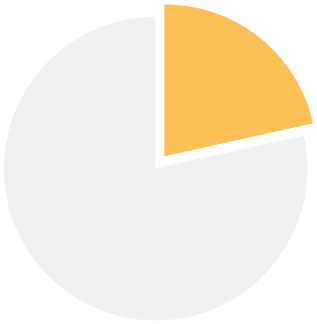


The role of gold in investment portfolios

A historical analysis and perspective

We examine some of the history and ongoing debate over owning gold from the context of an investor. Quantitative analysis of gold in different economic and market regimes demonstrates that gold has been valuable for investors as both an alternative source of return and also as a hedge. Contrary to conventional wisdom, the study finds that over the period from 1973 to 2015, the efficient allocations to gold for a typical balanced investor ranged from 5% to 45% depending on the desired risk preference. Furthermore, the optimal allocation was 25%, which produced higher risk-adjusted returns than any other portfolio.

By David Varadi, David Wismer, and Jerry C. Wagner (November 2013)

Revised by Jerry C. Wagner, Jason Teed, and Liangbo Yu (April 2016)

Flexible Plan Investments, Ltd.

What role should gold play in modern portfolio diversification?

New analysis supports optimal portfolio allocation to gold of 25%

Even the most ardent supporters of portfolio and investment management theory have had belief systems shaken to the core over the past 15 years. With all of the boom-and-bust volatility and unprecedented global systemic risk, both traditional advisors and individual investors have been forced to re-evaluate approaches to risk management and consider new alternatives in portfolio construction. Asset classes have, to say the least, challenged historical norms.

One thing is certain. Within the challenging environment we have all seen, it has become imperative to develop a portfolio approach that minimizes drawdowns and volatility, while delivering respectable returns, all within an individualized investor risk profile.

Perhaps nowhere has the debate raged more fiercely than in consideration of alternative asset classes, especially the role of commodities and precious metals, and most notably gold. Many traditional wealth and portfolio managers will begrudgingly acknowledge that gold should play a role in investors' portfolios, but frankly the rationale can seem quite thin and more instinctual than empirical.

This paper will present a brief discussion of the "gold debate," a broad overview of the tangible benefits of portfolio diversification with gold, and some eye-opening data suggesting a much more important role for gold in portfolios that seek optimal risk-adjusted returns.

Gold

There can be little doubt that throughout history gold has been universally revered as the physical embodiment of enduring wealth and status. King Midas (famed in Greek mythology for his "Midas touch") and El Dorado (the mythical "Lost City of Gold") are just two examples of the evocative and exotic images raised by the allure of gold. The quest for gold has created and toppled dynasties and nation states over the millennia.

Gold has been used as a form of currency for thousands of years. Unlike paper or electronic currency, gold has a fixed supply and as a physical commodity can be relatively difficult to obtain. As a result, gold has historically offered a natural hedge against inflation and provided an alternative to investors when the value of other forms of currency is depreciating.

But what does this all really mean for today's investors and those entrusted to manage their portfolios?

One can find compelling arguments from respected investment professionals, economists, hedge funds, and major Wall Street strategists on all sides of the gold issue as it pertains to portfolio management.

Ray Dalio, founder, chair, and CIO of Bridgewater Associates, LP (generally regarded as the world's largest and most successful hedge fund, with over $150 billion in assets under management), shared this in a 2012 interview with CNBC:

> *"I think gold should be a part of everybody's portfolio to some degree because it diversifies the portfolio—it is the alternative money. We have a situation where we have too much debt. Too much debt leads to the printing of money to make it easier to service. … Money can be produced, [but the supply of] gold is somewhat limited."*

Some traditional arguments for gold

Before we delve into the quantitative analysis, let's take a big-picture look at some of the most enduring arguments for the role of gold in a portfolio.

The literature from academia, the financial press, respected Wall Street firms, and the general investing community all generally come back to some basic assertions on the potential benefits of allocations to gold in a portfolio:

- As a hedge against inflation
- As a hedge against deflation
- As protection against a declining U.S. dollar (and other major global currencies)
- As a safe haven in times of geopolitical and financial-market instability
- As a basic commodity, with its own supply-and-demand fundamentals
- As a long-proven store of historical value
- As an "insurance policy" against black-swan and "long-tail" risk events
- As an asset with common (though not perfect) negative correlations with other asset classes
- As an investment with an underlying global central bank and sovereign wealth demand
- As an underowned investment class, suggesting future demand increases
- As an important portfolio diversifier

Each of these arguments can find its supporters and naysayers, all armed with their own particular analyses and biases. But even well-credentialed critics of gold grudgingly admit there is a place for it in most every investor's portfolio.

In a recent paper titled "The Truth about Gold: Why It Should (or Should Not) Be Part of Your Asset Allocation Strategy," professor Campbell R. Harvey of Duke University's Fuqua School of Business, summarized in part,

> *"The attractiveness of gold as an investment can generate heated arguments, many of which are based on wishful thinking rather than fact. … Most arguments for holding gold in a portfolio are not supported by an analysis of the data. Nonetheless, an argument can be made for including gold as a commodity in a well-diversified portfolio, particularly if investors and central banks increase their demand—even moderately—for gold."*

And an independent, proprietary study by Oxford Economics concluded,

> *"We find that because of its lack of correlation with other financial assets, gold has a useful role to play in stabilizing the value of a portfolio even if the conservative assumption of a modest negative real annual return is made."*

Of course, there are no guarantees of even "a modest negative real return" on one's investment in gold. Gold can go through periods of extreme volatility, like all asset classes. One only has to look at the period from 2008 to 2015, when gold suffered a 34% decline, then delivered a 281% price increase, followed by a sharp 38% retracement, for a total price decline of 31% by the end of 2015. Gold's volatility can be intimidating for short-term traders and should, for most investors, be considered principally as a long-term portfolio component. Of course, for professional traders, its volatility can make it an excellent tactical trading tool, as well.

A quantitative analysis of the role of gold in investment portfolios

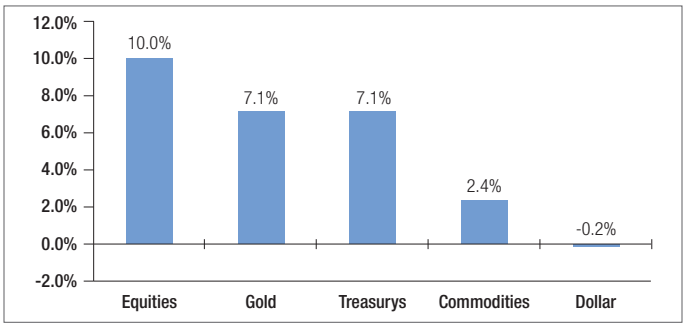
Opinions on the subject of gold as a portfolio component are highly polarized, and it is often difficult to separate hyperbole from facts. We believe it is necessary to fully understand the economic and market drivers that can make gold a valuable constituent of a typical investor's portfolio.

We will focus this quantitative assessment on a look at how gold has performed relative to other major asset classes since 1973 (the year in which the price of gold was finally unfrozen from its $35 per ounce Great Depression status) under a variety of market and economic conditions. The global and U.S. economies since that time have thrown a multitude of challenging situations at investors, from several energy crises, to the interest-rate spikes of the 1970s, to any number of macro geopolitical situations—including the two great booms and busts of the stock market over the past 15 years.

We have selected 1973 as the starting point for our analysis, as this represents what we believe to be the first "clean" calendar year for gold price performance following the momentous decisions of the Nixon administration in August 1971. Actions taken then effectively ended "ties" to the gold standard for the U.S. dollar and suspended convertibility of the dollar to gold.

Let's first look at the annualized rate of return of various asset classes from 1973 to December 31, 2015 (Figure 1).

Figure 1 Baseline: Performance of Various Asset Classes (1973–12/31/2015)



Definition: Annualized returns of various asset classes over time. See source data.

As shown, equities have been the best-performing asset class throughout this period, followed by gold and Treasury bonds. But equity performance has been far from a "smooth ride" for the past several decades. In contrast, gold's equally bumpy journey has demonstrated a unique ability to outperform equities in times of equity market stress and also under a variety of different economic conditions.

Let's examine several of those economic scenarios, again based on historical data from January 1973 to December 2015. We examined the favorable performance of gold relative to other asset classes under seven different conditions:

1. Real returns on the 10-year Treasury bond are negative (real interest rates less than zero).
2. Equities are in a bear market.
3. Commodity prices are in a bull market.
4. The U.S. dollar is in a bear market.
5. U.S. Treasury bonds are in a bear market (rising-interest-rate environment).
6. Inflation is rising.
7. Market volatility is high.

Scenario #1: Real rates on Treasury bonds are negative

One of the most important benchmarks for investor returns is the "real" 10-year yield, or the current total return to a 10-year Treasury bond minus the expected rate of inflation. Since the Treasury return is considered virtually "risk-free," this represents what an investor can reasonably expect to earn on a long-term investment adjusted for changes in currency purchasing power.

Typically, when real yields are positive, equities and bonds tend to perform well as long-term investments. However, the nightmare scenario that keeps pension-fund and other asset managers up at night is when real yields are negative.

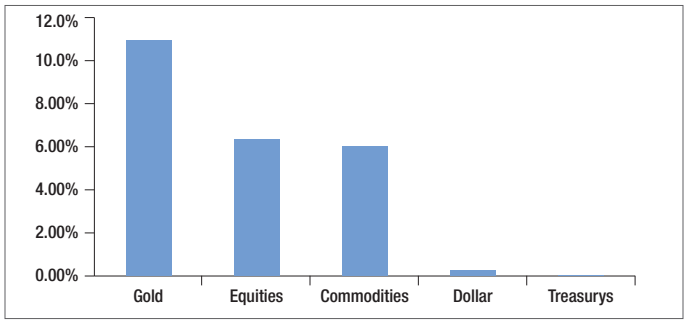
Under certain conditions, investors are willing to accept a negative real return in exchange for "safety" and the likelihood that they will recover most of the principal that they invest. This is most common for conservative investors that are near to or currently in retirement.

Negative real rates have been common throughout much of the era that has followed the financial crisis of 2007–2009. This has been a result of the Federal Reserve systematically lowering interest rates to near-zero levels in order to boost the economy. Treasury yields had fallen so far that they were below the rate of inflation for much of 2011 and 2012—indicating that real yields were actually negative.

The question then becomes, "How is an investor going to earn a real return on one's investments?" This scenario deserves very serious consideration. Real yields have been currently hovering around zero. As it turns out, the great savior in this scenario has historically been gold.

Figure 2 shows the compounded annual return for various asset classes when real 10-year yields are negative.

Figure 2 Performance of Various Asset Classes When Real Rates Are Negative (1973–12/31/2015)



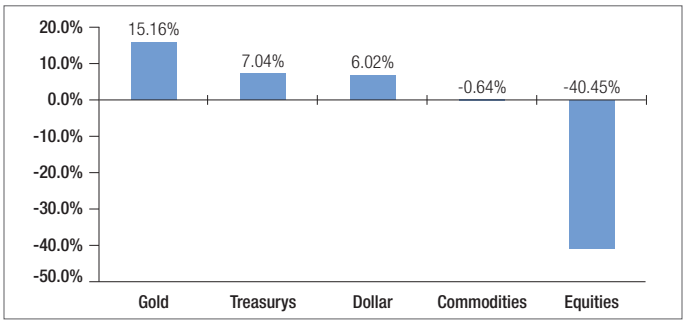
Definition: When the current total return to a 10-year Treasury bond minus the expected rate of inflation is less than zero.

As shown, gold is the best performing of all major asset classes, delivering nearly 11% annual returns when real Treasury returns are negative, while equities perform at a rate about one-half that of gold. Since 2013, when we first released this paper, real rates have persisted to remain near zero, occasionally moving into negative territory. Additionally, gold has been exceptionally weak. While the general principles and relative performance of each asset class remains the same, the absolute return in gold has decreased. Gold has responded to expectations of inflation and a rise in interest rates by giving back some of the gains it had experienced in the negative-real-rate environment.

Scenario #2: Equities are in a bear market

Another benefit attributed to investing in gold is that it provides valuable protection in equity bear markets. It would be reasonable to assume that Treasurys would perform best in equity bear markets, but that has not been the case. Looking across more than 40 years of market history, we identified bull, bear, and sideways markets in the S&P 500 Index*, then assessed the returns of alternative asset classes during the bear periods (Figure 3).

Figure 3 Performance of Various Asset Classes in Equity Bear Markets (1973–12/31/2015)



*Definition: Equity bear markets are said to occur when equity prices decrease more than 20%. *See Appendix.*

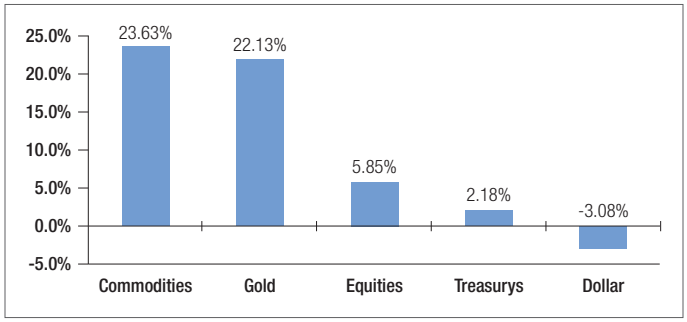
Clearly gold has outperformed all other asset classes during periods of equity market stress. Surprisingly, its historical compound return during major stock declines has been higher than the return of Treasurys. This disparity arises because gold offers inflationary protection as well as crisis protection. In addition, because gold has relatively minor demand as an industrial metal, and demand is only partially consumer driven, it tends to have very little economic sensitivity.

The period from 10/10/2007 through 3/9/2009 marked the recent credit crisis, and it was considered a major bear market, lasting 355 days. During this period, the equity market fell 55.2%. In contrast, gold rose 24.6%, more than both Treasurys and the U.S. dollar, which both gained 13.5%. Surprisingly, commodities as an asset class fell in value and did not prove to be a fully defensive allocation.

Scenario #3: Commodities are in a bull market

Figure 4 shows the performance of the different asset classes during bull markets in commodities. As you can see, although gold provided positive returns during equity bear markets, while commodities could only muster smaller losses, gold nearly matched the performance of commodities during bull markets in commodities themselves. It thus behaves well on its own and as a useful substitute for broader commodity exposure.

Figure 4 Performance of Various Asset Classes in Commodity Bull Markets (1973–12/31/2015)



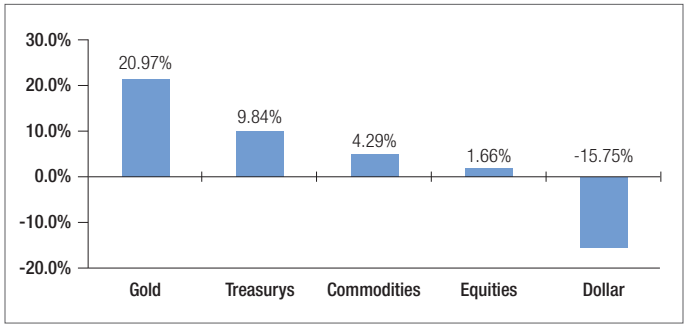
Definition: Commodity bull markets are said to occur when commodity prices rise 20%.

One of the significant bull markets in commodities occurred from 8/30/1977 to 2/11/1980. It coincided with U.S. President Jimmy Carter's warning that "the world is running out of oil," as well as the tensions with Iran and a phased deregulation of oil prices. Commodities rose 61% over that period, while gold soared 386%.

Scenario #4: The U.S. dollar is in a bear market

We have also looked at historical data that shows the U.S. dollar's value was decreasing relative to a "basket" of foreign currencies (Figure 5).

Figure 5 Performance of Various Asset Classes in U.S. Dollar Bear Markets (1973–12/31/2015)



Definition: Bear markets for the U.S. dollar are said to occur when prices decrease 10%.

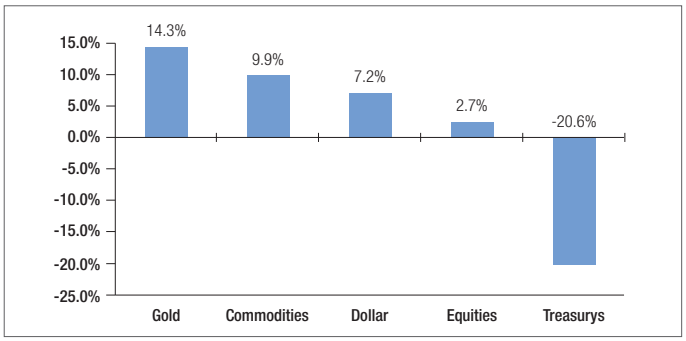
There can be any number of reasons for a dollar bear market, ranging from trade and budget deficits to monetary policy decisions. The data in Figure 5 shows that gold performed extremely well, and significantly outperformed all other asset classes, when the U.S. dollar was falling. Perhaps this is because it is considered to be the currency of last resort by many investors.

For example, the Bretton Woods agreement was a fixed exchange-rate system where the U.S. dollar could be exchanged for gold at a fixed price of $35 per ounce, and other major world currencies had a fixed exchange rate to the dollar. As mentioned earlier, in response to a growing deficit in U.S. gold reserves versus U.S. dollars outstanding, President Nixon decided to break the agreement in 1971. In March 1973, the fixed exchange-rate system officially became a floating exchange-rate system. The U.S. dollar was in a bear market from 1/22/1973 to 7/6/1973 and declined roughly 18% during that time frame. Gold gained 331% over that same time frame, reflecting the increased money supply that was not factored into the price.

Scenario #5: U.S. Treasurys are in a bear market

U.S. Treasurys reflect lower prices when interest rates are rising and yields increase. Gold has historically offered the best returns under such a scenario, even outperforming equities, as Figure 6 shows.

Figure 6 Performance of Various Asset Classes in Treasury Bear Markets (1973–12/31/2015)



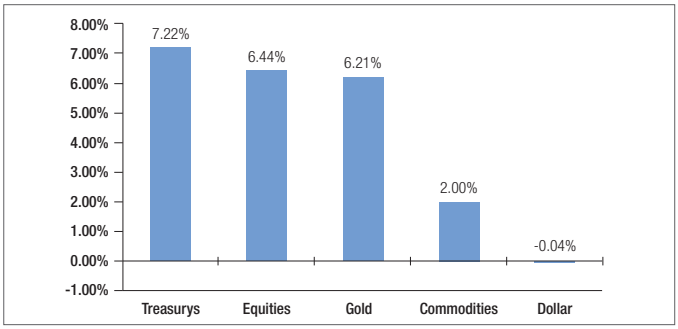
Definition: Bear markets for U.S. Treasurys are said to occur when Treasury prices decrease 10%.

Since the first release of this paper in 2013, we have experienced Treasury bear markets. The largest effect of these bear markets has been on the performance of equities, which have not fared well in these recent environments. Equities have decreased in compound annual growth rate (CAGR) from 16.2% to 2.7%, largely because these environments do not occur often, and recent performance has been poor. The expectation is that eventually interest rates will need to rise from their current near-zero levels, initiating another Treasury bear market. This highlights the important return and diversification benefits that gold may have in the future if history repeats itself.

Scenario #6: Inflation is rising

Figure 7 shows the historically superior performance of gold when there was a sustained increase in the general level of prices for goods and services. We have defined rising inflation as periods when the one-year rate of change of the Consumer Price Index (CPI) is positive, with causality arising from increased demand chasing too few goods or a rising-cost environment for producers and manufacturers. Within this type of environment, the U.S. dollar clearly weakened, in both "price" and purchasing power, while gold performed well, outperforming a basket of commodities.

Figure 7 Performance of Various Asset Classes When Inflation Is Rising (1973–12/31/2015)



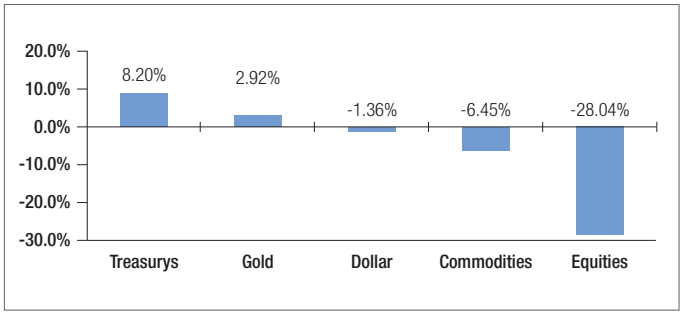
Definition: Rolling 12-month rate of change in the CPI is positive.

In 2006, in large part due to rising energy costs, G-7 nations faced the highest level of inflation since the early 1990s. Between January and August 2006, inflation rose 3.6%. In contrast, the price of gold rose 21.5%.

Scenario #7: Market volatility is high

We have defined high volatility as periods when the Implied Volatility Index (VIX) levels were in the top quintile of their 23-year history. As Figure 8 demonstrates, Treasurys performed best when volatility was high, as investors tended to "run for the safety" of preserving principal. But gold also had positive returns, averaging a 2.9% annualized return and serving as a useful "crisis" hedge for investment portfolios.

Figure 8 Performance of Various Asset Classes When Volatility Is High (1990–12/31/2015)



Definition: The VIX Index is in the top quintile of historical data.

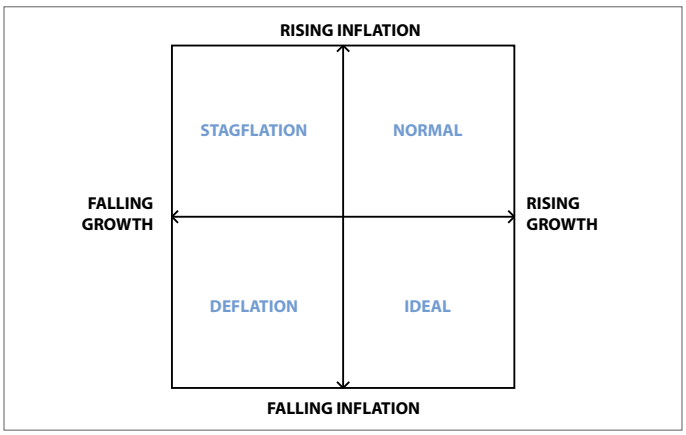
For example, during the Russian financial crisis in August 1998, volatility spiked to high levels starting on August 3 and remained elevated until November 19. In this short period, gold managed to gain 3.5%, while other assets endured a roller-coaster ride. More recently, the extreme levels of volatility seen during the 2007–2009 U.S. credit crisis saw gold sell off dramatically along with most other asset classes. However, it did not fall as far and subsequently recovered much faster, allowing it to exit 2009 at new all-time highs.

Performance of gold in different economic regimes

It is clear from these examples that gold can provide favorable returns and act as an important counterbalancing portfolio component under a variety of very specific market and economic conditions. But, how does gold perform under different classic economic regimes?

A popular concept in modern portfolio theory is the "All Weather" definition of economic regimes, with four different "states of the world" characterized by either rising or falling inflation and rising or falling economic growth. Bridgewater Associates, the large and very successful hedge fund mentioned earlier, has developed a simple conceptual graph to capture this idea (Figure 9).

Figure 9 Economic Regimes



In our analysis, we considered the different environments that could be characterized by the change in both inflation and economic growth, and then created our own identifying labels:

"Normal": Real economic growth rate (GDP) is rising and inflation (CPI) is rising.

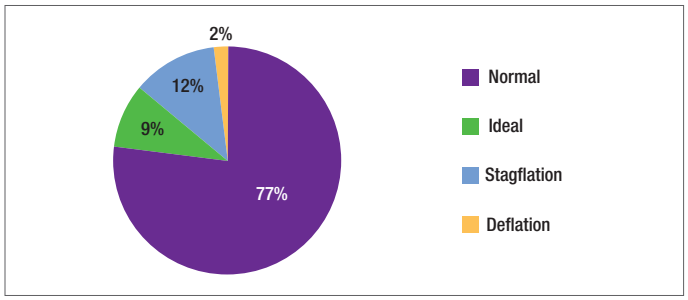
"Ideal": Real economic growth rate (GDP) is rising and inflation (CPI) is falling.

"Stagflation": Real economic growth rate (GDP) is falling and inflation (CPI) is rising.

"Deflation": Real economic growth rate (GDP) is falling and inflation (CPI) is falling.

Figure 10 shows the relative frequency of these different economic regimes over the 43-year time period that was studied. As you can see, the most frequently occurring economic state (77%) was what we call "Normal," characterized by rising economic growth and rising/moderate inflation. This is to be expected, as most central banks around the globe tend to target a 2–3% annual inflation rate, and governments and private industry obviously attempt to achieve economic growth over time.

Figure 10 Historical Frequency of Different Economic Regimes (1973–12/31/2015)



In contrast, the extreme opposite situation, "Deflation," fortunately has occurred relatively infrequently (2%). This is the destructive situation where both economic growth and inflation are falling. Japan is a modern case study of the deleterious effects of deflation. (The longest and most notable period of deflation in the U.S. was during the Great Depression, which is outside of the time frame of our study.) Governments generally attempt to avoid this situation at all costs, even if that means printing money and creating temporary excess inflation.

"Stagflation" is a situation where inflation is rising and growth is falling. This has occurred roughly 12% of the time. The most notable example of stagflation was during the 1970s when inflation was high, partially due to the energy crisis, and the economy endured some difficult times.

Finally, "Ideal" conditions are defined as the period where inflation is falling but economic growth is robust and rising. This regime was present roughly 9% of the time. This is a great environment for business expansion and for investors in many asset classes. The 1990s is the best example in recent U.S. history of an "Ideal" period.

Figures 11 through 14 summarize the performance of the various asset classes during each of these economic regimes.

Figure 11 Performance of Various Asset Classes in "Normal" Economic Conditions (1973–12/31/2015)

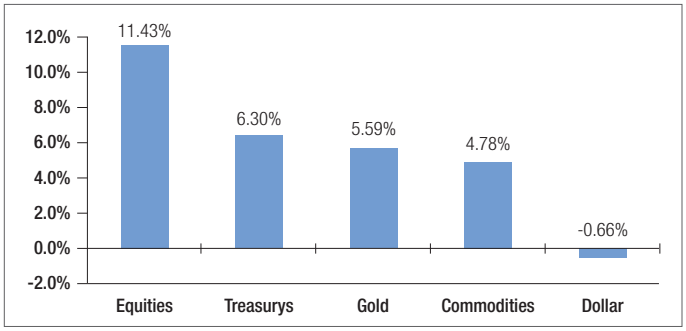


Figure 12 Performance of Various Asset Classes in "Ideal" Economic Conditions (1973–12/31/2015)

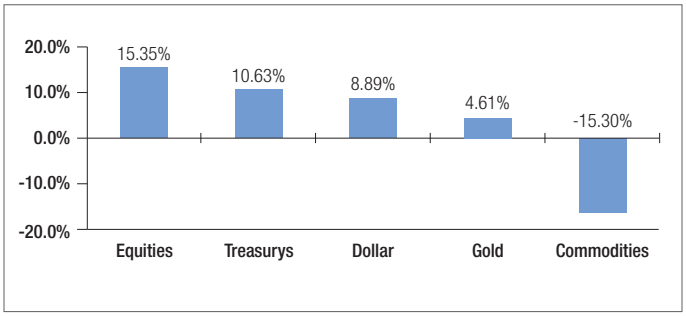


Figure 13 Performance of Various Asset Classes in "Stagflation" Economic Conditions (1973–12/31/2015)

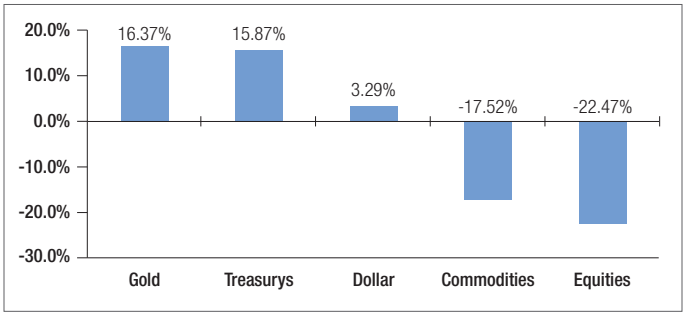
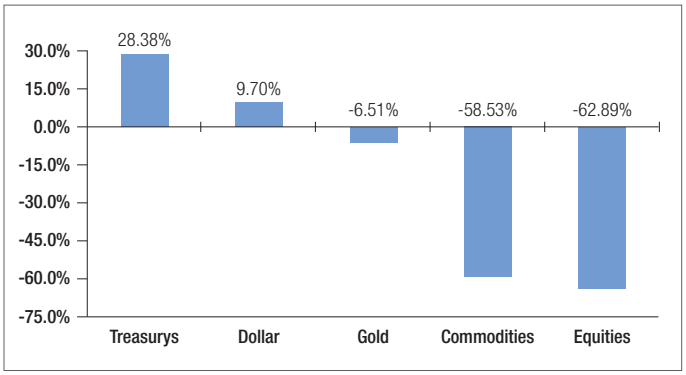


Figure 14 Performance of Various Asset Classes in "Deflation" Economic Conditions (1973–12/31/2015)



There are several takeaways from this analysis pertinent to gold:

- In the most commonly occurring circumstance of "Normal" economic conditions, gold finished a close second to equities in terms of average annual return.
- In "Ideal" conditions, equities provided the best performance.
- However, in the two most negative economic regime conditions, gold far outperformed equities. In fact, in times of "Stagflation," gold provided vastly superior returns to any other asset class.
- "Stagflation" tends to happen slightly more frequently than "Ideal" economic conditions (12% versus 9%), creating quite an interesting "trade-off" between gold's performance and that of equities under these two regimes. Gold provided positive returns during both periods, while equities only had positive returns in one. Still, gold underperformed equities significantly during "Ideal" conditions. Yet, during periods of "Stagflation," gold's 16.37% annualized gain versus equities' 22.47% loss is certainly a compelling statistic.

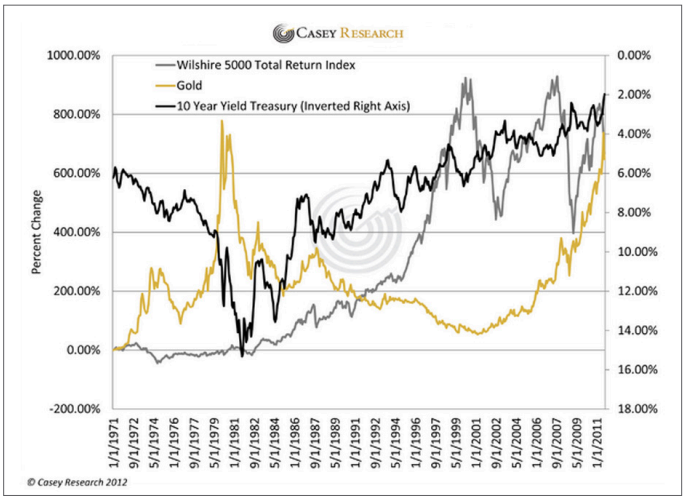
This, once again, reinforces the case for gold as an important portfolio diversifier. Gold provided positive returns under most market conditions (98% of the time in the last 43 years, as shown above). Gold may not outperform equities in times of normalcy and growth, but it has greatly outperformed equities in times of market stress and less-than-ideal economic conditions. Because such times have had the greatest negative returns for traditional equity portfolios, gold can have a significant effect on long-term portfolio volatility.

Gold as a diversifier versus other asset classes

The analysis presented illustrates that gold can provide diversification in several different economic regimes, each of which lies somewhere on the future economic horizon. But how does gold move in relationship to traditional asset classes like stocks and bonds?

As Figure 15 illustrates, gold provided a low correlation to both stocks and bonds and did not move in tandem with traditional asset classes.

Figure 15 Gold vs. Stocks vs. Bonds (Adjusted for Inflation)



One of the statistical measures used to capture this relationship is the correlation coefficient, which ranges between 1 and -1. A coefficient of 1 indicates that a pair of assets move in perfect tandem, while -1 indicates that a pair of assets move in an opposite or alternating fashion. Table 1 shows the correlation of gold for a basic set of institutional asset classes.

Table 1: Gold As A Diversifier: Inflation-Adjusted Correlation Matrix for Basic Assets (January 1974–December 2015)

Asset Names	Gold, London PM Fix
Average Correlation to All Basic Assets	0.05
T-Bills	-0.11
Intermediate U.S. Government Bonds	0.05
Long-Term U.S. Government Bonds	0.04
S&P 500 U.S. Equity	0.01
IA SBBI Small-Cap U.S. Equity	0.03
MSCI EAFE International Equity	0.19
CRB Futures Index	0.23

Gold had an average correlation of 0.06, indicating almost no relationship/dependency with other basic asset classes. Gold had the highest correlation to the CRB Futures Index, which is to be expected because this represents exposure to the commodities sector, which includes gold. Clearly gold has been an excellent diversifier for a basket of basic institutional asset classes.

Figure 16 Statistical Significance of Gold REF Allocation and 10th and 90th Percentiles Base Case: 1974–2005

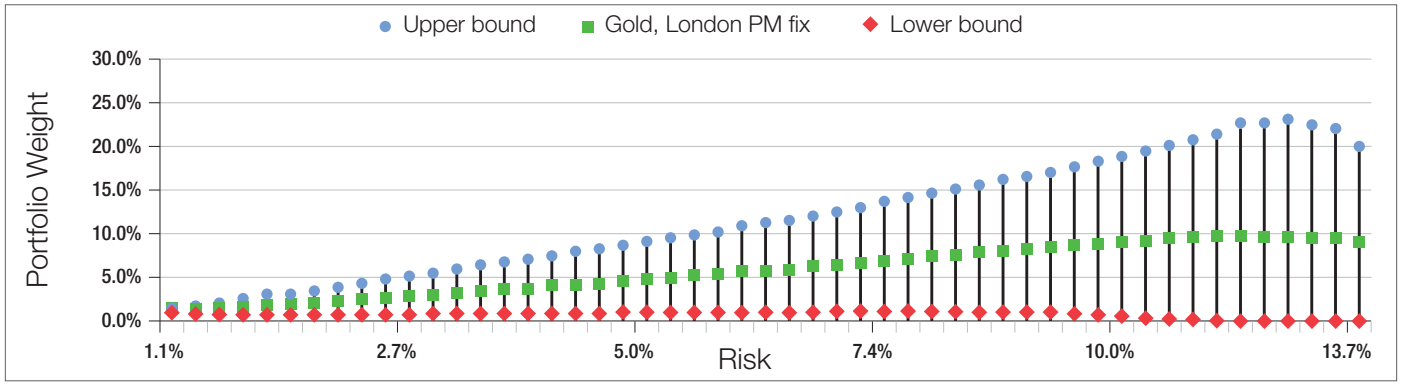
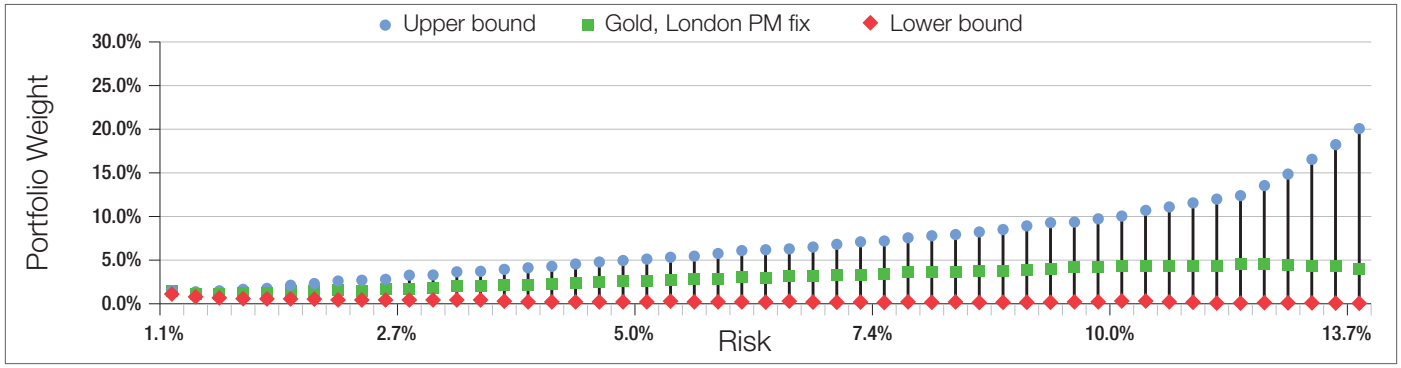


Figure 17 Statistical Significance of Gold REF Allocation and 10th and 90th Percentiles Base Case: Return Premiums: 1974–2005



Optimal portfolio allocations to gold

The study by Oxford Economics referenced earlier shows the optimal allocation to gold is 5%, assuming 2.2% growth and 2% inflation. Under the conditions where inflation was higher, the optimal allocation was also found to be higher than 5%, and the same was true for conservative investors in a low growth/low inflation scenario.

In a 2006 study, Richard Michaud, Robert Michaud, and Katharine Pulvermacher of New Frontier Advisors demonstrated that gold was part of the optimal portfolio for investors at all levels of risk preference tolerances—not just for a balanced investor. Adjusting for uncertainty and seeking the most robust solution, Michaud et al. found that for risk-level tolerances consistent with a balanced investor (around 10% risk), the optimal allocation to gold was found to be above 10% in the base-case scenario using multiple asset classes and historical market data.

Figure 16 is from the Michaud et al. study. It shows the optimal portfolio weight in gold and the maximum (upper) and minimum (lower) allocations at different levels of target portfolio risk.

Using a more conservative set of assumptions with estimated portfolio inputs, Michaud et al. found that the optimal allocation to gold was close to 5% at risk levels consistent with a balanced investor. Figure 17 shows the optimal portfolio weight in gold and the maximum (upper) and minimum (lower) allocations at different levels of target portfolio risk in their conservative case.

But, has gold boosted risk-adjusted returns for a more typical portfolio? What has the optimal allocation to gold been for a typical portfolio? These are more important questions than finding the optimal allocation across a broad universe of asset classes that are more commonly held in large pension portfolios.

First, we define typical: The most common portfolio is one that contains a 60% allocation to equities and a 40% allocation to bonds, or what the literature might refer to as a traditional "balanced portfolio."

As a test of gold's possible diversifying power, we can use this typical portfolio and add an allocation to gold to determine whether we can increase risk-adjusted returns. We will represent stocks in the portfolio with the Vanguard Total Stock Market Index, and for bonds we will use the 10-year Treasury Total Return Index.

Table 2 Risk/Reward Ratios of Portfolios with Different Allocations to Gold and a Balanced Fund

Allocation to Gold	Allocation to 60/40 Balanced Fund	Portfolio Risk/ Reward Ratio
0%	100%	0.62
5%	95%	0.66
10%	90%	0.69
15%	85%	0.72
20%	80%	0.73
25%	**75%**	**0.74**
30%	70%	0.73
35%	65%	0.71
40%	60%	0.68
45%	55%	0.65
50%	50%	0.61
55%	45%	0.57
60%	40%	0.53
65%	35%	0.50
70%	30%	0.46
75%	25%	0.43
80%	20%	0.39
85%	15%	0.36
90%	10%	0.34
95%	5%	0.31
100%	0%	0.29

Figure 18 Risk/Reward Ratio as a Function of Allocation to Gold for a Balanced Investor (1973–12/31/2015)

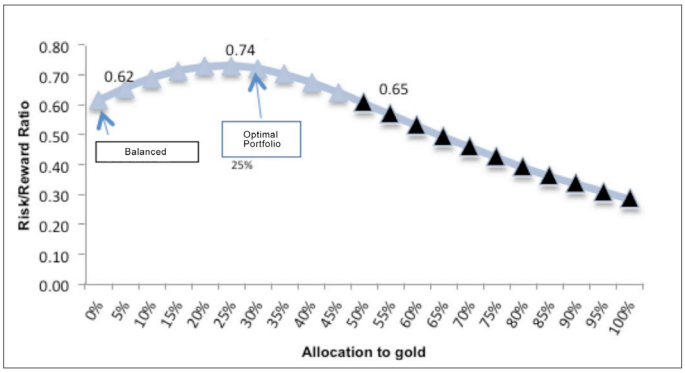


Figure 18 shows the risk-adjusted return ratio (Sharpe) as a function of the allocation to gold from 1973 to 12/31/2015.

Note that all of the blue "dots" left of the vertical center line are portfolios that dominate a balanced portfolio in terms of risk-adjusted returns. In finance parlance, these portfolios are considered to lie on the "efficient frontier." Table 2 shows a more complete breakdown, providing data points for various levels of allocation to gold and the resulting total portfolio risk/reward ratio. All portfolios with allocations to gold highlighted in green have been superior to a traditional balanced fund in terms of risk/reward ratio (0.74).

As Table 2 demonstrates, it has been possible to allocate as much as 45% to gold in a portfolio and still have a superior risk/reward ratio to a portfolio that only holds a balanced fund. The optimal allocation from a risk/reward standpoint has been to allocate 25% to gold and 75% to a balanced portfolio.

This is 5% higher than was optimal when we first released this paper in 2013. In terms of returns, all three asset classes offered less to investors than they did in our last study. In such an environment, diversification becomes more important than returns in creating the best risk-adjusted portfolio. Because the correlation between the asset classes has not changed much from when the previous study was performed, the amount of gold included in a portfolio to reach Sharpe optimality is higher.

Table 3 compares this "optimal portfolio" with both gold and a balanced portfolio.

Table 3 Gold vs. a Balanced Portfolio vs. an "Optimal Portfolio"

	Gold	Balanced Portfolio	Optimal Portfolio (25% Gold, 75% Balanced Fund)
Return (CAGR)	5.90%	7.10%	7.33%
Risk (Standard Deviation)	20.56%	11.40%	9.96%
Risk/Reward Ratio (Sharpe)	0.29	0.62	0.74

Looking at Table 3 we see that this optimal portfolio has had a higher return, lower risk, and higher risk-adjusted return than either a "gold-only" or a traditional "balanced portfolio." The higher return for the optimal portfolio may seem counterintuitive, but the low correlation of gold to a balanced portfolio permitted a gain in returns from periodic rebalancing (monthly in this case).

Concluding thoughts on the evidence

Our study demonstrates that adding gold to a typical/balanced portfolio has been beneficial across a wide range of allocations in terms of boosting risk-adjusted returns. Unexpectedly, over the 43 years studied, the optimal allocation has actually been 25% to gold and 75% to a balanced portfolio, representing a mix of roughly 45% stocks, 30% bonds, and 25% gold. In fact, investors could have allocated as much as 45% to gold based on historical analysis and still fallen on the frontier of efficient portfolios that dominate holding a pure balanced fund.

Both the optimal (25%) and upper range of efficient portfolios (45%) may seem fairly high relative to the 5% "rule of thumb" allocation to which a large number of financial advisors seem to subscribe. But there is precedent. The "Permanent Portfolio" by Harry Browne recommends an equal weighting (25%) across stocks, bonds, cash, and gold as being optimal across different economic regimes. We believe the evidence presented in this white paper strongly suggests that the current prevailing "conventional wisdom" greatly understates the potential role of gold in portfolios for a typical investor over the long term.

Every investor should reconsider their portfolio's current allocation to gold

Based on our 43-year study, it appears most investors are likely underinvested in a full range of investment alternatives, and specifically in gold as a long-term asset class. Research suggests that an allocation to gold over the long term can be as high as 45%, while still providing better risk-adjusted returns in various market environments as compared to the traditional "60/40 balanced" investment portfolio.

For investors, who have understandably grown more concerned about capital preservation in times of macroeconomic risk, but who are still looking for optimized returns, gold should be strongly considered as a key portfolio element. Over the long term, gold offers the broad benefits of (a) ongoing marketplace demand in the face of limited supply; (b) historic protection from extreme market events, high periods of inflation, and devalued currencies; (c) a time-tested component of portfolio diversification; and (d) liquidity and versatility in terms of the many forms of ownership possible for an investor.

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Source Data

Treasury compiled by converting U.S. Government 10-Year Yield (Bloomberg) to Price Index using Formula 1 for the date range 1/2/1962 to 2/28/1994 and Barclays Intermediate Treasury Total Return (Morningstar) from 2/28/1994 to 12/31/2015.

Dollar is Dollar Index (Bloomberg) 1/4/1971 to 12/31/2015.

CCI is Continuous Commodity Index (Bloomberg) 9/4/1956 to 12/31/2015. This is an equal-weight index across various commodity markets.

Equity index data compiled using S&P 500 (^GSPC from Yahoo) for the date range 2/24/1950 to 12/31/1987 and S&P 500 Total Return (Bloomberg) from 1/4/1988 to 12/31/2015.

Gold is London Gold PM Price (Bloomberg).

Treasury Yield is the U.S. Government 10-Year Yield (Bloomberg).

CPI is the BLS Consumer Price Index All Urban Consumers.

Appendix A: Quantified Definition of Bull, Bear and Sideways Markets

Here we outline a procedure to define quantitatively a bull, bear, and sideways tri-state market classification. First, we build a binary bull-bear market separation by marking bull or bear market's peak or trough days computationally:

a. Starting from the first daily close or a globally lowest daily close in the historical daily data, we continue day-by-day forward in time to find a higher daily close until we cannot find a higher high before we can find an at least 20% lower daily close compared to the currently found highest daily close. We can then mark the currently found highest daily close price as a first bull-peak.

b. From the current bull-peak daily close, continue day-by-day forward in time to find a lower daily close until we cannot find an at least 20% higher daily close, compared to the currently found lowest daily close. We can then mark the currently found lowest daily close as the current bear-trough.

c. From the current bear-trough daily close, continue day-by-day forward in time to find a higher daily close until we cannot find a higher high before we can find an at least 20% lower daily close compared to the currently found highest daily close. We can then mark the currently found highest daily close as the current bull-peak.

d. Repeat step b and c until we reach the day of all-time high in the historical data or the end of the data. Thus we define all the bull-peaks and bear-troughs before applying the duration requirements to a binary bull/bear market characterization. Going forward in time starting from a first bull peak, if the duration from a bull-peak to the next bear-trough (or a bear-trough to the next bull-peak) is not less than 42 trading days (average of 2 months calendar time), a bear (bull) market is marked; otherwise skip the current bear-trough and next bull-peak (or the current bull-peak and next bear-trough) to the next bear-trough (or the next bull-peak) to define a new bear (or bull) market.

Definition of binary bull/bear market classification based on Dow Jones Industrial Average (DJIA)'s historical prices (2/17/1885 to 5/23/2013) is listed in Exhibit 1.

Furthermore, we define sideways market periods separating each binary defined bull or bear market period using a 10% return swing threshold and a same duration threshold of 2 months (42 trading days as an average).

a. Starting from the data starting day or the ending daily close of last binary bear period, check within the current binary bull period forward in time day-by-day, until finding a daily close of at least 10% loss from the current highest daily close in the current binary bull market, then pre-mark a sideways period from the day after the highest daily close is reached to the day when the highest index level is first recovered or surpassed. This is possible since the binary bull market always has a bull peak day as the end.

If, after the marking separation by the current sideways period, any of the sub-periods of the binary bull market has a duration length less than 42 trading days, omit the separation by the currently found sideways period within the current binary bull market. Otherwise, mark the currently found pre-marked sideways period as a bull sideways market within the current binary bull period. Continue the search for a sideways market after the day that the current highest daily close is recovered within the current binary bull market. Repeat the pre-marking and marking sideways period until the end of the current binary bull market.

b. Duplicate (a) step correspondingly for every binary bear market to find bear sideways market. The difference is that finding daily close that is at least 10% gain from the current lowest daily close in the current binary bear market, than pre-mark a sideways period from the lowest daily close until the day when that low is first broken after the at least 10% rise.