

Gold and tail-risk hedging: an international perspective



About the World Gold Council

The World Gold Council is the market development organisation for the gold industry. Working within the investment, jewellery and technology sectors, as well as engaging with governments and central banks, our purpose is to provide industry leadership, whilst stimulating and sustaining demand for gold.

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We provide insights into international gold markets, helping people to better understand the wealth preservation qualities of gold and its role in meeting the social and environmental needs of society.

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Executive summary

Gold plays many roles within an investor's portfolio. It serves as a portfolio diversifier: it tends to have low correlations to most assets usually held by institutional and individual investors. It preserves wealth: gold is typically considered a hedge against inflation, but it also acts as a currency hedge, in particular against the US dollar and other developed-market currencies with which gold correlates negatively. Particularly important to investors, gold also helps to manage risks more effectively by protecting against tail-risk events¹ – namely, unpredictable events sometimes considered unlikely which cause considerable damage to investors' capital. Notably, these events are likely not only to continue but also to increase their frequency as interconnected global economies raise the possibility of spill-over effects to other markets.

The advantages of gold's role in portfolio risk management have, over the past decade, become better understood in Western markets. In Japan, the role of gold in a portfolio context has only recently gained recognition, yet has advanced substantially in the past 18 months. This is influenced by such developments as the continued weakness of the Japanese economy, deteriorating government finances, unfavourable public and corporate pension reforms, growing concern over event/tail risk, change of needs in pension management resulting from demographic shifts, adoption of international financial-reporting standards (IFRSs), and volatile performance of traditional assets. All these factors call for a stronger focus on wealth preservation and performance stability in pension fund management. Gold is increasingly considered by Japanese institutional investors as a solution that meets today's needs.

The country has experienced a prolonged weak economy, described by many as the "lost 20 years of Japan". Deflationary pressures, declining disposable income, reduced savings rates, and a dim corporate earnings outlook have prevailed. The government has not yet been able to turn the economy around. The national debt is now more than 200% of GDP, the worst among OECD countries.² The fast-ageing population has put

further structural strains on the country's fiscal condition, forcing the government to cut back benefits owed under the universal public pension programme. Facing an uncertain operating environment, corporate pension sponsors have also reduced plan benefits, a significant move in a country known for its protective employment culture.

As in other markets, we believe gold's role in Japan extends beyond affording protection in extreme circumstances. In previous studies, the World Gold Council has shown that including gold in a portfolio can reduce the volatility of a portfolio without necessarily sacrificing expected returns. However, a more detailed analysis on the effect gold allocations have during tail-risk events shows that portfolios including gold not only deliver better risk-adjusted returns, but that they can also help to reduce extreme losses.

This article discusses the benefits of including gold as a tail-risk hedge from an international perspective and compiles research findings from previous studies.³ We show that even modest allocations to gold between 2% and 10% – depending on the assets held by investors and their risk tolerance – can have a positive effect on portfolios. In particular, gold tends to reduce not only portfolio volatility but also losses that may be incurred during tail-risk events. Looking back at events including Black Monday, the LTCM crisis, and the recent global financial crisis of 2008 – 2009, our analysis shows that gold mitigated portfolio losses incurred by investors during almost all tail events under consideration. For example, investors in the US, Europe, and the UK who held a 5% allocation to gold, reduced losses by approximately 5% during eight tail risk events. Similarly, Japanese investors would have saved between 2.3% and 3.6% during nine tail-risk events by adding a 5% allocation to gold in a typical portfolio of foreign and domestic stocks and bonds.

1 Tail-risk events get their name from the fact that their occurrence results in extreme and unexpected changes in asset prices (typically negative) that fall in the 'tail' of the return distribution.

2 <http://stats.oecd.org/>

3 We concentrate on two previous research notes: *Gold: hedging against tail risk*, October 2010, and *The role of gold for Japanese investors during tail-risk events*, November 2012 – originally in Japanese – updating and contextualising their main findings.

The case for gold in portfolio risk management

A primary objective of portfolio management is to maximise returns and preserve capital. However, investments with higher expected returns bring higher risks. Put simply, risk is the cost investors incur in their quest for higher returns. While in its simplest form, risk is typically associated with volatility, there are various other kinds of risk that can prove very important, especially in times of economic distress: illiquidity, credit-worthiness, counterparty, market and event risk are examples.

While it is common for investors, in times of economic expansion, to seek higher returns for their portfolios at the expense of taking on more risk, there are economic events that can create structural shifts in the perception and acceptance-level of risk. These events give investors direct exposure to environments that can cause severe losses. The global financial crisis of 2008-2009 is one example of these structural changes. After experiencing substantial losses in their portfolios, investors around the globe have increased their usage of risk management.

Risk management can be achieved, in part, using traditional portfolio-diversification strategies, but investors need to dig deeper when it comes to protecting against tail risks.⁴ It is here that gold comes into play. Gold is a portfolio diversifier, given its low correlation to most other assets. The gold market is very

deep and liquid – with an estimated US\$3.2tn in bullion form in financial markets⁵ and US\$240bn in daily trading volume.⁶ In addition, gold bullion has no credit or counterparty risk.

How does gold act as a hedge against tail risks?

When estimating the appropriate mix of assets that go into a portfolio, most investors assume that the distribution of asset returns is close to 'normal' (i.e., returns are symmetric and the majority of them – 95% to be precise – fall within two standard deviations). In practice, this is rarely the case. Many asset returns have skewed distributions and are commonly negatively skewed. So-called 'heavy tails', where investors experience returns beyond two standard deviations, occur more frequently than a normal distribution would predict. Additionally, correlations among assets are not necessarily constant, and while long-term average correlations can be used to compute the optimal asset mix in a portfolio, extreme conditions can change how assets interact with one another in unexpected and typically unwanted ways during periods of systemic risk.

4 Depending on the likelihood of these occurrences (i.e., how far into the tail of the distribution they lie), they are known as 2-sigma (2σ), 3-sigma (3σ) or 6-sigma (6σ) events, where σ is the mathematical expression to denote standard deviation. While some definitions put tail risk as 3-sigma events, in this study, we concentrate on 2-sigma events to facilitate the statistical techniques used.

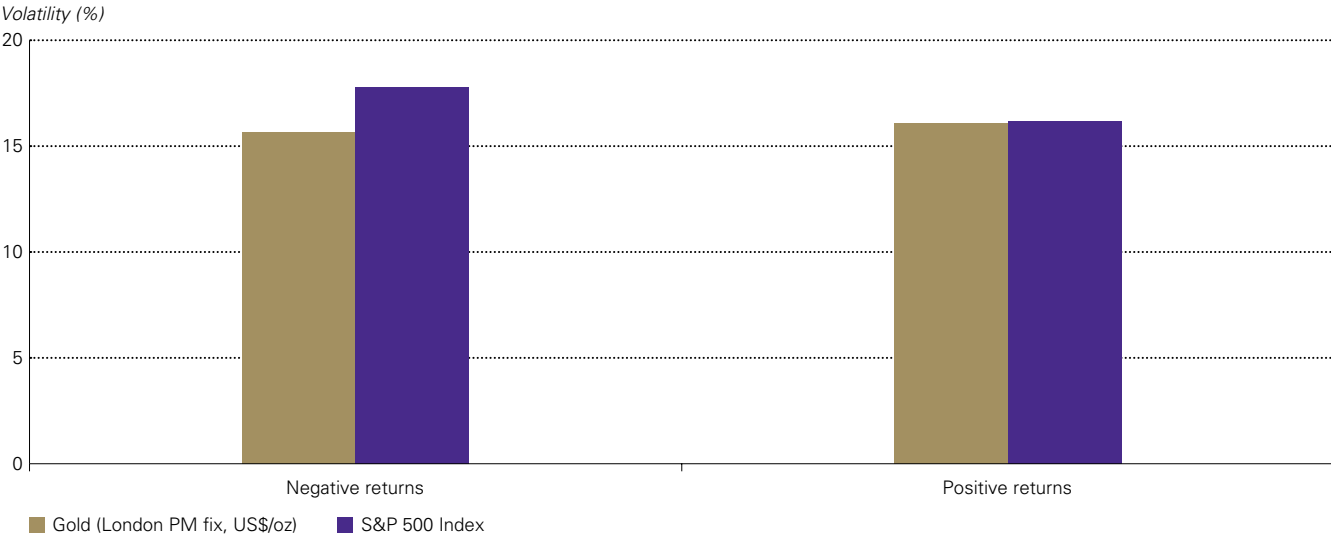
5 As of 2011, there were an estimated 62,500 tonnes of gold in the hands of individual and institutional investors, as well as central banks. Based on an average gold price of US\$1,668.98/oz for 2012 based on the London PM fix.

6 London Bullion Market Association, *Gold turnover survey for Q1 2011*, The Alchemist, August 2011.

Unlike other assets, gold tends to exhibit lower negative return volatility than positive return volatility (**Chart 1**). Between January 1987 and December 2012, gold’s annualised volatility was 15.9%; however, during this period, volatility stemming from negative returns only was lower. During the same period, the S&P 500 had an annualised volatility of 16.8% in which negative return volatility was 17.8% while positive return volatility was 16.1%. In other words, based on historical performance, gold is less likely to fall by more than two sigma ($2\sigma = 2 \times 15.9\% = 31.8\%$) in a year

than it is to rise by more than the same return. This is contrary to what tends to happen with equities. The economics behind this phenomenon are in part due to what is commonly known as ‘flight to quality’. As negative news hits the market, especially the equity market, and risk aversion increases, investors usually retreat from equity and other risky assets into assets that tend to protect wealth, such as US Treasuries and gold.⁷

Chart 1: Annualised volatility of positive and negative returns for gold (US\$/oz) and S&P 500*



*Computed on weekly return data from December 1987 to December 2012.
 Source: Bloomberg, LBMA, World Gold Council

7 For a more in depth analysis on negative economic news and gold, see Roach S.K. and M. Rossi, *The Effects of economic news on commodity prices: Is gold just another commodity?*, IMF Working Paper No. 09/140, July 2009.

Because gold tends to have little correlation with many asset classes, it is a strong candidate for portfolio diversification. Unlike other assets typically considered diversifiers, gold's correlation to other assets tends to change in a way that benefits portfolio returns. For example, while gold correlation to US equities is on average not statistically significant, it tends to decrease as US equities fall and increase when they rise.

This behaviour is more evident when one compares the correlation of equities to gold and commodities in periods when equity returns fall by more than two standard deviations from zero (**Chart 2**). From December 1987 to December 2012, the average weekly-return correlation of the S&P 500 and the S&P Goldman Sachs Commodity Index was 0.16; while this correlation changed to 0.41 in periods during which equity returns rose by more than 2σ , it increased even more to 0.55 when equities faltered. Put simply, in economic and financial downturns, most industrial-based commodities and equities have tended to follow a similar pattern. On the other hand, history shows that gold's correlation to equities became more negative during these same periods. Between December 1987 and December 2012, the average correlation between gold and the S&P 500 stood at -0.04. In periods during which equity returns rose by more than 2σ , the correlation turned positive to 0.41, but when equities fell by more than 2σ , the correlation coefficient dropped to -0.29. This is by no means a strong negative correlation but it serves to exemplify the benefits that gold can offer when managing the overall risk of a portfolio.

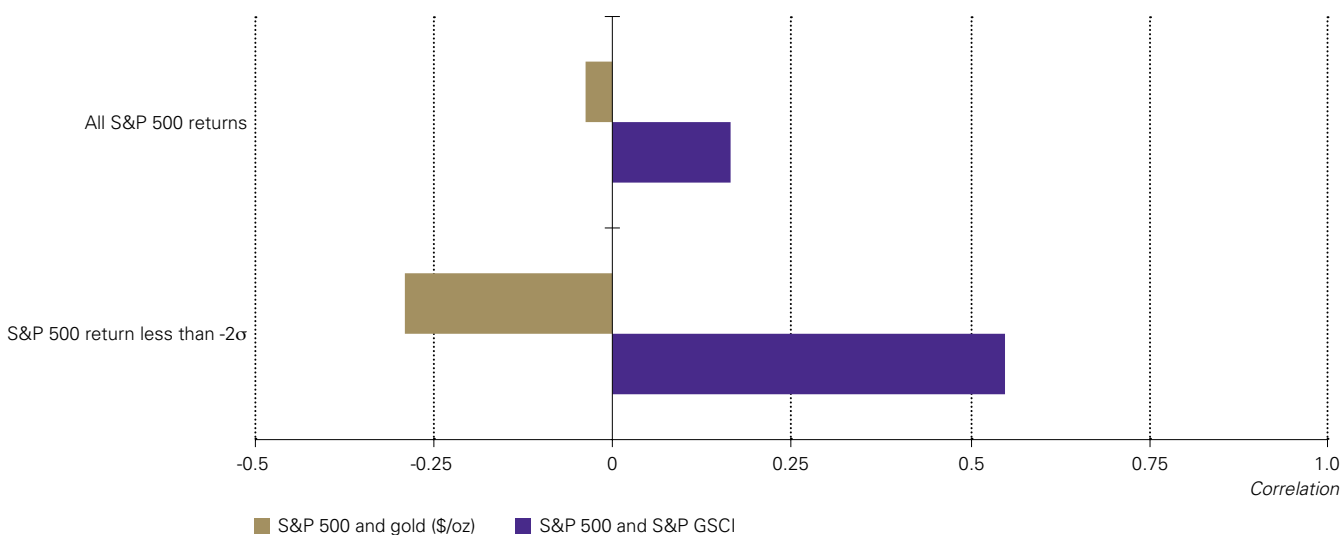
Optimal allocations to gold

The performance of an investor's portfolio is driven by its individual components and the interactions between these assets. In previous studies, the World Gold Council has found that gold allocations are statistically significant and can improve the efficiency of the portfolio.⁸ Put simply, investors benefit by having a long-term positive exposure to gold, which can be adjusted up and down as a response to the macroeconomic environment and the risk aversion of investors.

Optimal allocations to gold typically range between 2% and 10% across multiple currencies (**Chart 3**) and are based on conservative expectations for gold returns – at either 0% or 2% in real (inflation-adjusted) terms.⁹ These ranges are a function of the portfolio composition and the desired level of volatility. In other words, gold's appropriate weighting varies depending on what other assets are held in the portfolio and the riskiness of those assets. In general, the riskier the portfolio, the higher the gold allocation. Further, in *Gold: a commodity like no other*, April 2011, we demonstrated that gold brings unique benefits to investors in terms of portfolio efficiency and diversification that cannot be replicated solely by an allocation to a commodity basket.

Additionally, Oxford Economics found that¹⁰ – through an analysis on US-dollar-based assets – investors who are more concerned with the prospect of a higher inflationary or a deflationary environment benefit from higher average allocations to gold (**Chart 4**).

Chart 2: Long-term weekly-return correlation between equities, gold and commodities to S&P 500 during extreme moves*



*Conditional correlations computed using weekly returns from December 1987 to December 2012.

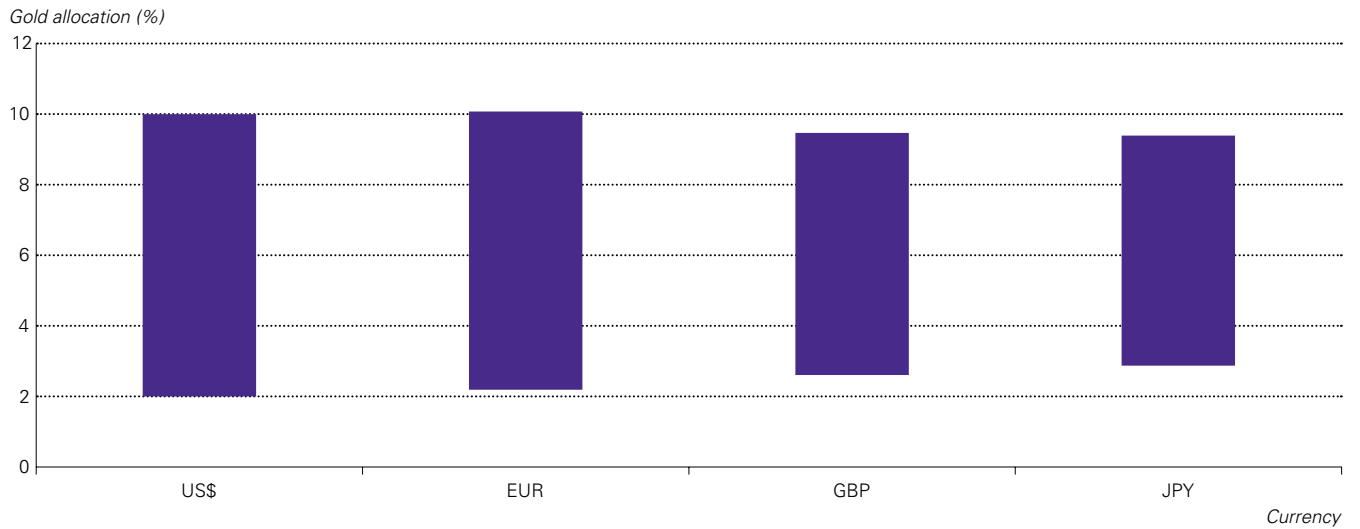
Source: Bloomberg, World Gold Council

8 For more details see the following papers from the World Gold Council: *Gold: hedging against tail risk*, October 2010; *Gold: a commodity like no other*, April 2011; *Gold: alternative investment, foundation asset*, October 2011; *Gold as a strategic asset for UK investors*, July 2012; *Optimal allocation to gold for Japanese investors*, July 2012; as well as those jointly published with New Frontier Advisors: *Gold as a strategic asset*, September 2006; and *Gold as a strategic asset for European investors*, December 2011.

9 To find the optimal weights employed to construct different sample portfolios, we used *Resampled Efficiency (RE) optimisation* developed by Michaud and Michaud.

10 Oxford Economics, *The impact of inflation and deflation on the case for gold*, July 2011.

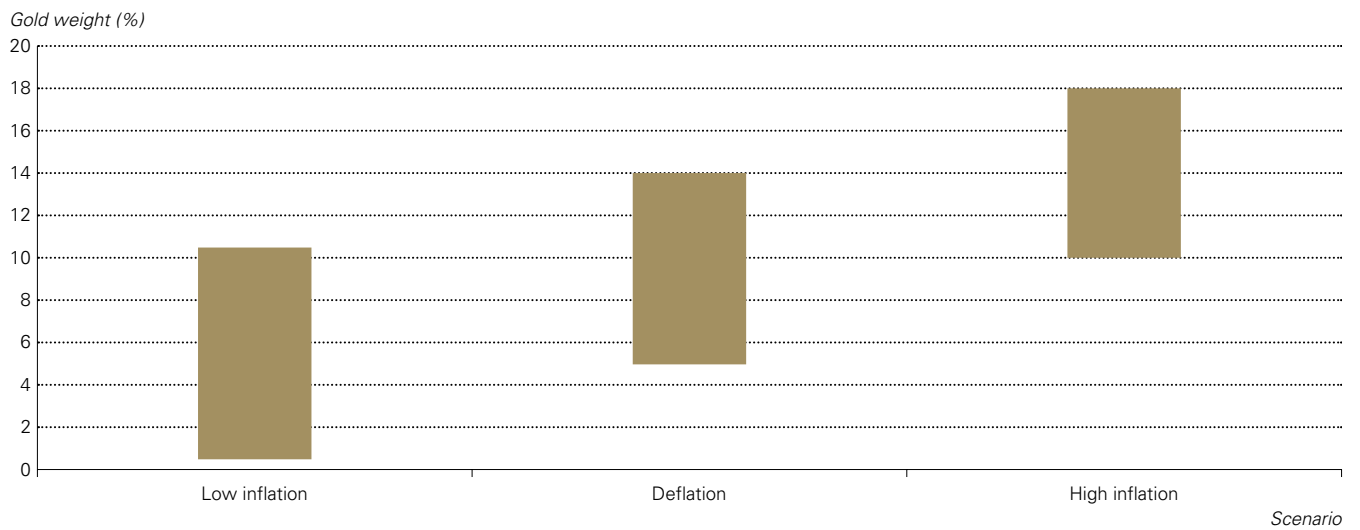
Chart 3: Research findings for optimal gold allocations for various portfolios*



*These ranges depend on investor risk tolerance and portfolio composition. Assets include cash, domestic and global bonds and equities, gold, commodities, and in some cases other alternative investments. Results based on research conducted by the World Gold Council and New Frontier Advisors.

Source: World Gold Council

Chart 4: Impact of inflation and deflation to optimal gold allocations*



*Allocation ranges to gold are a function of investor risk tolerance.

Source: Oxford Economics, World Gold Council

The role of gold in reducing extreme losses for Western investors

Intuitively, the characteristics that gold exhibits in terms of its performance, volatility and correlation to other assets discussed in section I, should also help reduce potential losses in a portfolio, but is this the case in practice?

To answer this question, we looked back at periods of financial stress and analysed a collection of assets representative of typical investment portfolios for US dollar, pound-sterling, and euro-based investors.¹¹ These include cash, government and corporate bonds, international debt from developed markets, domestic and international equities, and commodities as well as gold as separate asset class.¹² The portfolios under consideration had a benchmark 60/40 moderate composition with 5% allocated to cash, 35% to bonds, 50% to equities, 5% to commodities, and 5% to gold. When gold was not included, other assets were re-weighted proportionally. We analysed periods going back to 1987,¹³ when financial markets experienced an unexpected and negative shock that affected more than one asset class.

The eight events under consideration included:

- 1 The market crash around October 1987, also known as “Black Monday”;
- 2 The 1998 Long-term Capital Management (LTCM) crisis;
- 3 The Dot-com bubble burst in the period surrounding the dramatic drop in the NASDAQ index between March 2000 and April 2001;
- 4 The 9/11 terrorist attacks in 2001;
- 5 The 2002 market downturn;
- 6 The financial crisis of 2007-2009, also referred to as the Great Recession;
- 7 The first phase of the European sovereign-debt crisis between April and July 2010; and
- 8 The second phase of the European sovereign-debt between February and October 2011.

Our analysis shows that portfolios including gold tended to perform better in most cases (either by boosting gains or reducing losses) than those without (**Chart 5**). We found that, by adding a 5% allocation to gold, European and UK investors would have reduced their losses during all tail-risk events under consideration, while US investors would have saved capital in all events except for the Dot-com bubble burst. A possible explanation is that the Dot-com bubble sector concentration reduced the market-wide impact and subsequently the move into gold. By holding gold during all tail events under consideration, investors in the US, Europe and the UK would have saved approximately 5.5% in total. This would have translated to savings of almost US\$54,800 for every US\$1mn in assets held in a portfolio. Equivalently, it would translate to €55,200 or £54,600 for every one million euro or pounds in holdings.

Moreover, long-run average returns for the portfolios with and without gold were similar. In other words, average gains remained consistent but extreme losses were, on most occasions, reduced. Thus, gold not only helps to manage risk for expected or theoretical losses, but on multiple occasions it was shown to reduce the observed loss of an investment while keeping a similar average return profile.¹⁴

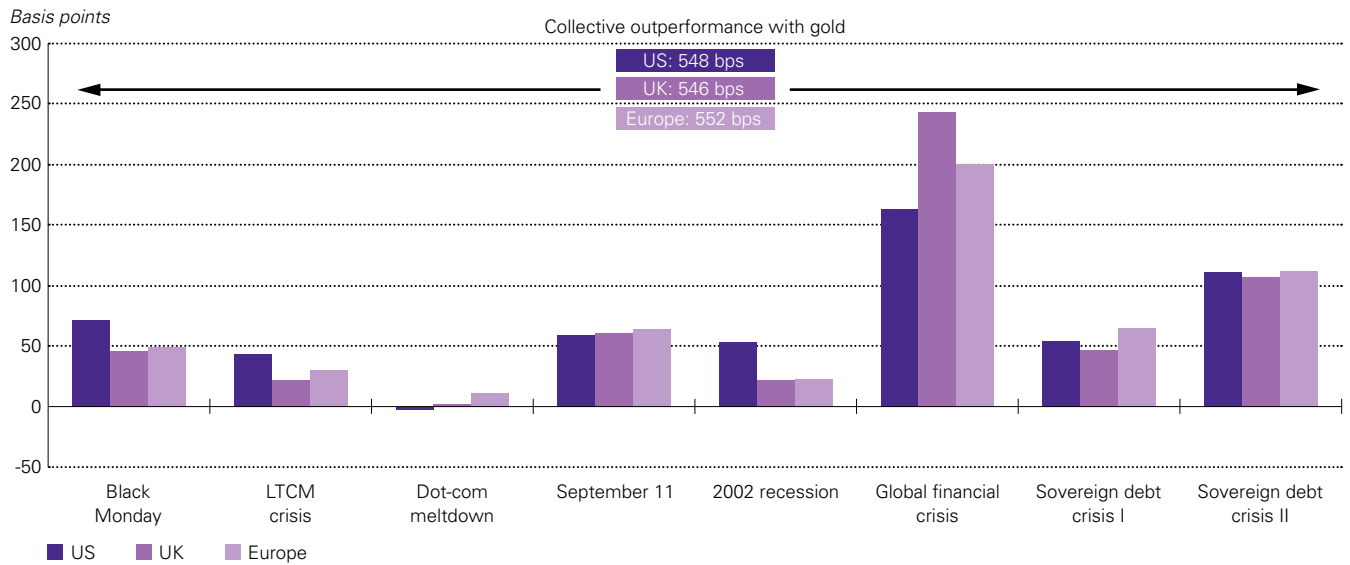
11 This section summarises (and updates) some of the key findings in *Gold: hedging against tail risk*, October 2010, where details on methodology and additional results can be found.

12 See **Table 2** in the Appendix for more details on representative indices/securities used for each asset class.

13 Ideally, we would use series going back as far as 1972, the year by which the gold window had been closed and gold was allowed to float freely. However, a modern investor typically holds many more assets in a portfolio than those available in the 1970s and early 1980s, or for which data are unavailable or unreliable, such as high-yield bonds or emerging-markets sovereign debt and equities. Moreover, the period starting 1987 is sufficiently relevant as it contains at least three business cycles and includes multiple market crashes: <http://www.nber.org/cycles/cyclesmain.html>.

14 A constraint of this analysis is that the portfolios used to show the properties of gold as a tail-risk hedge were constructed using information that may not have been available to investors prior to the event’s occurrence. In other words, we are using an “in-sample” approach to compute returns, volatilities and expected losses. This does not invalidate the analysis, but it does raise the question of whether selecting a portfolio allocation using only information available during a specific period of time will still deliver similar results (i.e., if adding gold to the portfolio mix allows investors to manage risk more effectively) for events that happen outside of that period. The answer is that it does. Gold can be shown to reduce losses even in out-of-sample analysis for most cases. We estimated average correlations and volatilities using weekly returns between January 1987 and June 2007, excluding the most recent period. We found optimal portfolios using the same methodology as before: with and without gold. We selected the portfolio with the maximum information ratio, as well as a portfolio with allocations similar to a typical benchmark portfolio for a total of four portfolios.

Chart 5: Improvement in performance resulting from a 5% gold allocation*



*Portfolio contains 30% in domestic equities, 10% in global equities, 10% in EM equities, 25% in domestic bonds, 10% in global bonds, 5% in cash, 5% in commodities and 5% in gold. Black Monday: September 1987 – November 1987, LTCM crisis: July 1998 – September 1998, Dot-com meltdown: March 2000 – March 2001, 11 September: August 2001 – September 2001, 2002 recession: March 2002 – August 2002, Global financial crisis: August 2008 – March 2009, Sovereign debt crisis I: April 2010 – August 2010, Sovereign debt crisis II: February 2011 – October 2011. See table 2 in the appendix for a list of the indices used for each asset.

Source: Barclays, Bloomberg, J.P. Morgan, World Gold Council

The role of gold for reducing extreme losses for Japanese investors

Most gold-related literature discusses the effects that gold holdings have on Western investor's portfolios, but a natural question for Japanese investors is whether these benefits can also be extended to yen-based portfolios. To answer that question, we first determined which events qualify as tail-risk events from a Japanese perspective.¹⁵ Subsequently, we examined these major tail-risk events based on their underlying drivers and analysed the performance of traditional assets – such as stocks and bonds – and gold during these periods.¹⁶ Finally, we analysed the effect gold has on portfolios that include it, relative to those that do not.

Tail events can be defined by looking at abnormal returns in a given market when asset prices fall sharply, typically on the back of a macroeconomic or financial shock. For investors, it is not only the performance of a particular asset class that is relevant to studying tail-risk events, but also the interaction among assets that causes a significant overall drop in investors' capital. We analysed the performance of Japanese equity and bond markets (referenced by the Nikkei 225 and Japanese Government Bond indices) to determine the periods that qualified as tail-risk events from the perspective of a Japanese investor.¹⁷

The nine events under consideration included:¹⁸

- 1 The market crash around October 1987, also known as "Black Monday"
- 2 The Japanese market bubble burst, known in the West as the Nikkei crash, in 1990
- 3 The 1998 Long-term Capital Management (LTCM) crisis
- 4 The Trust Fund Bureau shock between the end of 1998 and beginning of 1999
- 5 The Dot-com bubble burst as the NASDAQ index dropped sharply in 2000
- 6 The VaR shock in 2003
- 7 The first phase of the financial crisis stemming from the subprime crisis in 2007 and 2008
- 8 The second phase of the financial crisis, during the credit-crunch, which occurred after the collapse of Lehman Brothers between the end of 2008 and beginning of 2009
- 9 The Japanese earthquake and tsunami of 2011

In almost every case, Japanese equity prices fell steeply alongside global equities. In contrast, gold (in US dollar terms) typically outperformed domestic and global equities, and delivered positive returns during five of the nine tail-risk events under consideration (**Chart 6**). Gold in US-dollar terms also outperformed Japanese bonds when the tail events originated from a shock to yields.

Gold in US-dollar terms outperformed gold in yen-terms in all but two tail-risk events. Exceptions were the bursting of the Dot-com bubble and the earthquake and tsunami disasters in eastern Japan. This was the result of a flight-to-quality to the yen, which increased gold prices in local-currency terms relative to its US-dollar price. While Japanese investors may have benefited the most from holding gold in US-dollar terms, gold in yen terms still outperformed versus many other assets in most tail-risk events providing investors with relief during periods of financial stress. In fact **Table 1** shows that gold, in US dollar terms, outperformed all traditional assets collectively during the nine tail events under consideration, while gold in yen terms outperformed collectively against all assets except JGBs. Most investors would expect JGBs to have outperformed, as they are typically seen in Japan (and across the globe) as an asset of last resort.

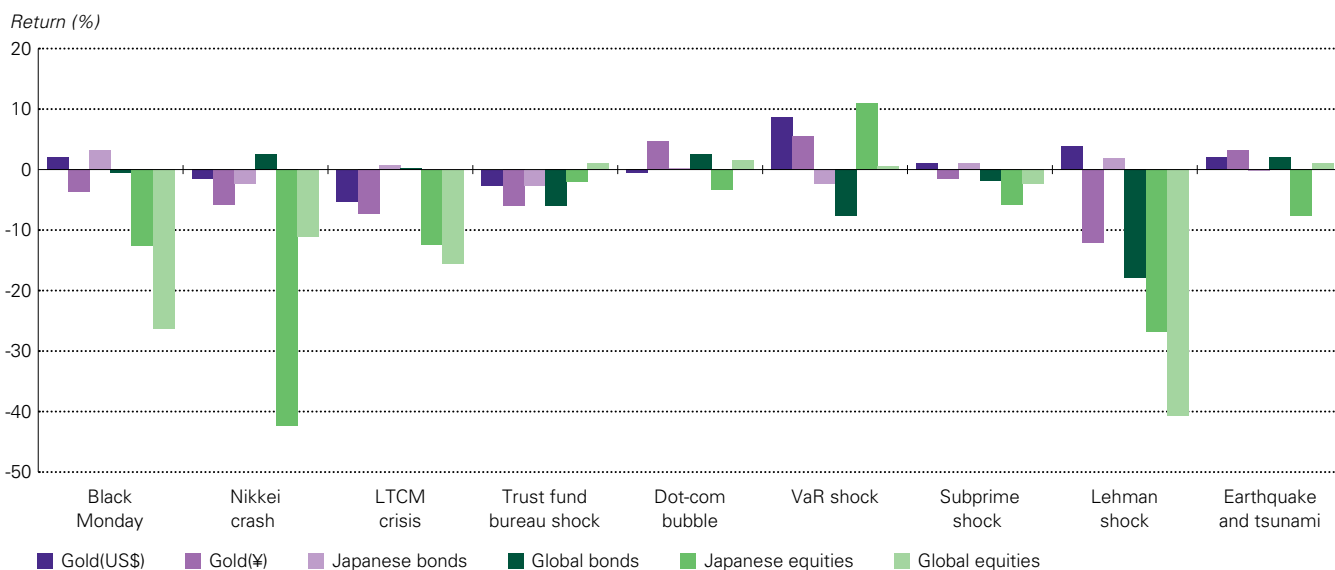
15 This section summarises some of the key findings in from *The role of gold for Japanese investors during tail-risk events*, November 2012, where details on methodology and additional results can be found.

16 See **Table 2** in the Appendix for more details on representative indices/securities used for each asset class.

17 A period of shock, generated by a tail event, is determined here by the duration of a severe impact on the assets prices, with acute fluctuations in stocks, interest rates and other assets. To identify the length of these shocks, we measured asset returns and marked beginning and end by periods in which market prices had fallen by more than 2.5 standard deviations. For example, while the impact from the Lehman shock continues to this day, only the period from October 2008 to January 2009 saw equity returns falling by more than 2.5 standard deviations.

18 Some of the tail-risk events considered for the purpose of a Japanese-based investor analysis differ from the Western investor analysis perspective.

Chart 6: Performance of portfolio assets during select tail-risk events*



*Black Monday: October 1987, Nikkei crash: February 1990 – September 1990, LTCM: August 1998, Trust Fund Bureau: December 1998 – February 1999, Dot-com bubble: April 2000, VaR shock: July 2003 – August 2003, Subprime: August 2007, Lehman: October 2008 – January 2009, Earthquake and tsunami: March 2011. All assets measured in Yen (¥), except gold shown in US dollar terms.

Source: Bloomberg, Citigroup, Nomura, World Gold Council

Table 1: Cumulative individual asset performance during the nine tail-risk events under consideration

	Gold (¥/g)	Gold (US\$/oz)	Japanese bonds	Global bonds	Japanese equities	Global equities
Cumulative asset performance	-23%	7%	0%	-26%	-102%	-92%

*Performance is computed by adding the returns for each asset for all nine tail-risk events in consideration.

Source: Bloomberg, Citigroup, Nomura, World Gold Council

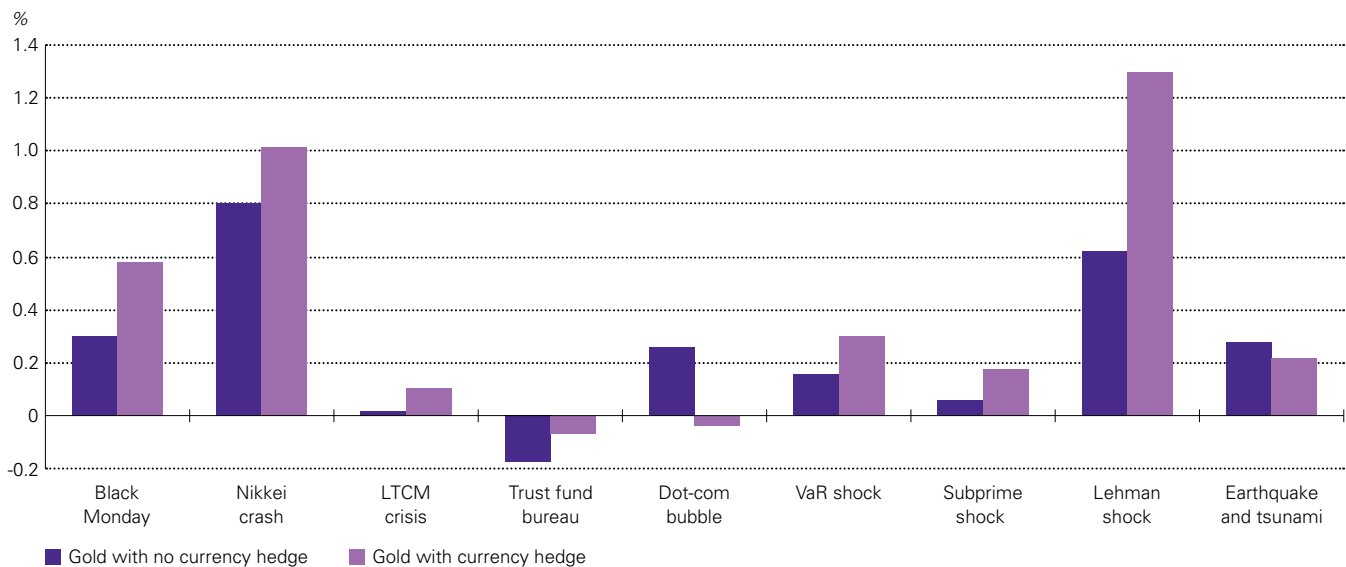
As previously discussed, gold's benefits are even more evident at the portfolio level when seen in conjunction with other assets. We analysed assets typically held by Japanese pension funds and compared the performance of two portfolios,¹⁹ one which included a 5% allocation to gold, and one with no allocation to gold.²⁰ Further, we considered two cases: the first one from the perspective of a Japanese investor holding gold in yen terms, and the second where the investor holds gold in US-dollar terms (i.e., by hedging the yen-US\$ foreign-exchange exposure).

Chart 7 shows the difference between the portfolio returns with and without gold during tail-risk events. Similar to results obtained for Western investors, Japanese investors generally benefitted from holding gold in their portfolios, either by reducing losses or increasing gains. The results show that a 5% allocation to gold in yen terms mitigated losses during all tail events except during the Trust Fund Bureau shock. Japanese investors would have saved a cumulative 2.3% over the nine tail-risk events under consideration. For investors currency hedging gold (and holding it in US dollar terms), the collective loss reduction rose to 3.6%, despite the fact that the portfolio with gold underperformed during the Trust Fund Bureau shock

and the bursting of the Dot-com bubble. The underperformance during the Dot-com bubble was due to the fact that the shock was primarily limited to the technology industry, and gold tends to benefit more in periods of broad-reaching, systemic events. The reason the portfolio holding gold in yen terms outperformed was a by-product of a strengthening yen. During that period, the rate differential between the US and Japan mitigated the positive effect of the gold allocation in US dollar terms.

The study shows that during past tail-risk events even a small 5% gold allocation in a portfolio would have mitigated losses and its effect would, on average, have been even greater where gold was held in US dollars. Interestingly, despite the fact that as an individual asset, gold may not have performed so strongly in yen terms, when analysed as part of a portfolio it clearly demonstrates that it can play a role in hedging tail-risk events. Thus, whether in yen or US-dollar terms, gold can benefit investors during periods of systemic risk.

Chart 7: Improvement in portfolio performance from a 5% gold allocation*



*Black Monday: October 1987, Nikkei crash: February 1990 – September 1990, LTCM: August 1998, Trust Fund Bureau: December 1998 – February 1999, Dot-com bubble: April 2000, VaR shock: July 2003 – August 2003, Subprime: August 2007, Lehman: October 2008 – January 2009, Earthquake and tsunami: March 2011.

Source: Bloomberg, Citigroup, Nomura, World Gold Council

19 For our analysis, we created a typical portfolio, taking as our point of reference the average asset allocation held by Japanese pension funds at the time, as detailed by the Japanese Pension Fund Association.

20 For the hypothetical portfolio, the 5% gold allocation was made as a substitution, replacing in the average portfolio of the time 1% Japanese bonds, 2% Japanese equity, 1% global bonds, and 1% global equity. Optimal allocation to gold is 4.9% for a conservative portfolio as discussed in *Optimal allocation to gold for Japanese investors*, July 2012.

The role of gold during possible future tail-risk events

The recent financial crisis has made it ever more evident that tail-risk events are not a theoretical construct but a harsh reality that investors should consider when making portfolio risk-management decisions. So far, we have shown that gold mitigated losses during past tail-risk events. But what kind of tail-risk events could Japanese investors experience in the future, and what would be gold's contribution to portfolio performance during those events?

While there are a myriad of possibilities, we concentrated on the following three scenarios that a Japanese investor might encounter, and then estimated the effect on asset performance and the role gold would have in such environments. These scenarios included:

1 A sharp rise in Japanese government bond yields

Interest rates in Japan have remained low for over a decade – below 1% since late 2011. The fear of a rise in long-term interest rates in the country is a topic of discussion from various perspectives, but here we assume the possibility that such a rise occurs rapidly. However, we study a situation in which the Japanese economy recovers and interest rate levels normalize through a 'good rise' in interest rates – with stock prices rising according to expectations. While an equity bull market may not be categorised as 'negative' by most investors, a sudden and unexpected rise in rates result from a market rally, may indeed have negative consequences in Japanese pension fund portfolios, for which government bonds are an important component. For the purpose of this study, we assumed a parallel yield curve shift, with interest rates rising 100 basis points, and assessed the hypothetical portfolio using benchmarks commonly employed by investors. Long-term interest rates in Japan rose rapidly on two occasions between 1998 and 2003, yet the correlation between gold prices and interest rates during those times did not increase. Therefore, in theory, gold should be able to mitigate losses stemming from a shock to bond prices.

2 A Japanese market selloff

This scenario also assumes a rise in interest rates stemming from negative conditions. Under this scenario, concern over Japan's debt wreaks havoc on the local bond market and subsequently affects the Japanese stock market. Interest rates rise and stocks fall. The Japanese stock market has been in the doldrums for 20 years, with the last 10 years seeing a decline of about 50%. It is not unthinkable to assume a further drop. While a Japanese-led selloff may translate into a weaker yen, we took a more conservative approach by assuming it remained flat in order to highlight the possibility of investors benefiting from holding foreign assets while hedging away the currency exposure. Under this second scenario, we assumed Japanese government bond yields rose by 100 basis points, and Japanese stocks fell by 50%.

3 A global shock impacting primarily developed markets

Given that more than half of the historic tail-risk events analysed in this study originated outside of Japan, yet had devastating consequences on the country, it is only natural to assume that potential risks to Japanese investors lie abroad. In this scenario, stock values in Japan, the US and Europe plummet simultaneously as a result of the European debt crisis, causing ripple effects into developed bond markets. This scenario was first proposed by the Bank of Japan in their *Financial System Report* published in April 2012. It assumes yields on German government bonds will rise by two percentage points, US Treasury bonds by 2.5 percentage points and Japanese government bond by 90 basis points. Further, it assumes European stocks lose about half their value, causing a similar drop in Japanese and US stock markets.

Portfolio impact stemming from potential tail-risk events

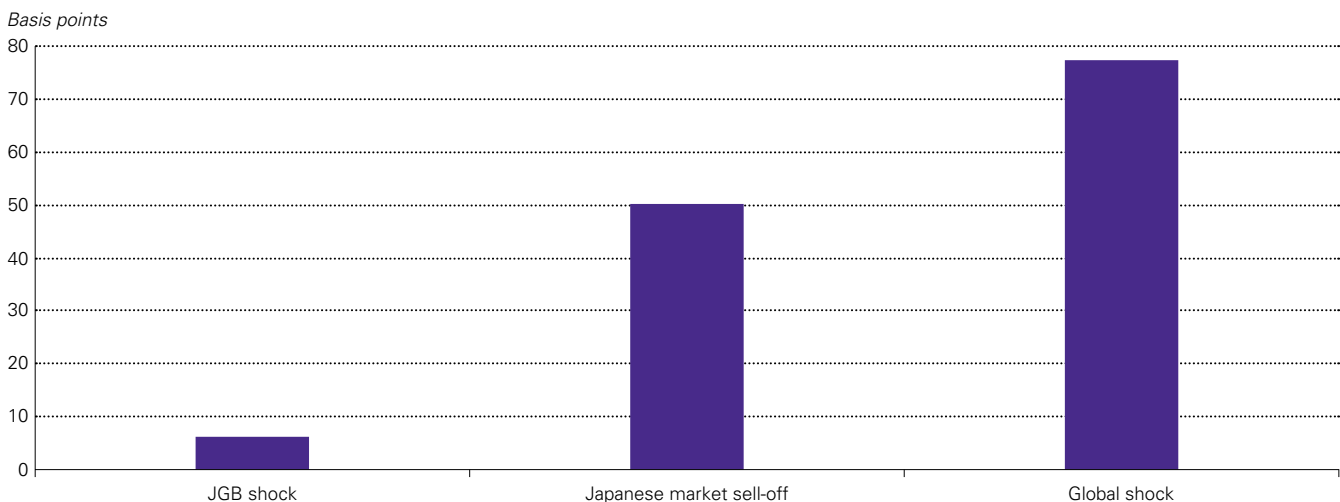
Based on current market expectations – in particular mid-term forecasts of asset managers²¹ – and historical volatility and correlations, we constructed an optimal portfolio including cash, stocks and bonds – both foreign and domestic – to use as a benchmark. Additionally, we constructed an optimal portfolio including gold – using the conservative assumption of 0% real returns to study the effect that gold would have during future tail-risk scenarios.²²

The benchmark portfolio with the highest information ratio (risk-adjusted return) resulted in a fairly conservative allocation which included 5.7% in cash, 61.4% in Japanese bonds, 12.2% in global bonds, 10.4% in Japanese stocks and 10.3% in foreign stocks. With a volatility level of 4.5% and an expected return of 2%, this portfolio represents a typical asset mix that Japanese investors would hold if they based their allocation decision process on market expectations. The portfolio including gold was similar, shaving off a few percentage points across assets to accommodate for an optimal 4.6% allocation to gold.²³

When subject to the three potential tail-risk scenarios, the benchmark portfolio, not surprisingly given the fairly high allocation to bonds, suffered losses of 3.9% under the first scenario, 9.3% under the second and 15.3% under the third.

Our study shows that adding gold to the portfolio reduced such losses for investors, even under the rather conservative assumption that gold prices would remain flat in real terms (go up 30 basis points nominally) during the shock. As seen in the previous section, gold investors may benefit even further as prices, especially in US-dollar terms, tend to rise during periods of tail risk. **Chart 8** shows that investors would have saved 6 basis points under the first scenario, 50 basis points under the second and 77 basis points under the third. While these reductions in losses may appear small at first sight, it is important to note that for pension funds, which hold large portfolios, a few basis points can make a big difference in meeting liabilities. For example, a five-basis-point reduction to a JPY100bn (US\$1.25bn) portfolio translates into savings of JPY50mn (US\$625,000). Further, considering that the average pension-fund portfolio return has been approximately 1.2% per annum over the past decade,²⁴ a five basis-point reduction is noteworthy.

Chart 8: Improvement in performance from a 5% gold allocation during three potential future tail-risk events*



*Assumes the same portfolio construction as the in-sample tail-risk analysis. JGB shock assumes yields increase by 100 bps, Japan market sell-off assumes a yield increase of 100 bps and Japanese stocks fall by 50%. Global shock assumes that a crisis in the West impacts global equities and bonds along with Japanese equities and bonds.

Source: Bloomberg, Citigroup, Nomura, World Gold Council

21 The calculations used values forecasted by Japanese trust banks, as reported in the 2 April 2012 issue of *Newsletter on Pensions and Investment*.

22 In comparison, the annual real return of gold between January 1985 and December 2011 was 2.5% in yen terms and 4.2% in US dollar terms based.

23 The optimal portfolio with gold included 5.4% in cash, 59.2% in Japanese bonds, 11.1% in global bonds, 9.7% in Japanese stocks, 10.0% in foreign stocks and 4.6% gold allocation.

24 Pension Fund Association.

Conclusion

Gold helps investors diversify their portfolios and preserve capital and effectively helps manage risk in a portfolio. It increases risk-adjusted returns and can help reduce losses incurred under extreme market conditions. As globalisation intensifies, one can expect to see greater correlation among stock and bond markets across various geographies and even greater linkages during tail events. Short- and medium-term investors, individual and institutional investors alike, can take advantage of gold's unique correlation to other assets to achieve diversification objectives in normal environments and better returns during times of turmoil. This is especially true given that gold's correlation tends to change in a way that benefits investors who hold it in their portfolios. Also, by including gold in their portfolios, long-term holders, including pension plans, endowments and other institutional investors, can manage risk without necessarily sacrificing much sought-after returns. This applies to investors in the major markets we have studied, including the US, UK, Europe and Japan.

Even relatively small allocations to gold, ranging from 2% to 10%, can have a positive impact on the performance of a portfolio. Further, during the eight tail-risk events analysed for Western investors and the nine events we studied in Japan, gold's performance reduced losses (or increased gains) for investors who held it in all but a few instances. In general,

US, UK and European investors with standard allocations to stocks and bonds would have saved approximately 5.5% cumulatively during all the tail-risk periods examined. Japanese investors would have reduced their losses between 2.3% and 3.6% by holding gold in yen or US-dollar terms, respectively, during Japanese tail-risk events. We not only found that gold has been valuable to Japanese investors in the past but, that looking forward, it has the ability to protect against potentially devastating shocks to the Japanese market by reducing losses incurred by other assets in the portfolio.

We also note that investors who hold gold only as part of a broad commodity index are likely to be under-allocated. There is a strong case for gold to be allocated as an asset class on its own merits. It is part commodity, part luxury consumption good and part financial asset and, as such, its price does not always behave like other asset classes and especially other commodities.

Finally, while the analysis summarises optimal allocation to gold and concentrates on its function as a tail-risk hedge, gold has other unique characteristics that make it very useful in periods of financial distress. The gold market is highly liquid and many gold investments have neither credit nor counterparty risk, it is increasingly being accepted as source of collateral and is an integral part of the global monetary system.²⁵

²⁵ More information can be found in *Liquidity in the global gold market*, April 2011, and *Gold as a source of collateral*, May 2011, published by the World Gold Council and available on our website.

Appendix

Table 2: Name keys for assets used for research analytics

Perspective country	Short name	Index name
US	Cash	JPM US\$ 3M
US	Domestic bonds	Barclays US Agg
US	Global bonds	Barclays Global Tsy Agg ex US
US	Domestic equities	MSCI USA Gross
US	Global equities	MSCI World ex US
US	Emerging market equities	MSCI EM
US	Commodities	S&P GSCI
US	Gold	Gold (US\$/oz)
UK	Cash	JPM sterling 3M
UK	Domestic bonds	JPM GBI Europe
UK	Global bonds	JPM GBI Global ex EMU
UK	Domestic equities	MSCI Europe
UK	Global equities	MSCI World ex Europe
UK	Emerging market equities	MSCI EM TR
UK	Commodities	S&P GSCI TR
UK	Gold	Gold (GBP/oz)
Europe	Cash	JPM euro 3M
Europe	Domestic bonds	JPM GBI UK
Europe	Global bonds	JPM GBI global ex UK
Europe	Domestic equities	MSCI UK
Europe	Global equities	MSCI World ex UK
Europe	Emerging market equities	MSCI EM
Europe	Commodities	S&P GSCI
Europe	Gold	Gold (EUR/oz)
Japan	Cash	JPM yen 1M
Japan	Domestic bonds	Nomura bond performance
Japan	Global bonds	Citigroup world government bond
Japan	Domestic equities	Tokyo stock price index
Japan	Global equities	MSCI Kokusai
Japan	Gold	Gold (JPY/oz)

Source: Barclays, Bloomberg, J.P. Morgan, World Gold Council

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