another, gold is gold everywhere. Its price is the same everywhere (after adjusting for exchange rates). If the price of gold was not the same everywhere, there would be an attractive arbitrage opportunity from buying gold inexpensively in one country and selling it for a lot more in some other country. This idea that the nominal price of gold is the same everywhere also leads to the idea that the real price of gold is the same everywhere, even though countries differ in the ways that they honestly or dishonestly calculate inflation.

conventional, fundamental driver of the price of gold, the high real price of gold has been about 8.73, the low real price of gold has been about 1.47 and the current real price of gold is about 5.50.[5]

Exhibit 2
The Real Price of Gold



Source: Bloomberg. The real price of gold is the nominal US dollar price of an ounce of gold divided by the U.S. Consumer Price Index. The average price of gold is the equally weighted average of the real price of gold observations. Monthly observations.

In the future high and low real prices of gold may be more or less extreme than in the past. The historical low real price of gold of 1.47 reflects the historical volatility of the real price of gold and it is a measure of how low the real price of gold actually sank in the past. It is not an indication that the real price of gold cannot fall to a lower level in the future. The high and low real prices of gold highlight that even if there is on average a golden constant the real price of gold has strayed, and probably will stray, far from this possible central tendency. It is also possible that the future will be unlike the past.

There are at least two ways to think about the current historically high real price of gold. One is that the real price of gold may "mean revert" towards the horizontal rust colored line, the golden constant value for gold linked with the average real price of gold. Or it is also possible that "history is more or less bunk", as Henry Ford once put it, reflecting an idea that bold investors and innovators were never slaves to history.

Mean reversion may be consistent with the idea of a long run golden constant in which the real price of gold mean reverts to its average. However, in a very obvious way, Exhibit 2 also suggests that when the real price of gold falls the golden constant level is not a floor -- a protective line in the sand that the real price of gold will not cross. Since the future has not happened yet, it is not possible to forcefully opine that the real price of gold will not fall below its average, the golden constant, level in the future. Of course, it is worth considering how rewarding an investment in gold might be if the real price of gold falls to its previous low level, or lower. Focusing on the idea that inflation is the fundamental driver of the price of gold, somewhat similar in spirit to thinking about earnings or cash flow[6] as the fundamental drivers of

[5] Current price of gold/Current CPI = $1,321/239.927~ 5.504.
[6] If inflation is the fundamental driver of gold, inflation may not be more difficult to forecast than earnings or cash flows for stocks.

stocks, the real price of gold can be thought of as a valuation ratio. Historically has there been any relationship between the real price of gold and subsequent gold real returns? Or, alternatively, does valuation matter?

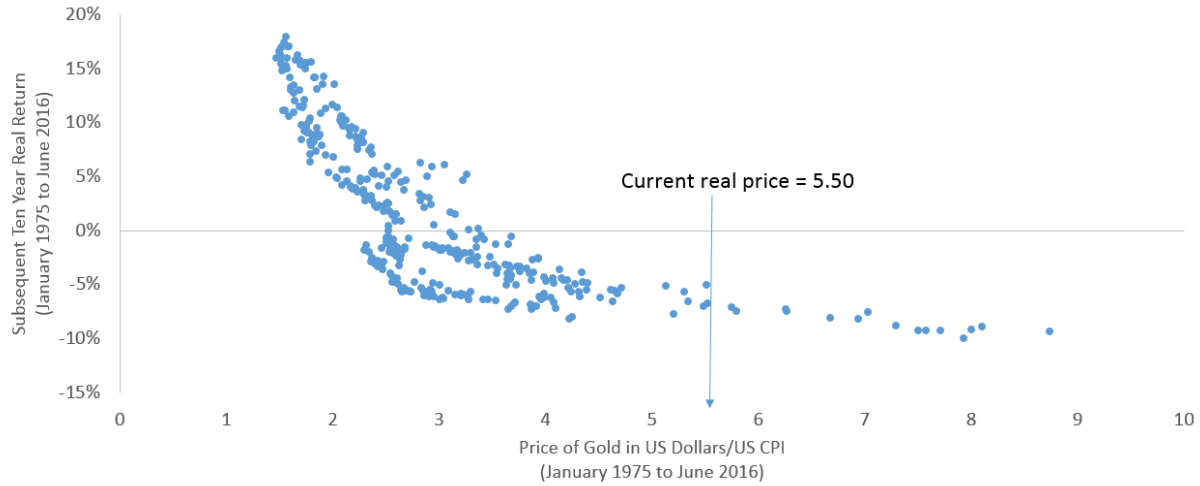
Exhibit 3 depicts the historical relationship between the real price of gold and subsequent 10 year real gold returns. Historically, below average real gold prices have been followed by above average 10 year real gold returns and above average real gold prices have been followed by below average 10 year real gold returns. Since the real price of gold is currently above its historical average, Exhibit 3 suggests that over the next 10 years real gold returns could be below average. Thinking of the real price of gold as a valuation metric this may seem to suggest that valuation matters. Since the devil is in the details, it does and it does not. In a golden constant sense, valuation matters since deviations from a "normal" real price of gold are inconsistent with the concept that gold is an inflation hedge, the long run real price of gold is constant over time and the long run real return of gold is zero. There are, of course, alternative views, such as the idea that "the price of gold equals the value of gold", or a belief that the Chinese control the gold market, in which the real price of gold has no obvious role.

One can view Exhibit 3 as a typical predictive chart that echoes the work of Campbell and Shiller (1998) and many others. The real price of gold in January 1975 is matched with the real gold return from January 1975 to January 1985, the real gold price from February 1975 is matched with the real gold return from February 1975 to February 1985, etc. It may be common to look 10 years into the future in these illustrations, however it is worth noting that it is easier to view the choice of a 10 year horizon as a convenient convention rather than a scientific revelation.[7]

[7] It is possible to compare the real price of gold with real gold returns over the next day, week, month, year or any time period. It is common to believe that if "valuation" plays some role in subsequent returns that its impact will probably be more significant at a longer horizon, such as 10 years, than at a short horizon, such as one day. For example, Campbell and Shiller (1998) examined the relationship between a measure of stock market valuation and subsequent real stock market returns. A challenge with long-run return predictability studies is that if a researcher, say, has a desire to find evidence that there is a useful "value" metric it may not be surprising to see evidence that is more apparent than real supporting the researcher's beliefs.

Exhibit 3

Historical Relation Between the Real Price of Gold and Subsequent Real Gold Returns

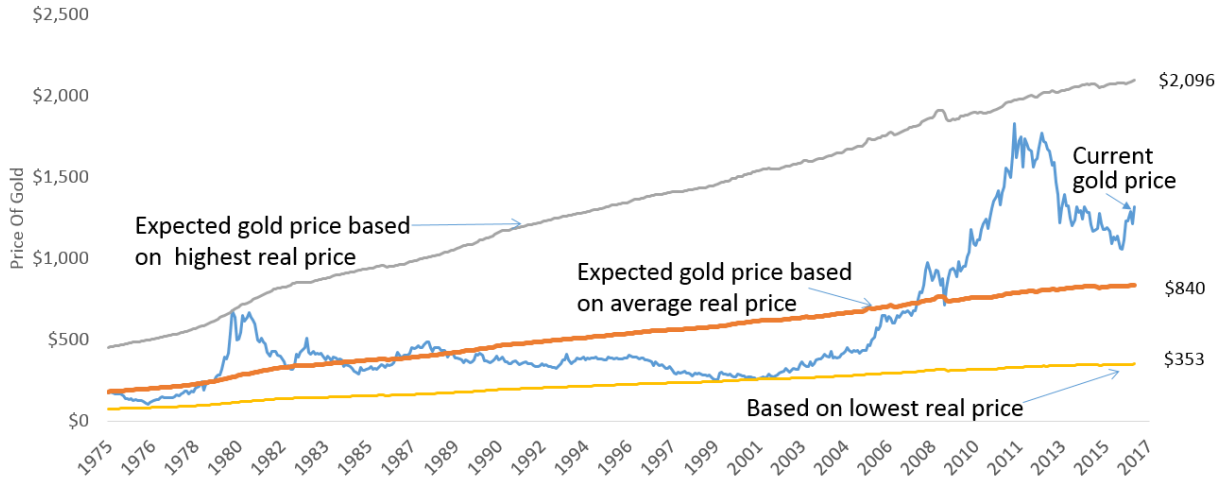


Source: Bloomberg . The expected price of gold is derived by multiplying the value of the U.S. Consumer Price Index by the average real price of gold, the average of the nominal price of gold divided by the U.S. Consumer Price Index. Starting with the real gold price for a specific date, the real gold return is the annualized geometric real gold return over the next ten years. Monthly observations.

Given a golden constant perspective, Exhibit 4 tries to answer the question "how low might the price of gold go if the previous low real price of gold is revisited?" Given the value of the U.S. Consumer Price Index for June 2015 and the previous low real price of gold, a possible low price for gold is about $353 an ounce. This does not mean that the price of gold will immediately fall to $353 an ounce. Rather it is a suggestion that, given the volatile history of real gold prices that exists, the real price of gold once fell to 1.47 and it could fall to that level again. A consideration of the opportunities and the pitfalls of an investment benefit from a consideration of probable and possible outcomes. If the question is "what is the likely price for gold given a belief in the golden constant" then an answer is $840 an ounce. If the question is "how low could the price of gold go given the history of real gold prices and a belief in the golden constant" then an answer is about $353 an ounce. Aternatively it is possible to invoke the "history is bunk" view and ignore the possibility, or declare the impossibility, that the real price of gold could fall to a low real price level. In a golden constant context, $353 an ounce is the downside risk to the price of gold given the existence of a golden constant framework, a prior low real price of gold and the current level of the U.S. Consumer Price Index.

Exhibit 4

The Price of Gold and Average, High and Low "Golden Constant" Values



Source: Bloomberg. The expected price of gold is derived by multiplying the value of the U.S. Consumer Price Index by the average real price of gold, the average of the nominal price of gold divided by the U.S. Consumer Price Index. The "high" and "low" observations use the historically observed high and low real prices of gold. Monthly observations through June 2016.

If, in a golden constant sense, a "fair value" of gold is currently $840 an ounce and a possible low value of gold is currently $353 an ounce, how does that translate into expected nominal and real return? Resorting to the convention of peering 10 years into the future, Exhibit 5 provides a framework. Look at the case in which inflation is expected to be 2% per year for the next 10 years (this assumption can be compared with the 10-year Treasury break-even rate). The golden constant value of gold would increase from $840 an ounce to $1,024 an ounce, and the "overshoot" price would rise from $350 an ounce to $430 an ounce. If over a 10 year investment horizon the price of gold fell from $1,321 an ounce to $1,024 an ounce it would experience a nominal return of -2.5% per year and a real return of -4.4% per year. If the price of gold fell from $1,321 an ounce to a 10 year hence "overshoot level" the nominal and real returns would be -10.6% per year and -12.4% per year, respectively.

Exhibit 5 also shows what 10 year nominal and real returns might look like if inflation for the next 10 years was 0% per year or 1% per year. Not surprisingly, if the level of inflation differs from one scenario to another then nominal returns differ from one scenario to another by the difference in inflation rates. What may be a bit more interesting is that real returns do not seem to vary across inflation scenarios. Regardless of the future inflation rate the real rate of return is -4.4% per year if gold declines over 10 years to its golden constant fair value. Regardless of the future inflation rate the real rate of return is -12.4% per year if gold declines over 10 years to its "overshoot level". The observation that the level of inflation does not affect the real rate of return is similar to the observation in Erb and Harvey (2013) that from 1980 to 2000 the real return of gold was the same in Brazil and the U.S. even though inflation rates were quite different in the two countries.

Exhibit 5

"Golden Constant" Real Returns

	Current Gold Price	Current Golden Constant Level	Forecasted 10 Year Inflation Rate	Year 10 Golden Constant Level	Geometric Nominal Forecasted Annualized Return	Geometric Real Forecasted Annualized Return
Average	$1,321	$840	0%	$840	-4.4%	-4.4%
"Overshoot"	$1,321	$353	0%	$353	-12.4%	-12.4%
Average	$1,321	$840	1%	$927	-3.5%	-4.4%
"Overshoot"	$1,321	$353	1%	$390	-11.5%	-12.4%
Average	$1,321	$840	2%	$1,024	-2.5%	-4.4%
"Overshoot"	$1,321	$353	2%	$430	-10.6%	-12.4%

*In the "Overshoot" scenario, gold returns to its lowest real price observed since 1975

Suppose an investor views gold as a possible inflation hedge and the investor is able to perfectly forecast inflation over the next 10 years. In a historical U.S. context how valuable might this skill have been in forecasting future 10 year nominal gold returns? Exhibit 6 provides some perspective. Exhibit 6 shows rolling 10 year total returns for the nominal price of gold, the real price of gold and the rate of inflation. The rate of inflation has declined over time but there does not seem to be much of a linkage between the 10 year rate of inflation and either the nominal or real return of gold. Exhibit 6 highlights that even if inflation is a long-term fundamental driver of the "fair value" of gold, it is important to identify those circumstances under which clairvoyant forecasts of future inflation will be helpful.

Exhibit 6

Rolling 10-Year Gold Returns, Real Gold Returns and Inflation

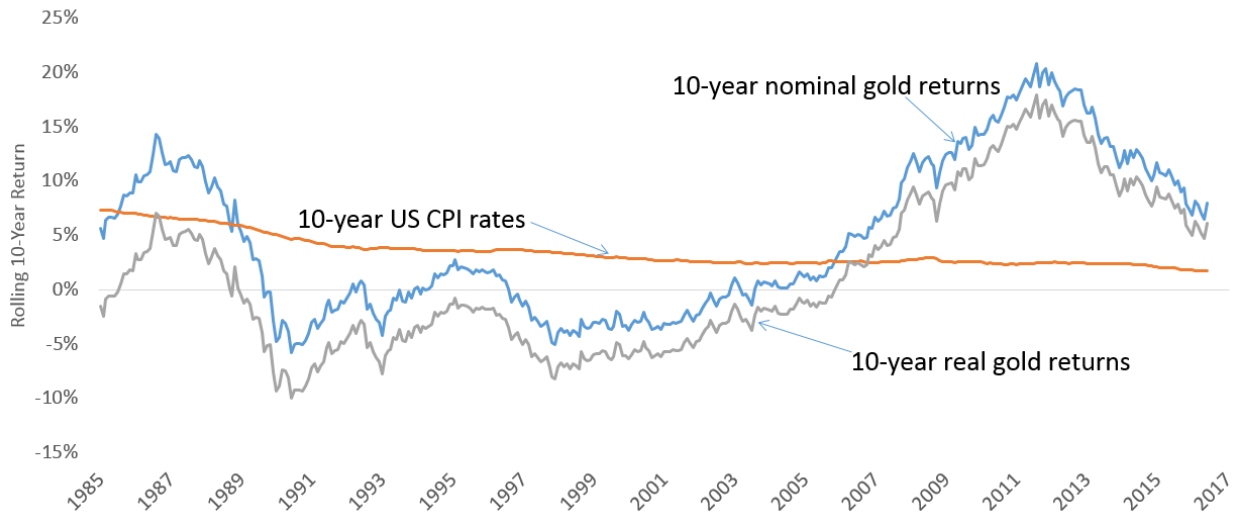
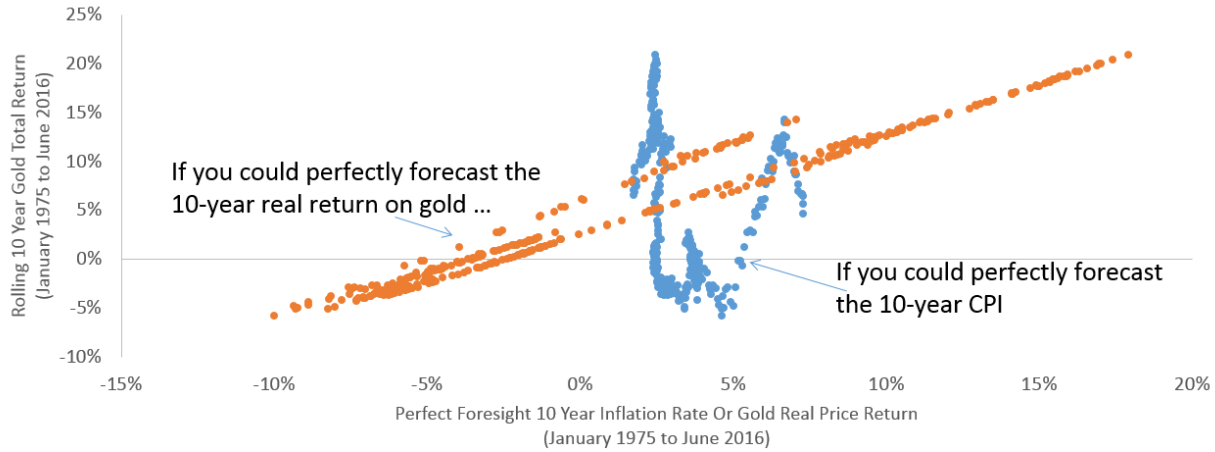


Exhibit 7 presents another way of thinking about the value of perfect forecasts of inflation and the realized nominal returns from gold. The y-axis of Exhibit 7 shows the rolling 10 year nominal returns for gold and the x-axis plots the rolling 10 year returns for both inflation and the real rate of return of gold. The message in Exhibit 7 is simple. Exactly knowing the inflation rate over the next 10 years has been of little help in forecasting the future nominal return on gold. On the other hand being able to know the future real return on gold delivers a highly accurate forecast of the nominal return on gold. This insight should also be evident from Exhibit 6. Historically, inflation in the U.S., measured over 10-year periods, has very low volatility. In contrast, the price of gold has large volatility. As a result, being able to forecast inflation does not really help you forecast the volatile nominal price of gold.

Importantly, even though there is little relation between the nominal price of gold and inflation when measured over 10-year periods, the evidence in Erb and Harvey (2012) suggests that gold holds its value over the very long run. They present historical evidence that the wage of a Roman centurion (in gold) was approximately the same as an US Army captain's pay. They also detail that the price of bread (in gold) thousands of years ago is about the same as we would pay today at an upscale bakery. So while gold might protect against inflation in the very long run, 10 years is not the long run. In the shorter run, gold is a volatile investment which is capable and likely to overshoot or undershoot any notion of fair value.

Exhibit 7
The Value of Perfect Foresight



Conclusion

A golden constant framework suggests that $840 an ounce is a possible estimate of gold's "fair value" and that the price of gold could fall as low as $353 an ounce. Thought of in terms of possible real returns over the next 10 years, an expected real return for gold is about -4.4% per year using this notion of "fair value" and in the case of an "overshoot" scenario, the real return of gold could be about -12.4% per year.

Depending upon one's beliefs, the golden constant framework may or may not be a useful way to think about the "fair" and "possible" values of the price of gold. The golden constant framework suggests that inflation is a fundamental driver of the price of gold in the longer term. It is common for stock and bond investors to point out that stocks and bonds have cash flows that drive their fundamental values. Many fixed rate bonds have fixed cash flows and fixed maturities. Stocks have unknown expected cash flows and no specified maturity. Gold has neither fixed nor expected cash flows and it does not have a maturity. As a result, it is much more difficult to define gold's fundamental value. Given the challenge of specifying a pricing model, it is not surprising that gold exhibits substantial price volatility even measured over longer-term horizons.

References

Campbell, John Y. and Robert J. Shiller. 1998. "Valuation Ratios and the Long-Run Stock Market Outlook", *Journal of Portfolio Management*, vol. 24, no. 2:11-26

Erb, Claude B. and Campbell R. Harvey. 2012. "An Impressionistic View of the 'Real' Price of Gold Around the World", SSRN working paper

Erb, Claude B. and Campbell R. Harvey. 2013. "The Golden Dilemma", *Financial Analysts Journal*, July/August, vol. 69, no. 4: 10-42.

Jastram, Roy W. 1978. *The Golden Constant-The English and American Experience 1560-1976*. New York: John Wiley and Sons.