WORLD
GOLD
COUNCIL

Gold Investor
Risk management and capital preservation

In this edition:

- Gold and US interest rates:
  A *real*ity check

- What drives gold?

- The role of gold in
  defined-contribution plans:
  Mexico case study

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.

We develop gold-backed solutions, services and markets based on true market insight. As a result we create structural shifts in demand for gold across key market sectors.

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.

Based in the UK, with operations in India, the Far East, Europe and the US, the World Gold Council is an association whose members comprise the world's leading gold mining companies.

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Foreword

Marcus Grubb
Managing Director, Investment

Welcome to the third edition of *Gold Investor.* We are pleased to share a selection of the latest research from the World Gold Council.

The first half of this year proved a tumultuous one for the gold market. Sustained downward pressure on the gold price following April's exceptional pullback created two distinct trends: some investors and speculators took the drop in price as a sign that gold's bull run was probably over; other investors and consumers saw an opportunity to buy jewellery and add gold to their portfolios. Gold-backed ETFs experienced substantial redemptions, but at the same time bar and coin demand in Asian markets as well as in many parts of the Western world surged.

The dichotomy seen in the responses of market participants highlights gold's varied consumer and investor base, which in turn points out gold's role as a portfolio diversifier. In fact, the strategic case for owning gold is still very much in place, and given its price pullback, investors can take advantage of the portfolio benefits gold brings at a lower cost. Gold helps investors preserve capital and manage portfolio risk more effectively. It increases portfolio diversification through its lower correlation to other assets; reduces portfolio losses during tail-risk events; adds a high quality, liquid asset; hedges against both high inflation and deflation; and hedges against currency risk and loss of purchasing power.

In this edition of *Gold Investor,* we first explore the oft-cited relationship between gold and real interest rates in *Gold and US interest rates: a reality check.* Common wisdom suggests that rising interest rates diminish the benefits of gold – a reason used by some investors to reduce their gold exposure earlier in the year. Our analysis finds, however, that while negative real rates have indeed coincided with periods of higher gold returns, a moderate interest rate environment (with real rates ranging between 0% and 4%) is not necessarily adverse for gold and that gold's portfolio benefits are maintained. Next, in *What drives gold?,* we discuss the main factors that influence gold and provide investors with a broad framework to analyse its performance. Finally, in *The role of gold in defined-contribution plans,* we discuss the role gold plays in helping investors achieve their retirement goals, using Mexico's defined-contribution pension system as an example. This article finds that modest allocations to gold – ranging from 1% to 7%, depending on market performance expectations and portfolio composition – can significantly reduce risk without diminishing returns.

I hope you find this edition of *Gold Investor* informative and stimulating, and I welcome your views. To access the full suite of World Gold Council research, please visit www.gold.org

I: Gold and US interest rates: a *real*ity check

As the US economy starts to show signs of rebalancing, paving the way for monetary policy normalisation, we explore the misconceptions surrounding the relationship gold has with real interest rates. We demonstrate that higher real rates are not unconditionally adverse for gold, as the effect of other factors needs to be considered. Thus, gold's portfolio attributes are not compromised by a return to a normal interest rate environment. In addition, we find the influence US real interest rates have on gold has receded over the last few decades as demand has shifted from West to East.

US Macro Economy

$

%

Influence
on the price of gold

Global Markets / Economy
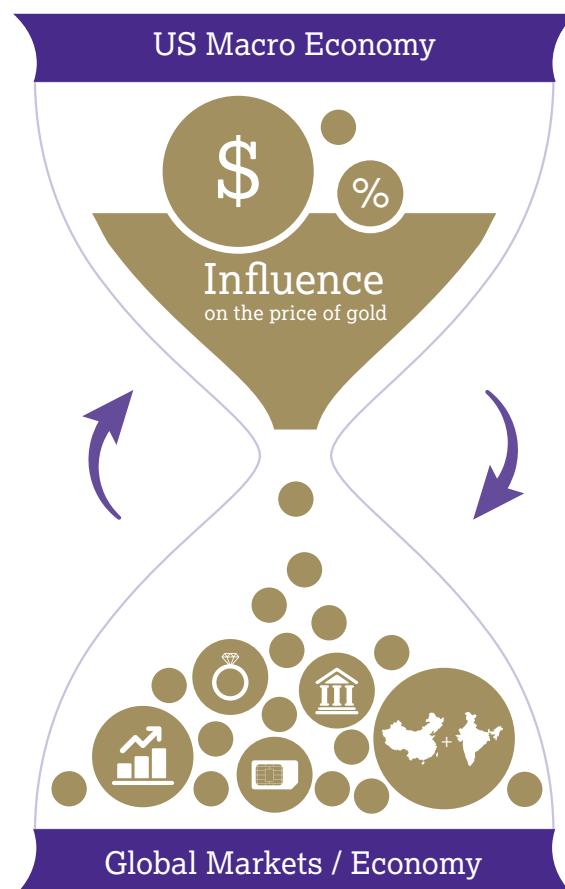
The potential cessation of QE has increased market volatility.

Over the last few years, in the shadow of the financial crisis, a crescendo of commentary has preceded major central bank policy announcements. Positioning ahead of anticipated quantitative easing programme launches or extensions was particularly feverish, pushing short-term US **real** rates close to -2%, a level not seen since the 1970s. Now the focus has shifted to the potential end of these programmes. Though a normalised target interest rate appears some time away, the longer end of the curve has shifted in expectation of sustainable economic growth, with 10-year **nominal** yields in the US leaping 85 basis points to 2.4% between May and mid-June 2013. Talk of normalising interest rates has fuelled uncomfortable oscillations in other asset prices.

A return to 'normal' in the US is consistently seen as negative for gold…

The consequences of higher interest rates are many and bear both positive and negative implications for investors, households, corporations and even governments. Yet, where most market commentators appear to agree is the negative implication a rising interest rate environment will have for gold. Why is this?

…as it increases the opportunity cost for investors holding it.

Theory will tell you that interest rates have a traditional relationship with gold through the channel of rational investment decisions. In other words, investors measure the relative attractiveness of gold by how much they can earn elsewhere. With gold viewed primarily as a currency and capital preservation asset – but without a yield – there is a cost to holding it if other assets yield more.

Traditionally, US rates have functioned as a global benchmark.

The relationship between gold and real rates is usually linked to US investment markets, but commentators typically extrapolate implications to global gold buyers elsewhere. The basis for the assumption that US interest rates form a benchmark for global interest rates is rooted in the following reasons:

- Gold is primarily traded in US dollars
- The US dollar is the world's reserve currency
- US assets form the lion's share of the global investment portfolio

However, while investment demand in Western markets is important, it is just one of the many variables that influence gold.

However, gold is not only used for investment purposes in periods of low interest rates. It is also a consumer product that can be positively influenced by economic growth – even if real rates are rising. Further, a rise in US real rates has to be seen in the context of rates cycles in other parts of the world, especially emerging markets. In fact, as developing markets continue to expand, US interest rates will likely become only one of many measures to gauge global opportunity costs. Given the structural changes that gold has experienced for more than a decade, it is likely that the US real interest rate will be less relevant than before, particularly as demand increasingly originates in emerging markets where domestic inflation rates are more relevant than the US inflation rate.

Gold's portfolio attributes would still be relevant in a normal rate environment...

What can be inferred from gold's relationship to US real rates?
While returning to a more normal US interest rate environment should have implications for gold investment – especially in Western markets – these may not be as negative as some market commentators expect. In fact, our analysis shows that gold's attributes appear favourable in a moderate real rate environment compared to either negative or high rate environments:

• In a moderate rate environment (with real rates ranging between 0% and 4%), returns for gold are in line with the long-term average of an annualised 6 – 7%.

• Rising rates are worse for gold than falling rates, but still provide annualised returns well in excess of a conservative 0% long-term inflation-adjusted return estimate often used to show gold as a core portfolio asset.

• Gold's volatility is significantly lower in a moderate real rate environment. While rising real rates are associated with increased volatility, it is only marginally higher than the long-run average.

• The correlation between gold and global equities in a moderate real rate environment is close to zero, which forms part of the basis for gold's diversification properties.

• High rate environments (with real rates exceeding 4%) are least favourable towards gold in terms of returns, but volatility and correlations remain moderate relative to other assets.

...especially as gold's relationship to US rates has weakened over time.

Finally, a re-estimation of the gold price model developed for the World Gold Council by Oxford Economics suggests that the gold price and US real rate relationship is weaker than in the past. This is likely due to the effect of the increasing relevance of emerging market demand for gold and consequently the influence of their local macro-economic factors in determining its price.

The established view and that well-worn chart

A simple view suggests a strong and consistent negative link between real US interest rates and gold price.

Chart 1 shows one of the most common arguments with regard to holding (or selling) gold. It pits the US real rate – measured as the three-month T-bill interest rate less US headline CPI inflation – versus the gold price in US dollars per troy ounce. Advocates of the strong relationship between US real interest rates and gold point to the clustered shaded areas to the left and right, which appear to have been almost unanimously associated with rising gold prices: the bull market of the 1970s and the bull market over the last twelve years, respectively. Accordingly, they will point to the long fall in the gold price from its peak in the early 1980s through to 2001 and highlight that this occurred during a positive and often high real rate environment in the US and elsewhere. It does suggest a compelling association.

Chart 1: Gold is typically assumed to have a strong negative correlation to US real rates
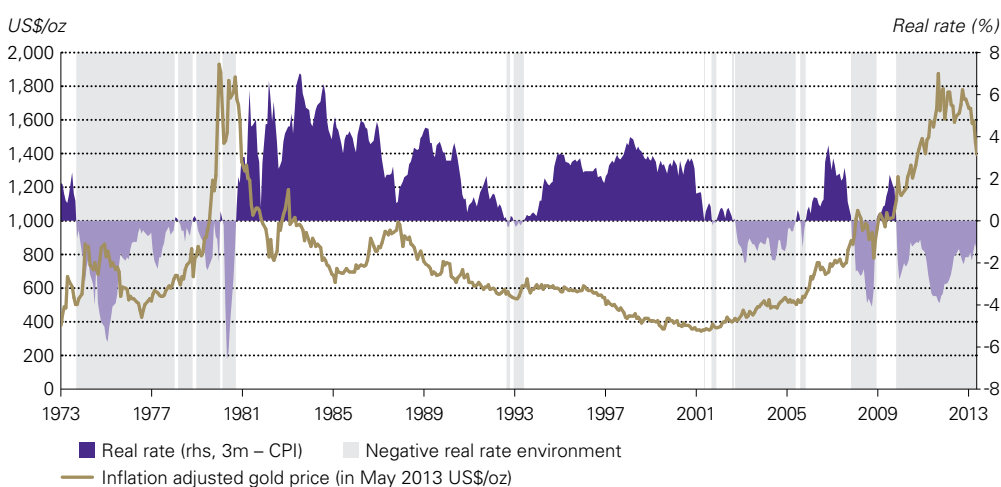
US$/oz   *Real rate (%)*

Legend:
- Real rate (rhs, 3m – CPI)
- Negative real rate environment
- Inflation adjusted gold price (in May 2013 US$/oz)

Reference notes are listed at the end of this article.

Source: Thomson Reuters Datastream, World Gold Council

Yet not all real rate environments are created equal.

But the chart does not show how different these two periods were:

- **High inflation/low inflation:** The low to negative real rates during the 1970s occurred amidst very high and rising inflation, while the low real rates we have mainly experienced during the 2000s (barring two episodes) have existed in a low nominal rate but low inflation environment.

- **Strength of the US dollar:** These two periods are also defined by very different US dollar settings. The 1970s witnessed mixed fortunes for the US dollar but with an overall modest decline. This is contrasted by the protracted decline in the US dollar over the last 10-plus years.

- **Gold demand and supply:** The underlying supply and demand picture for gold has changed significantly. Today, emerging markets are key components in demand, and mine production is almost evenly distributed throughout the different continents. Further, the period from the early 1980s to the late 1990s was characterised by active central bank and producer-hedging activity. Today, central banks are net buyers of gold and while producer hedging, a possible source of supply, is at negligible levels.

- **Relative importance of US real rates:** The advent of forward and futures markets during the 1980s provided a new vehicle for participants in the gold market. Centred on LIBOR, a US dollar-based benchmark for global interest rates, these market advances consequently had a strong link to movements in physical gold and probably to prices as well.[1] As developing markets increase their importance in the global economy, the predominance of the US dollar and its real rates will likely shift.

1 O'Callaghan, Gary, *The structure and operation of the world gold market,* December 1991.

The fundamental picture of the gold market

The supply and demand makeup of the gold market suggests that the relationship with US real interest rates is less clear than common wisdom has it.

Investment demand linked to the US market is one of many factors that influence gold. Thus, why should US real rates be assumed so influential?

Firstly, the established view relates gold prices to movements in the real US interest rate through investment channels. Over a five-year average, global investment constitutes 27% of gold demand (**Chart 2a**). Adding both exchange-traded funds (ETFs) and over-the-counter (OTC) demand takes this share up to 37%, well below the 48% accounted for by jewellery demand. Further, investment demand linked to the US and Europe only accounts for 18% of total demand over the last five years – even if all OTC-related demand is assumed to originate here. One therefore draws the conclusion that this is the exposure that most directly dictates the negative relationship between the gold price and US interest rates. However, it is understood that although constituting a small share of global demand (**Chart 2b**), the US and European investor markets have a strong influence on price oscillations simply because of the size of their transactions, accessibility of their markets, and to some extent their influence on investor behaviour elsewhere. But that these two markets are the sole arbiters of gold prices is questionable in the medium- to long-term.

Chart 2: (a) Jewellery and technological applications make up more than 50% of demand, while (b) most gold is bought in emerging markets

● Jewellery	48%
● Investment	27%
● Technology	11%
● Central banks	4%
● ETFs and OTC	10%

● Europe	17%
● North America	11%
● Middle East	11%
● Indian sub-continent	25%
● East Asia	30%
● CIS	2%
● Latin America	1%
● Africa	1%
● Other	1%
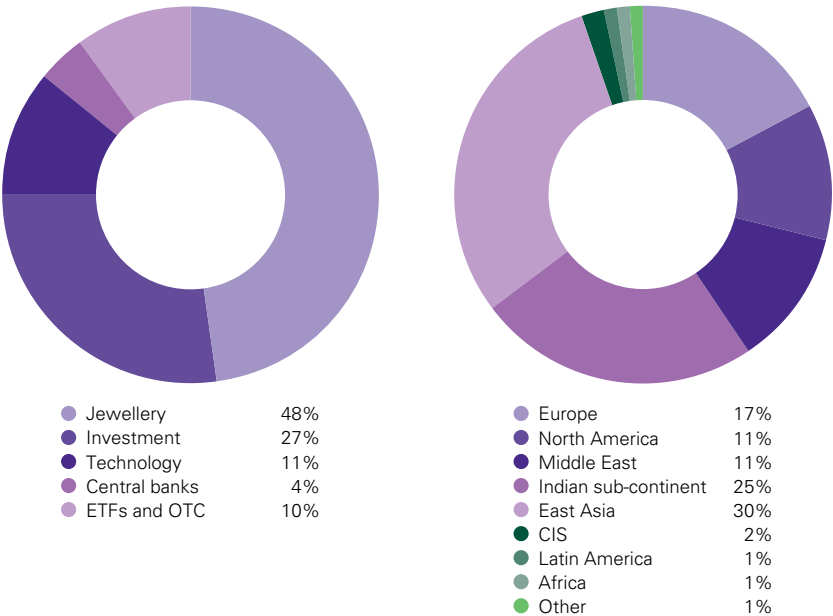
Reference notes are listed at the end of this article.

Source: Thomson Reuters GFMS, World Gold Council

Even local real rates appear not to have much impact on buying behaviour…

Secondly, how do the other categories of demand respond to interest rates? The historical sensitivity of jewellery demand to gold prices would, by extension, mean that jewellery demand is positively correlated to interest rates (if the rate/price relationship holds). Therefore, lower prices would stimulate gold jewellery buying. In some corners of the world this does not hold, particularly in emerging markets where buying is a consistent feature of landscapes that include cultural incentives to buy gold. In India for example, the motives for investment and jewellery buying are not mutually exclusive, and real rate sensitivity is unclear. An econometric analysis of gold demand in India by Dr. R Kannan found that the domestic real deposit rate had "no statistically significant effect on gold demand". Rural consumers, lacking access to financial services and having a strong preference for the 'physical' were seemingly indifferent to real interest rates.

…while gold 'consumption' is typically pro-cyclical.

The pro-cyclical nature of technology demand also tends to be positively correlated to real interest rates. Higher or rising domestic real rates are often consistent with improving economic health, which spurs the demand for gold in industrial and technological applications.

Further, central banks' activity should be less sensitive to rates.

Finally, while prior to the global financial crisis central banks had mandates more closely tied to a search for yield, the events of 2007 – 2008 propelled risk mitigation to the core of most central bank reserve management strategies. As such, risk management takes precedence over yield, and the response by central banks to higher interest rates is likely to be fundamentally different from that of investors.

How do real rates impact gold's portfolio attributes?

We determine the effect that rates have on gold and its portfolio attributes by looking at different rate environments.

While real interest rates are one of the factors that influence gold prices, the core value of gold to an investor lies in its contribution to portfolio performance – via the attributes that make gold a foundation portfolio asset. Using a simple regression analysis with dummy variables representing different rate environments, we explore how gold's attributes have fared historically. These real rate environments are defined as follows:[2] high (>4%), moderate (0%-4%) and low (<0%).[3] All data cover the period January 1975 to May 2013. Volatilities and correlations are calculated on a rolling 52-week basis and averaged to a monthly frequency.[4]

Returns

Returns are highest in low real rate environments.

Return is the primary characteristic of interest to most investors. Clearly, very few investments are held with a complete disregard to the returns they provide, with some hedges serving as a rare exception. **Table 1** shows the results of the regressions where each of three real US interest rate environments are explanatory dummy variables for gold returns.

Table 1: Gold's return is higher under low and moderate real rate regimes

	Long term	Real rate level			Real rate trend	
		Low (<0%)	Moderate (0%-4%)	High (>4%)	Falling	Rising
Average monthly return	0.6%	1.5%	0.7%	-1.0%	0.8%	0.3%
Standard error	0.3%	0.5%	0.4%	0.6%	0.3%	0.4%
Statistically different from zero	No	Yes	No	No	Yes	No
Statistically different from long term?	-	No	No	Yes	No	No

Reference notes are listed at the end of this article.

Source: Bloomberg, World Gold Council

2 A simple approach is adopted here primarily to maintain consistency with perceived wisdom. Thus, the real rate we use to represent both rational and actual expectations is a straight average of two of the simplest: the US CPI inflation and the established Michigan survey of inflation expectations covering the outlook one year ahead. Our numerator is a one year continuous Treasury bond yield.

3 These boundaries are a logical and symmetrical extension of the neutral real interest rate (estimated at 2.25% in 2005), which is the rate at which output growth matches its potential.

4 Other frequencies and longer/shorter windows did not materially affect the results.

In addition, returns during moderate rate environments are in line with gold's long-term average.

The results effectively exhibit average returns for the various rate environments.[5] Gold's average monthly return since 1975 is 0.6%, translating to an annualised 7.5% nominal return.[6] The best returns have been achieved during low real rate environments (1.5% monthly). During moderate real rate environments gold's monthly rate of return is 0.7%, largely in line with the long-term average. High real rates, as might be expected, are associated with lower monthly average returns of -1%. The average returns suggest, as common wisdom has it, that real rate regimes are negatively correlated to returns. However, average returns during the various environments analysed are mostly not statistically different from the long-run average and, other than returns during low interest rate environments, they are not statistically different from zero.[7]

While high real rates have historically coincided with lower gold returns, their effect may be overcome by changes in the US dollar or inflation expectations.

After looking at the level of real rates, let us consider their trajectories. **Chart 3** below details the trajectory of gold during high US real rate environments. There is by no means a clear-cut pattern in behaviour. Gold fell during the mid and late 1980s (2nd and 4th boxes in the chart), but showed resilience in the early part of the decade and even rose during the 1985 to 1987 period. This unexpected behaviour suggests that other macro-economic or fundamental factors are dominant. For example, previous research has also found it difficult to disentangle the effects of real rates on gold from those stemming from changes in the US dollar and inflation.[8]

Chart 3: Gold's relationship with real rates is less clear when viewed in the context of other fundamental factors (100 = 01/1978)
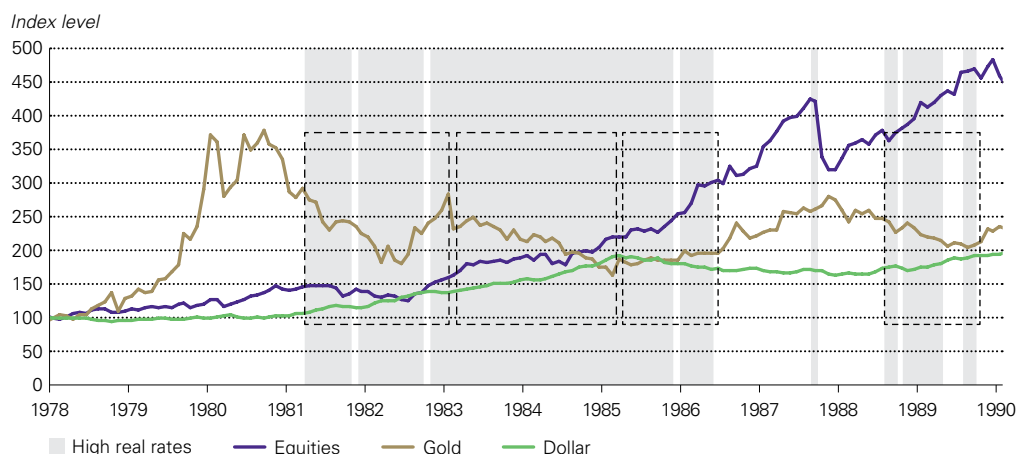
Index level

Reference notes are listed at the end of this article.

Source: Bloomberg, World Gold Council

Rising real rate environments are only marginally worse for gold than falling ones.

As **Table 1** shows, rising real interest rate environments have lower (yet positive) returns for gold than do falling ones, with 0.3% average returns versus 0.8% for falling rate environments. While the low returns for the rising environment may not thrill those who opportunistically hold gold for capital gains, they do, however, support gold's portfolio attributes. Indeed, the bulk of lower returns come from **high and rising** rate environments. By contrast, the period between October 2003 and October 2006 saw US real rates **rise from low levels** – negative 1% to almost 3% – yet gold had a cumulative return close to 60% over the period.

5 These results do not suggest any causal link and do not control for other factors.

6 Returns are calculated using an arithmetic average.

7 As a rough rule of thumb, estimates are considered significantly different in statistical terms only if they are more than two standard deviations away from each other.

8 Sherman, Eugene J., *A gold pricing model,* The Journal of Portfolio Management, Spring 1983.

Volatility

Gold volatility is significantly influenced by the real rate environment.

Return is not the only variable that matters to investors. Understanding risk is particularly important in portfolio management. Thus, we examined how gold's volatility has behaved during the three real interest rate regimes. Results suggest that volatility is significantly influenced by the prevailing real rates regime (**Table 2**).

Table 2: Gold's volatility is lowest in a moderate real rate regime

	Long term	Real rate level			Real rate trend	
		Low (<0%)	Moderate (0%-4%)	High (>4%)	Falling	Rising
Annnualised volatility	17.3%	20.5%	14.1%	21.2%	17.2%	17.6%
Standard error	1.0%	2.1%	1.0%	2.7%	2.6%	3.3%
Statistically different from long term?	-	Yes	Yes	No	No	No

Reference notes are listed at the end of this article.

Source: Bloomberg, World Gold Council

Moderate real rate environments lower volatility on average by 6 to 7 percentage points compared to high or low environments.

The long-term average for the sample is 17.3%. In fact, gold has exhibited lower volatility during moderate real rate environments. Both high and low rate environments have shown consistently higher volatility at 21.2% and 20.5%, respectively, a likely cause being that both these environments are associated with higher market uncertainty (as seen during the last few years) or high inflation (as experienced in the late 1970s). However, the volatility estimate for the high interest rate environment is not statistically different from gold's long-term volatility. Additionally, gold's volatility has displayed almost no difference during falling or rising rate environments. It appears that the level of rates is more strongly associated with gold's volatility than the direction of the moves. This makes sense as the direction of interest rates is unlikely to influence asset volatilities unless the movement is unexpected, fast or sizeable.

Correlation

Gold's correlation profile with risky assets – in particular equities – changes over time…

The final characteristic to consider is correlation. Gold's unique correlation behaviour has been documented at length in our research. But few correlations are constant over time. Are changes in correlation systematic or random? In other words, are there regimes during which gold's correlation is systematically different from its long-run average? We have noted previously that gold's correlation with equities is generally asymmetrical: falling equities often lead to a negative correlation with gold, whereas rising equities are often associated with a zero or slightly positive correlation.

…tending to increase when rates are high.

At first glance, there seems to be no consistent pattern in terms of correlation between gold and risk assets during different interest rate scenarios. However, one might expect some convergence in shorter-term returns between riskier assets as uncertainty prevails and a reduced number of factors drives asset returns. This is something we have seen during various periods over the last few decades (**Chart 4**).

Chart 4: The relationship between gold's correlation to equities and real rate regimes is less obvious
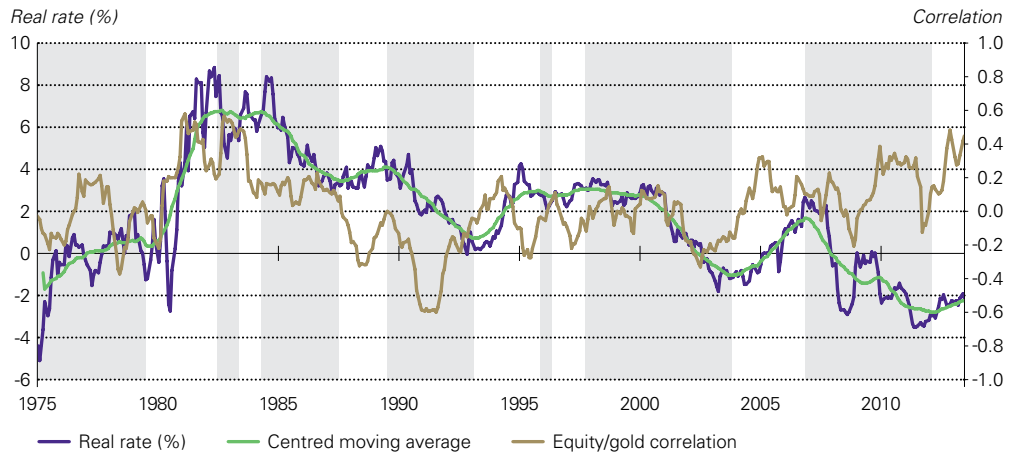
Real rate (%)   Correlation

— Real rate (%)   — Centred moving average   — Equity/gold correlation

Reference notes are listed at the end of this article.

Source: Thomson Reuters Datastream, World Gold Council

A moderate regime is most beneficial for the correlation between gold and risk assets, while correlations increase during high rate environments.

Table 3 details the results for correlations between gold and global equities during the three real rate environments.[9] For a moderate environment, correlations are very close to zero and slightly on the negative side, close to the sample average of 0.03. This long-term correlation is a key driver of gold's diversification benefits. During moderate real rate environments, gold has even exhibited a slightly negative correlation. High real rate environments, however, suggest that gold and equities are more likely to move together. Why is this? While such an environment was prevalent only during the 1980s, higher real interest rates can be negative for equities as well as gold stifling investment and pushing down valuations via the discount rate. However, the US dollar appears to have played a large part in this dynamic as high interest rates did not prevent gold and equities from rallying in tandem in the mid 1980s as the broad US dollar index fell. Further, an average correlation of 0.2 is still low relative to the typical correlations found between equities and other assets.

Table 3: Gold's correlation to equities is lowest in a moderate real rate regime

	Long term	Real rate level			Real rate trend	
		Low (<0%)	Moderate (0%-4%)	High (>4%)	Falling	Rising
Correlation	0.03	0.08	-0.06	0.20	0.00	0.09
Standard error	0.04	0.05	0.04	0.06	0.05	0.07
Statistically different from long term?	-	No	Yes	Yes	No	No

Reference notes are listed at the end of this article.

Source: Bloomberg, World Gold Council

However, other factors, such as the US dollar, can influence these correlations.

As discussed in previous sections, the relationship between gold and real interest rates is not clear cut, even in an environment where the opportunity cost may seem prohibitive. A weaker dollar may mitigate the negative effect of a rise in rates as it appeared to do in the late 1980s, when the gold price almost doubled amidst periods of high real interest rates.

9 The global equity index assumes local currency returns to minimise the US dollar impact.

Has the relationship with real interest rates changed over time?

Previously, high real rates have reduced gold's return, but the market has experienced significant changes.

High US real rates do appear to apply the brakes to gold performance. The last time such an environment existed was in the early 1980s. Has the relationship between gold and real rates changed since then? Given the aforementioned structural changes in the gold market in the last two decades, it would be conceivable to believe that some of these established relationships have shifted.

Consequently, real rates may now be less influential.

To determine whether this might be the case, we re-estimated the robust gold price model developed by Oxford Economics in 2011 over a contracting window, incrementally dropping older data, quarter-by-quarter. The original model's estimation period included the mid-1970s, so it captured the dynamics in play at the time. In addition, we also re-estimated the parameters using a 15-year moving window. The results are displayed in **Charts 5a** and **5b**. The charts suggest that ignoring the high real rate environment, which was prevalent in the late 1970s and early 1980s, the US real rate variable has little meaning for gold prices.

In fact, a closer inspection reveals that the US dollar and other variables are more relevant than US interest rates.

Of the macro-economic variables in Oxford Economics model, the US dollar has the most persistent significance as a consistently negative coefficient, as the window is reduced to exclude older data or moved along with a 15-year window. The most remarkable change is the drop in the statistical significance of the real rate, to close to zero if estimated from the early 1980s until today, and the effective disappearance of its economic impact. While the other variables show shifting significance, consistent with being important only during certain regimes, only the real rate appears to have lost and not regained its significance since 1981.

Chart 5: The influence of US real rates has receded over time, whether estimated by (a) removing past periods, (b) or using a moving window
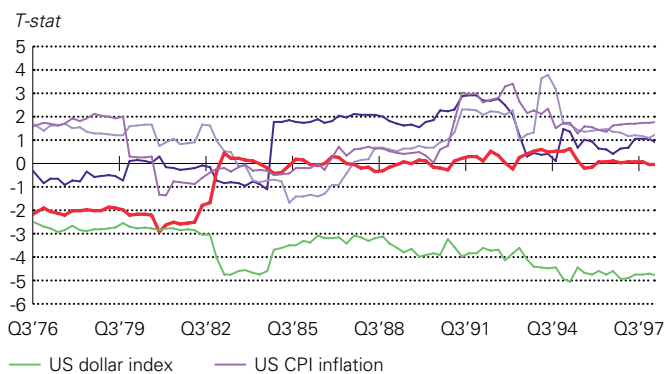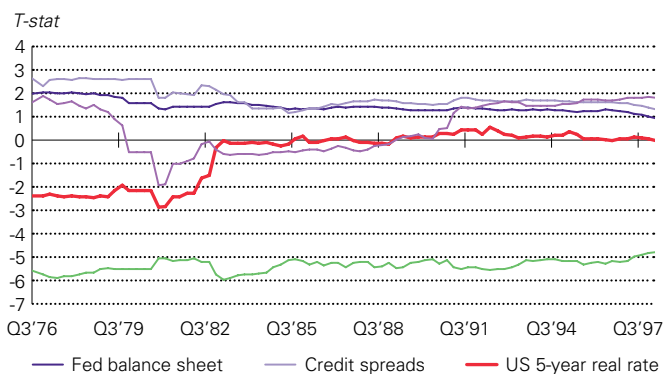
Reference notes are listed at the end of this article.

Source: Oxford Economics, Thomson Reuters Datastream, World Gold Council

Conclusion

Gold's relationship with US real rates is not linear and is changing.

Real rates are an important consideration when constructing the framework for understanding movements in the gold price, but an awareness of when they are important is key. While the relationship is logically and practically a driver of investment demand at times, it is only one of several. In addition, investment demand is not the sole arbiter of gold prices, nor does it originate solely in the US. Gold's relationship with US real rates is not linear and is arguably changing. As the dominant influence of both the US economy and the US dollar slowly makes room for emerging markets and their currencies, their macroeconomic factors will become structurally more important in setting prices on the global stage, including that of gold.

A high US real rate environment has not been friendly to gold investment demand, but other factors, including the US dollar and emerging market demand, can wield significant influence.

Results from our analysis show that contrary to the simplistic view that higher US real rates should lead to lower gold prices, moving to a moderate real rate environment promotes gold's portfolio characteristics further. Returns in such an environment are in excess of the conservative return estimate used to provide evidence of gold's portfolio contribution credentials. Volatilities fall as rates move into a moderate real rate environment, as do gold's correlation with global equities. While it is true that a high real rate environment has not been friendly to gold on average, the underlying data is mixed and obscured by movements in other driving factors, such as the US dollar. We do not know what a high real rate environment would mean for gold, as it would be contingent on so many other factors, not least of which are those that now originate in emerging markets. It is this last facet of the gold market that lends credence to the idea that the influence of the US real rate on gold has receded over the last couple of decades.

References

Chart 1: Gold is typically assumed to have a strong negative correlation to US real rates

Real rate is computed as the difference between the 3-month US Treasury bill yields less the headline US CPI inflation. Shaded areas denote negative real interest rate environments.

Chart 2: (a) Jewellery and technological applications make up more than 50% of demand, while (b) most gold is bought in emerging markets

(a) The figures are computing using a trailing 5-year average of gold demand by sector.

(b) The figures are computing using a trailing 5-year average of gold demand by sector. CIS stands for Commonwealth of Independent States or the former soviet republics. Total demand includes jewellery, investment, technology and ETFs. Data assumes that the origin of buyer is the domicile of its fabrication.

Table 1: Gold's return is higher under low and moderate real rate regimes

Gold (US$/oz) returns are calculated on a monthly basis from January 1975 to May 2013 as percentage changes. Standard errors correspond to the (absolute) average of each regime: moderate, high or low and falling or rising. Statistical significance reported at the 5% level.

Chart 3: Gold's relationship with real rates is less clear cut when viewed in the context of other fundamental factors

Equities are represented by the MSCI World index denominated in local currency. Gold is shown in US dollars. Trade-weighted US dollar basket is used to represent the dollar against other major currencies. Real rate is computed as the 1-year Treasury bill yield less the average of headline US CPI inflation and Michigan 1-year-ahead inflation expectations. High real rates are defined as greater than 4%.

Table 2: Gold's volatility is lowest in a moderate real rate regime

The real rate is computed as it was in Table 1. Gold (US$/oz) volatility is calculated on a monthly basis from January 1975 to May 2013. The value for each month is the annualised average of rolling 52-week volatilities for that month, using weekly log returns. Standard errors correspond to the (absolute) average of each regime: moderate, high or low and falling or rising. Statistical significance reported at the 5% level.

Chart 4: Relationship between gold's correlation to equities and real rate regimes is a bit less obvious

Correlation is represented by the monthly frequency of 52-week rolling correlation between MSCI global equities in local currency and gold (US$/oz). Real interest rate is computed as the difference between the 1-year Treasury bill yield less the average of headline US CPI inflation and Michigan 1-year-ahead inflation expectations.

Table 3: Gold's correlation to equities is also lowest in a moderate real rate regime

The real rate is computed as it was in Table 1. Gold (US$/oz) and equity (MSCI world equity index in local currency) correlation is calculated on a monthly basis from January 1975 to May 2013. The value for each month is the average of rolling 52-week correlations for that month. Standard errors correspond to the (absolute) average of each regime: moderate, high or low and falling or rising. Statistical significance reported at the 5% level.

Chart 5: The influence of US real rates has receded over time, whether estimated by (a) removing past periods, (b) or using a moving window

(a) The t-statistics were computed from the equation that was published by Oxford Economics in the paper, *The effect of inflation and deflation on the case for gold,* June 2011. That regression equation was re-run with a contracting estimation window. The dates shown on the x-axis are the starting points of the regression which goes to Q4 2010. What this chart shows is if the regression is run from 1983 onwards, the effect of the US real rate is negligible when seen in the context of the dollar, the Fed balance sheet, credit spreads and CPI inflation.

(b) The t-statistics were computed from the equation that was published by Oxford Economics in the paper, *The effect of inflation and deflation on the case for gold,* June 2011. That regression equation was re-run with a 15 year moving estimation window. The dates shown on the x-axis are the starting points of the regression with the ending date occurring 15 years after the starting date. What this chart shows is if the regression is run from 1983 onwards, the effect of the US real rate is negligible when seen in the context of the dollar, the Fed balance sheet, credit spreads and CPI inflation.

II: What drives gold?
Factors that influence gold and its role in a portfolio

To some investors, gold seems arcane: a non-productive asset that is simply extracted and stored. To many others, gold plays an important role as a store of wealth and portfolio risk management vehicle. To most, a key challenge is finding an appropriate framework of reference: what gold does, what it does not do, how and why it responds to various economic environments. Gold's performance can be understood in the context of seven primary interrelated global themes: its relation to currencies, global inflation and interest rates, consumer spending and income growth, market risks, short-term investment flows and supply-related drivers.

Market commentators tend to link gold to a few US-driven factors. Such an approach falls short.

When market commentators discuss gold, they typically use only one of a few recurring factors in evaluating gold's price performance. US-specific factors have historically received a preeminent focus. Such an approach, however, over-simplifies and often leaves investors under-informed, given gold's global market and the numerous components that can affect its performance in different economic environments.

A comprehensive framework can help investors become comfortable with gold.

This does not mean that gold's performance is unexplainable or that gold's investment characteristics are difficult to understand. A comprehensive but simple framework can provide investors with a deeper understanding of this asset and ensures they have the appropriate expectation for gold's role in a portfolio.

Influencing factors affect gold through four channels of demand and two channels of supply.

This research note seeks to outline a more comprehensive framework for gold by discussing various factors that influence the gold market. Many of these factors can be categorised into themes, which in turn influence gold through one or more of the four sources of demand: jewellery, technology, central banks and investment, or one of two sources of supply: recycled gold and mine production.

This note is a segue to several research papers that explore the aforementioned themes, including *Gold and US rates: a reality check*. While this brief note provides only an outline, when combined with additional research it will provide investors with a comprehensive view of the asset including the benefits it brings to investment portfolios.

Common misconceptions about gold

Often, spurious correlations have led to erroneous conclusions about the relationship between gold and equities.

On various occasions during the past few years, some market participants focused on gold's increasing correlation to the stock market and falsely concluded that gold was becoming a risk asset. However, as shown in our Q1 2012 *Investment Commentary*, in the context of a statistically significant variable like the US dollar, gold's correlation to US equities became negligible. Interpreting this correlation as a causal relationship could lead to a false conclusion about gold's economic relationship to equities. Instead, it is prudent to view gold against all of its influencing factors simultaneously. Indeed, it is necessary to consider the bigger picture when evaluating a particular variable.

Traditional frameworks used for stocks and bonds also prove inadequate.

Applying common valuation models used for other financial assets to gold overlooks its unique components. Typical discounted cash flow valuation models that apply to equities and fixed income do not adequately adapt to gold. In addition, the approach of evaluating commodities on the basis of a supply and demand imbalance cannot readily be applied either because of its large and available stock; a by-product of gold's non–perishing qualities. An apparent lack of a framework for thinking about gold's value and returns is a commonly cited barrier to investment.

The exclusive use of US-driven factors is insufficient to encapture gold's global dynamics – increasingly influenced by emerging markets.

Additionally, the analyst community tends to use solely US-specific economic variables to explain changes in the gold price. This approach is overly limited, given the global nature of the gold market. The US represented 10% of physical gold demand in 2012, while emerging markets represented close to 70%. While the US represents a large portion of financial markets and US variables are indeed important in understanding macro-economic developments, exclusive reliance on them to explain fluctuations in the gold price is inadequate.

Key themes that help explain gold's performance

In this research note we outline the main themes that influence gold.

In the following section we discuss the general themes that influence gold in order to help investors develop a more comprehensive and accurate framework. These themes should be viewed as an interconnected set of factors. These themes include:

Gold has a negative relation to the US dollar, a positive relationship to the quantity of money supply, and is used as a diversifier for FX reserves.

Currencies. Gold is often thought of as a currency based on its widespread use as a store of value and a unit of exchange. In 1971, the world adopted a floating currency regime, and gold was no longer an official anchor of currencies. However, it retained some of its currency-related attributes. In particular, its negative correlation to the US dollar and other developed market currencies, as well as its use as a store of value in countries with volatile foreign exchange rates. In contrast to fiat currencies, the quantity of available gold stocks cannot be expanded at will, thus helping investors to protect against losses in purchasing power. See *Gold and currencies: hedging foreign-exchange risk* and *Gold and currencies: protecting purchasing power,* included in previous editions of *Gold Investor.*

Gold is a global inflation hedge, and investor inflation expectations influence flows.

Inflation. Variables such as inflation have a profound impact on how investors and consumers view gold. Global inflation and inflation expectations dictate consumers' purchasing power, driving the decisions of whether we buy something today or save it for tomorrow. High inflation is fairly disruptive, and expectations of such an environment have a significant influence on gold's demand. However, gold's hedging qualities need to be analysed in the context of global – not local – inflation. See *The impact of inflation in the case for gold* and *Gold and currencies: protecting purchasing power.*

Interest rates affect the opportunity cost of investing.

Interest rates. Interest rates are a key component in the valuation of financial assets because they measure the opportunity cost of keeping money in cash (and high-quality short term bonds) relative to any other asset. High interest rates can increase the opportunity cost of investing in gold, but the economic environments in which they develop can also be supportive of gold as a consumption good. However, global interest rates (not only US ones) ought to be taken into consideration. See *Gold and US rates: a reality check.*

Consumer spending and income growth support demand, as well as gold-related savings.

Consumer spending and income growth. Jewellery, bars, coins and technological applications make up the majority of demand. Growth in disposable income and consumer spending promote purchases of these goods. In particular, as emerging markets (which account for the largest share of demand) expand further economically, higher levels of wealth increase demand for gold.

Gold investment typically increases during periods of systemic and tail risks.

Systemic and tail risks. Systemic market disruptions and tail risks impact global markets and have an influence on gold as crises tend to drive flight to high-quality, liquid assets. These types of events are difficult to predict but can have a devastating effect on investors' wealth, typically exacerbated by market momentum. Assets such as gold help to partly mitigate these losses. See *Gold: hedging against tail risk.*

Investment flows driven by momentum and technical factors can affect gold prices in the short run.

Short-term investment flows. There are incentives that propel short term investment flows, including momentum and technical drivers that are not always correlated with fundamental drivers of demand and supply. Many investors wishing to make purchases based upon momentum or technical indicators use the futures market because it is a liquid and highly marginable vehicle.[1] This is a natural consequence of capital markets but also a source of liquidity and price discovery.

Supply from mine production and recycled gold impacts its availability.

Supply-side drivers. The factors above look at the motivations for purchasing gold. The supply of gold that is used to meet demand for these purchases is a factor that could potentially influence the gold price. All else being equal, a short term decline in mine production could induce physical buyers to pay more for gold.

Taking a holistic approach to gold is paramount, as gold's drivers respond to various economic environments…

The aforementioned drivers have an influence on gold and interact with each other through various channels. For example, US interest rates and inflation have a large impact on the attractiveness of the US dollar. Interest rates and inflation have an impact on consumer spending and miners' decisions to expand production. The appearance of systemic risks can lead investors to change their risk management practices and allocate to diversifying assets like gold. These relationships are just a few examples that could potentially complicate investors' attempts to use individual variables when thinking about gold.

…calling for a dynamic framework.

Furthermore, gold is a global asset, and the changing nature of the gold market means that a static valuation framework will not account for changes in the importance or the mutual interaction of these variables.

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1 A highly marginable security is one that allows an initial payment that is substantially smaller than the value of the security. Margining leads to increased leveraged which could amplify losses and gains.

Gold's role in a portfolio

As a by-product of the factors described above, gold has two primary functions in investors' portfolios:

As a result of those factors, gold provides risk management…

Gold as a risk-management vehicle

- **Gold provides portfolio diversification** through its lower correlation to other assets. Gold's correlation to equities and bonds is, on average, 0.1 and, as discussed in *Gold: a commodity like no other,* it has a correlation of 0.3 to the broader commodity complex.

- Gold provides **tail-risk protection** by consistently reducing portfolio losses during tail-risk events as summarised in *Gold: hedging against tail-risk.*

- **Gold is a high quality, liquid asset.** Gold traded an average of US$240bn per day in the first quarter of 2011,[2] higher than most liquid equities, German Bunds, UK gilts, US agencies and certain currency pairs (see *Liquidity in the gold market*). Gold lacks credit risk, helping investors to balance the risks present in their fixed income and equity allocations.

…and capital preservation to investors.

Gold as a source of capital preservation

- **Gold hedges against extreme inflation scenarios** like deflation and hyperinflation. In the paper *The impact of inflation and deflation on the case for gold,* Oxford Economics shows that both environments lead to gold's relative outperformance over other assets.

- **Gold protects against falls in developed market currencies.** Gold has a -0.5 correlation to the US dollar and a negative correlation against most other developed market currencies (see *Gold as a hedge against the US dollar*).

Conclusion

Investors often reduce gold's determinants to a handful of US-led variables…

Investors tend to analyse gold through the lens of a few US-driven variables, typically in isolation. This exercise is inadequate as it fails to consider all of gold's influencing factors as well as the global nature of the gold market and could lead to false conclusions about gold's investment characteristics.

…yet gold's drivers are global and interconnected. An understanding of these dynamics is critical in developing a framework for gold.

Instead, there are several globally interrelated factors that influence the gold market, including: currencies, interest rates, inflation, consumer spending, systemic factors, short-term investment flows, and supply-side drivers. Furthermore, the changing importance and mutual interactions of these themes reinforce the need for a dynamic framework in which to think about the gold market. Such a framework gives investors a tool to thoroughly analyse fluctuations in gold and truly understand the source of gold's portfolio attributes: portfolio risk management and capital preservation.

2 LBMA, *Gold turnover survey for Q1 2011,* August 2011.

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III: The role of gold in defined-contribution plans: Mexico case study

As more pension funds around the world opt for defined-contribution structures and move away from defined-benefit plans, contributors will not receive the same guaranteed payouts seen in the past. A comfortable retirement will be based on the combination of careful planning and a thoughtful investment strategy. Complementing absolute return performance with comprehensive portfolio risk management should become a foremost priority. Gold provides diversification and capital preservation for investors wishing to protect their nest egg.

Gold

For retirement portfolios, risk management is key to a successful investment strategy.

There are a myriad of pension fund structures and savings vehicles in various countries designed to ensure that workers save sufficient funds for their retirement. Retirement portfolios are very much goal-focused, and contributors (future retirees) look to achieve a target level of wealth that is sufficient to maintain a consistent standard of living during their retirement years. However, these funds can also provide a source of funding during various life events prior to retirement. Thus, as market shocks can occur at any time, appropriate risk management is essential. In a series of papers on gold's role for retirement funds, we will focus our attention on gold's function as an integral part of strategies that help investors achieve their long-term goals.

Our analysis shows that gold can reduce risk in Mexican pension portfolios and help preserve wealth.

This study explores the Mexican pension fund experience and gold's function in retirement portfolios. Our analysis shows that gold can improve the risk/reward profile of investment portfolios where allocations to commodities are permitted. Adding a modest allocation to gold (1% to 7% using historical asset performance or 1% and 3% using conservative return assumptions for gold) can reduce the volatility and Value-at-Risk (VaR)[1] of a portfolio while adding liquidity, hedging against systemic risks, and helping to preserve wealth in the long term.

From defined benefits to defined-contributions

The retirement landscape has been moving away from defined-benefit (DB) plans to defined-contribution plans (DC).

Defined-benefit plans, still prevalent around the world, typically offer a pre-negotiated percentage of contributors' salaries during retirement. As a result, portfolio managers try to sustainably meet the long-term liabilities associated with the plan. However, over the past two decades, there has been a shift in the pension fund space toward defined-contribution systems.[2] Here, employers typically contribute a pre-determined amount (or match some portion of the employees' contributions), but the funds available at the time of retirement are solely dictated by the performance of the investments – whether the investment decisions are made by the contributors themselves or by dedicated portfolio managers.

Around the world, DC plans have been gaining momentum.

While defined-contribution systems expose contributors to market risk (and potential rewards), they are generally viewed as more efficient and sustainable from an economic perspective. As of 2012, 45% of pension fund assets in the 13 largest markets were held in defined-contribution plans, led by Australia, the US and the UK.[3] In particular, in the US, 401(k) plans and IRA accounts held US$9.9tn (58% of the market) by the end of 2012, comfortably surpassing assets managed by traditional defined benefit plans.[4]

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1 The Value-at-Risk of a portfolio measures the maximum loss an investor can expect with a certain degree of confidence during a defined period of time. More formally, the VaR of a portfolio at given confidence level $(1-\alpha)$ is the maximum expected loss such that the probability that any other loss exceeds that value is no greater than a for a defined period of time.

2 Towers Watson, *Global pension assets study 2013,* January 2013.

3 Ibid.

4 Ibid.

The Mexican pension fund experience

Mexico has a fully convertible currency, liquid capital markets and an equity market comparable to Singapore's.

Mexico has a fairly well developed financial market for a country that is typically classified as an emerging economy. It has a fully convertible currency and liquid capital markets. It has a wide array of financial products that includes cash (Cetes), longer-term government bonds (Bonos), inflation-linked bonds (Udibonos), and corporate bonds. Its equity market is one of the largest amongst developing economies and is comparable to that of Singapore. Additionally, Mexican investors can access international equities and bonds generally without capital restrictions.

Legislative changes led to a large scale move towards DC plans…

Legislative changes that started during the 1990s led to the privatisation of the pension fund space. Contributors to the old defined-benefit system were incentivised to migrate to the new system. Newcomers were automatically enrolled. Thus, a system that by the end of 2012 held approximately US$160bn (MXN$2tn) in assets under management has grown at a rate of US$2.5bn (MXN$30bn) per month.

…where DC investments are not self directed but administered by fund managers (AFORES).

In the Mexican system, pension fund managers (known as AFORES) are responsible for investment decisions, but they need to follow a comprehensive set of guidelines determined by their regulatory agency (referred to by its acronym CONSAR). These guidelines include the types of assets in which they can invest, rules on asset allocation, the amount of risk permitted depending on the time to retirement, and the value-at-risk a portfolio may experience. In early 2013, legislation was passed that allowed the use of gold and commodities in pension funds for all but the oldest contributing age group.

Gold has a role to play in the portfolios of young and older participants.

The current pool of employees varies considerably in age, ranging from younger participants who have more than 40 years until their retirement phase to older participants who just have a few working years remaining. As this case study will show, gold has an integral role to play in the portfolios of young, middle-aged and older plan participants in the developing Mexican pension market.

The structure of the typical Mexican pension portfolio

The average Mexican pension portfolio is allocated in a conservative manner.

Driven by the investment rules set by the CONSAR, the average defined-contribution pension fund portfolio in Mexico has a relatively conservative allocation, where local government securities allocation makes up 53.2% of assets, non-government fixed income allocation makes up 23.4% and an equities allocation accounts for 23.3%.[5] Defined contribution providers in Mexico offer four different portfolio options (SIEFOREs), all of which vary in risk level linked to the age bracket of the contributors. These are:

- SIEFORE 4 for participants younger than 36

- SIEFORE 3 for participants between 37 and 45

- SIEFORE 2 for participants between 46 and 59

- SIEFORE 1 for participants older than 60

AFORES have four different portfolios (SIEFORES), which they manage for plan participants ranging from low risk to higher risk.

Asset allocation varies significantly within each age bracket (as we discuss later). Conventional life-cycle theory states that younger plan participants have a longer period of time until retirement and consequently have a greater amount of human capital, defined as the present value of future earnings. For most individuals, future earnings are relatively certain and could be labelled a fixed income asset that will produce cash flows well into the future. As a result of a longer time horizon and larger human capital, younger participants should hold more equities in their portfolio. Older participants, on the other hand, have only a few years to their retirement and don't have enough time to recoup potential losses in equity markets. Their allocation tends to be more conservative and concentrated in shorter term government bonds. SIEFORE 4 (younger participants) has the highest risk tolerance, while SIEFORE 1 (older participants) has the lowest.

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5 J.P. Morgan, *Mexico: Pension funds monitor,* May 2013.

SIEFOREs follow a set of constraints set by the regulator to ensure appropriate risk and concentrations levels.

Regulations set forth by the CONSAR help ensure that each pension manager selects an asset allocation that is appropriate for the plan participants. **Table 1** outlines the constraints that portfolio managers need to follow for each SIEFORE. The maximum equity allocation allowed reduces with age, and so does the one for commodities. The maximum commodities allocation (including gold) is 10% for SIEFOREs 4 and 3 but only 5% for SIEFORE 2 and 0% for SIEFORE 1.

Table 1: Defined-contribution portfolios are subject to multiple constraints set by the regulator (CONSAR)

SIEFORE	4	3	2	1
Age category	<36	37 – 45	46 – 59	>60
Equities	40%	30%	25%	5%
Foreign currency	30%	30%	30%	30%
Foreign securities	20%	20%	20%	20%
Securities from single issuer	5%	5%	5%	5%
Commodities	10%	10%	5%	0%
Inflation bonds (Udibonos)	-	-	-	min 51%
Daily VaR (historical, 95%)	2.1%	1.4%	1.1%	0.7%
Maximum number of VaR breaches allowed	26	26	26	26

Source: CONSAR, J.P. Morgan

Gold's role in Mexican defined-contribution portfolios

Most assets, especially gold, performed well over the December 2003 – April 2013 period.

To assess the effect that gold has in Mexican pension fund portfolios, we first looked at past performance (in Mexican peso terms) of typical assets held within retirement portfolios.[6] As part of the wave of growth in emerging markets, Mexican equities and bonds have performed fairly well over the past decade. Gold was also one of the best performing assets, but in general most asset classes, with the exception of the general commodity complex, had annual returns of more than 5% per year (**Chart 1a**). At the same time, when seen in isolation, gold was also one of the most volatile assets, although it was lower than that of a broader commodity basket, which happened to be the most volatile asset in the group (**Chart 1b**).

Chart 1: (a) Mexican equities and gold outperformed most asset classes in Mexican-peso terms, but (b) they also had higher volatility
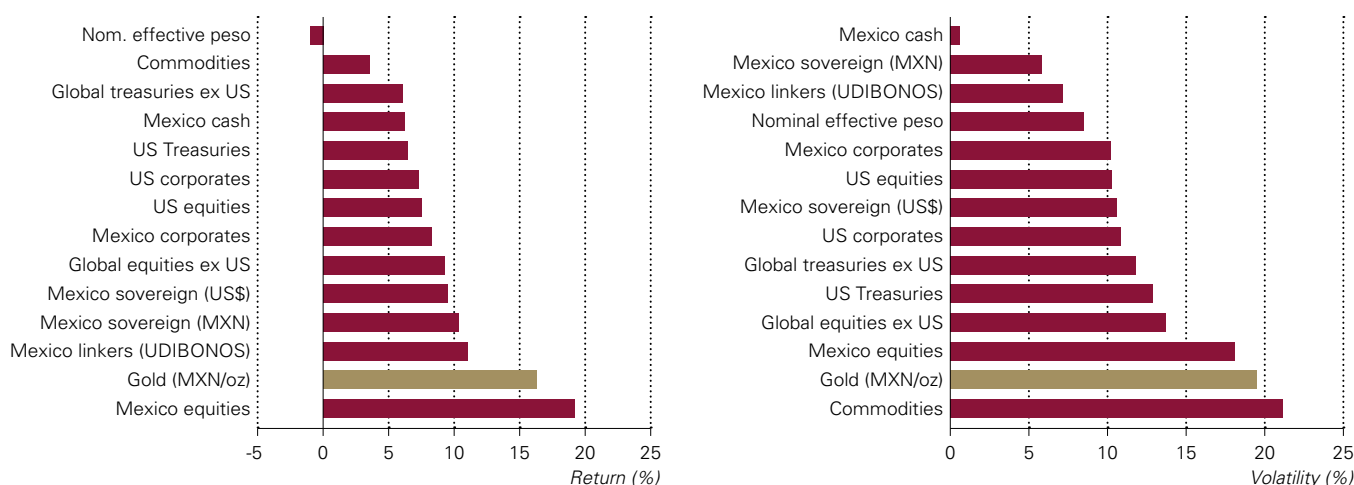
Reference notes are listed at the end of this article.

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

6 Due to data availability for fixed income assets (which account for the lion's share in pension fund portfolios) we used monthly data in the period between December 2003 and April 2013 for this study.

Gold's correlation to other assets in the portfolio are relatively low, providing portfolio diversification.

Correlations between gold and other portfolio assets (denominated in Mexican pesos) are relatively low, ranging from -0.25 to 0.50 over the selected time period. Gold's lack of correlation to most portfolio assets is particularly advantageous as it is the source of gold's portfolio diversification benefits (**Chart 2**).

Chart 2: Gold's correlation to other assets is typically low
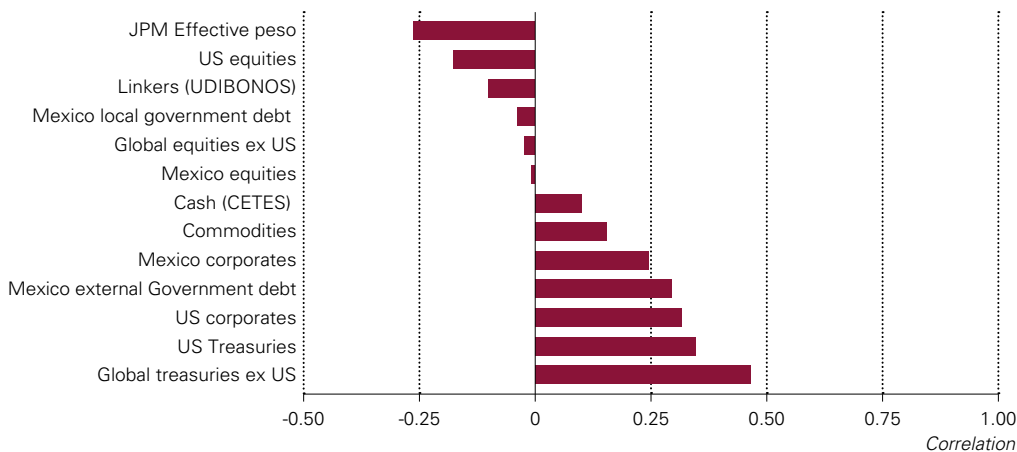
Reference notes are listed at the end of this article.

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

Focus 1: The case for gold as a strategic asset

In previous editions of *Gold Investor* and in other reports, the World Gold Council has demonstrated gold's integral role in investor portfolios. The research has found that optimal allocations range from 2% to 10% depending upon investor risk tolerance. Reports by J.P. Morgan, Mercer and New Frontier Advisors show similar results with the consensus that gold should be a foundation asset in investors' portfolios.[7]

In summary, the strategic case for gold is founded on its ability to preserve long-term wealth and manage risk effectively. As an inflation and currency hedge, it helps to protect purchasing power. Underpinned by its multiple sources of demand and supply (in terms of uses and geographic distribution) which reduce gold's correlation to most assets, gold acts as a portfolio diversifier. As a store of wealth and driven by inflows in times of systemic risk, gold helps reduce downside risks during tail-risk events. Supported by a broad and global market, gold provides a healthy dose of liquidity to a portfolio, with the capacity to reducing credit and counterparty risk.

7 New Frontier Advisors, *Gold as a strategic asset for European investors*, December 2011.

What can gold do for the average Mexican retirement portfolio?
As an initial test of gold's contribution to retirement portfolios, gold was added to a generic
pension portfolio with the other assets proportionally re-scaled to make room for a 5% gold
allocation, the middle point between 0% and the maximum allocation of 10% as dictated by
CONSAR. Due to data limitations, we had to estimate the asset allocation in relation to the indices
that were publicly available for analysis. **Chart 3** details an approximation of the average pension
portfolio. **Table 2** shows the improvement in portfolio performance by adding a 5% allocation to
an average portfolio over the December 2003 to April 2013 period. The portfolio performance
improved considerably as:

• Portfolio returns were improved by 28 basis points

• Portfolio volatility was reduced by 8 basis points

• 5% Value-at-Risk (VaR) was reduced by 2 basis points while maximum loss was
  reduced by 43 basis points

• Gold reduced the maximum and average portfolio peak-to-trough drawdown

**Chart 3: The average Mexican pension
fund portfolio is fairly conservative**
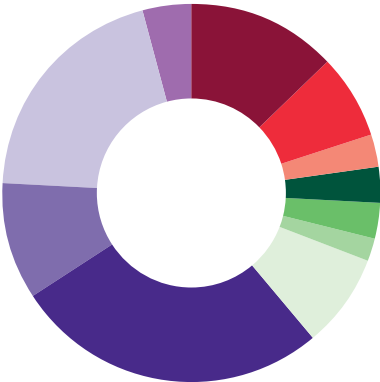
● MSCI Mexico	13%	
● MSCI US	7%	
● MSCI AC World ex US	3%	
● US Treasuries	3%	
● US corporates	3%	
● Global treasuries ex US	2%	
● Mexico sovereign (US$)	8%	
● Mexico sovereign (MXN)	27%	
● Mexican corporates	10%	
● Mexican linkers	20%	
● Mexico cash	4%	

Reference notes are listed at the end of this article.

Source: J.P. Morgan, World Gold Council

**Table 2: Gold improved risk-adjusted returns of the
average pension portfolio**

	Gold (5%)	Current allocation
Return	10.9%	10.6%
Volatility	5.09%	5.17%
Information ratio	2.15	2.06
5% VaR	1.59%	1.57%
Max Loss	3.31%	3.74%
Max pullback	7.11%	7.27%
Average pullback	0.62%	0.66%

Reference notes are listed at the end of this article.

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

Finding gold's optimal allocations

The results in the previous section were performed using an average pension portfolio. To make the analysis more relevant, we looked at optimal allocations to gold using those same assets and tested those for statistical significance.

Historical return assumptions and expected return assumptions were used for the optimisation study.

Both historical and expected return assumptions were used and contrasted for the purpose of this optimisation (**Table 3**). Historical return assumptions were based on the performance of the assets using monthly returns between December 2003 and April 2013. The expected return assumptions were the based on assets' estimated future returns. For example, for fixed income assets we use the yield-to-worst of the index. The expected return for all foreign currency denominated assets is equal to the expected movement in the currency given the interest rate differential plus any other premium that is applicable to that asset. An additional premium was included for all equity securities to reflect the long-term equity premium over bonds.[8] Expected return assumptions are significantly lower than historical return assumptions, partly reflecting lower interest rates but also relatively conservative return assumptions, especially for gold and commodities. Volatility estimates were computed using historical monthly returns.[9]

Table 3: Two scenarios under consideration: one using historical performance and the other based on market expectations

Asset	Real return and volatility assumption		
	Historical	**Expected**	**Volatility**
Gold (MXN/oz)	**12.0%**	**0.2%**	**19.5%**
Commodities	-0.8%	0.2%	21.1%
MSCI Mexico	15.0%	7.9%	18.1%
MSCI USA	3.2%	3.3%	10.2%
MSCI AC World	5.0%	2.6%	13.7%
US treasuries	2.2%	-1.0%	12.8%
US corporates	3.1%	0.8%	10.8%
Global treasuries ex US	1.8%	-0.4%	11.8%
Mexico external government debt	5.2%	2.1%	10.4%
Mexico local government debt	6.0%	0.4%	5.8%
Mexico corporates	4.0%	2.9%	10.1%
Linkers (Udibonos)	6.7%	1.7%	7.1%
Cash (Cetes)	1.9%	-0.6%	0.5%

Reference notes are listed at the end of this article.

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

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8 The equity risk premium was sourced from the Credit Suisse returns yearbook. Credit Suisse, *Global investment returns yearbook 2013,* February 2013.

9 Data limitations prevented us from using longer data series as we have used in other studies. However, using a 10-year period span is consistent with industry practices and may be a more robust approach when looking at emerging markets where currencies can have a big impact on volatility estimates of foreign-denominated assets.

Optimal allocations based on historical returns
The first set of optimisation returns used historical returns, volatility and correlation. The efficient frontier was constructed using a re-sampled optimisation process based on historical assumptions.[10] Additionally, we included the investment constraints described in **Table 1**.[11] The results were relatively consistent with previous findings, even under the stringent criteria set forth by the CONSAR. **Chart 4a** illustrates the optimisation results for each SIEFORE 2, 3 and 4. (Because SIEFORE 1 is not allowed to invest in commodities, we omitted those results.) Portfolios that included gold were selected on the basis of their Sharpe ratio and the portfolio's resemblance to the typical portfolio in its group. Portfolios that excluded gold were selected to match the return of the portfolio containing gold to ensure a like to like comparison.

Optimal gold allocations for SIEFORE 4 and SIEFORE 3 were 7.3%, an impressive figure considering that the total commodities constraint was 10%. For SIEFORE 2, the optimal gold allocation was 3.9% compared with a commodity constraint of 5%. These results are fairly consistent with previous World Gold Council research, which found that an allocation of between 2% – 10% is optimal for most investors.

More importantly, optimal gold allocations had a profound impact on portfolio performance. In the case of SIEFORE 4, for example, gold was able to reduce portfolio volatility by 76 basis points while maintaining the same levels of return (**Chart 4b**). Three-quarters of 1% for a US$1bn portfolio is equivalent to US$7.5mn in annual swings, a significant figure by most standards.

Chart 4: (a) Optimal portfolios contain a significant gold allocation, (b) as gold expands the efficient frontier

Legend:
- Gold (MXN/oz)
- Commodities
- Mexico equities
- US equities
- Global equities
- US Treasuries
- US corporates
- Global treasuries ex US
- Mexico sovereign (US$)
- Mexico sovereign (MXN)
- Mexico corporates
- Mexico linkers
- Mexico cash
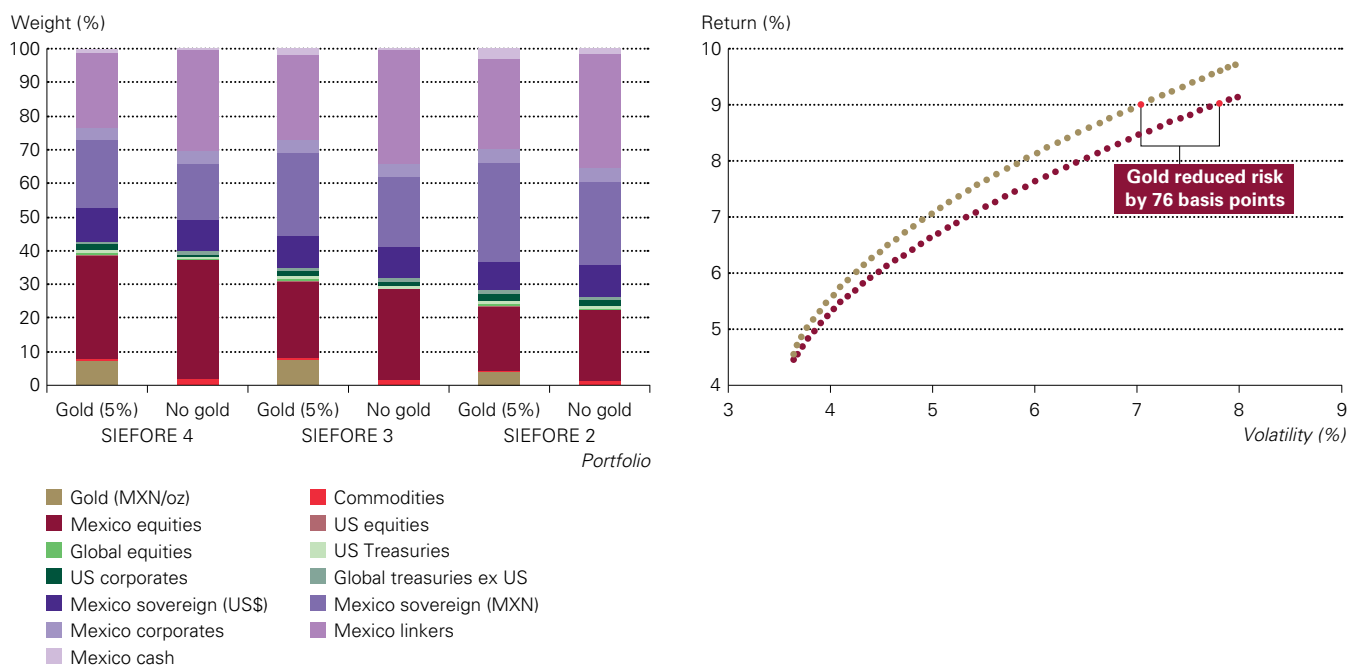
Reference notes are listed at the end of this article.

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

10 We used New Frontier Advisers' patented portfolio optimiser, which is based on a re-sampled efficiency optimisation technique. The Michaud Re-sampled Efficient Frontier has been acknowledged by Harry Markowitz, founder of modern portfolio theory, to be more effective and robust than classical mean-variance optimisation.

11 A constraint on cash was added on the basis of typical pension holdings. While some AFORES offer cash alternatives, most funds don't allocate more than 10% of assets to cash. Due to a limitation in the number of high quality of corporate debt, Mexican corporate bonds were capped at a 10% weighting. In addition, the cap on individual issuer holdings translated into a 5% cap on US treasuries.

The historical performance of the portfolios that included gold compared well to their counterparts without gold. Gold was able to reduce risk through lower volatility, lower Value-at-Risk (VaR) and decrease peak-to-trough draw-downs (**Table 4**).

Table 4: Gold significantly reduced risk across all pension portfolios where gold and commodities are permitted

Portfolio results	SIEFORE 4		SIEFORE 3		SIEFORE 2	
	Gold (7%)	No Gold	Gold (7%)	No Gold	Gold (4%)	No Gold
Return	13.28%	13.31%	12.50%	12.51%	11.90%	11.90%
Volatility	7.48%	8.57%	6.21%	7.09%	5.61%	6.13%
Information ratio	1.78	1.55	2.01	1.76	2.12	1.94
5% daily VaR	0.65%	0.75%	0.51%	0.61%	0.45%	0.51%
Daily VaR limit	2.10%	2.10%	1.40%	1.40%	1.10%	1.10%
Number of breaches	3	7	6	15	14	17
1% VaR	1.30%	1.60%	1.04%	1.25%	0.89%	1.02%
Average daily pullback	1.80%	2.27%	1.40%	1.78%	1.25%	1.46%
Maximum pullback	23.04%	26.27%	19.75%	22.78%	18.12%	20.11%

Reference notes are listed at the end of this article.

Source: J.P. Morgan, World Gold Council

Portfolios containing gold also help to reduce the number of daily threshold breaches set by the CONSAR.

One of the other criteria set out by the CONSAR is the number of daily performance breaches. SIEFORE 4 has a performance limit of -2.1%, SIEFORE 3 has a performance limit of -1.4%, and SIEFORE 2 has a limit of just -1.1%. CONSAR allows a maximum of 26 daily breaches.[12] The portfolio that contained gold was able to reduce the number of daily breaches for all SIEFORE portfolios.

Focus 2: Using gold denominated in US dollars (currency-hedged exposure)

Some investors may prefer to invest in gold denominated in US dollars instead of in Mexican pesos by currency-hedging the exchange rate risk. In doing so, investors are taking the view that the Mexican peso is likely to appreciate against the US dollar over the long term, or that the added volatility of the currency does not work in gold's favour. While the Mexican peso has been depreciating since the crisis of 1994, many forecasters believe that the currency is set to appreciate. In fact, the median analyst estimated expectation[13] is for the peso to appreciate by 9% against the dollar by the end of 2015, a dramatic reversal of the historical trend of depreciation.

Investors wishing to take this view get the benefit of slightly lower volatility (as currency risk is eliminated) and slightly lower cross correlation to other peso denominated assets in the portfolio. But in return investors are sacrificing gold's currency hedging benefits. This investment would not perform as well if the depreciation of the peso were to continue or if there was a crisis that led to a sharp sell-off in the peso. Because a large portion of gold investors are attracted to gold partly based on its currency hedging benefits, this option might not be ideal for all investors.

12 The CONSAR limits the funds to 26 breaches over the course of the last 1,000 days.

13 Median analyst expectation for the Mexican peso – US dollar exchange was sourced from Bloomberg.

Performance during tail-risk events

Gold was able to reduce losses in five episodes of tail risk events considerably across three SIEFORE portfolios.

We extended this analysis to look at select tail risk events over the 2003 to 2013 period including the peso fall of 2006, the financial crisis, the first and second parts of the European sovereign debt crisis, and the peso fall of 2012. Findings indicate that a portfolio containing gold outperforms a portfolio without gold by a cumulative amount of 11.4% for SIEFORE 4, 10.6% for SIEFORE 3 and 5.5% for SIEFORE 2. The greatest outperformance came during the great financial crisis and second stage of the European sovereign debt crisis.

Table 5: Portfolios with gold outperformed during tail-risk events

Event	Start date	End date	Asset performance			Portfolio outperformance		
			Mexico equities	MXN/US$	Gold (MXN)	SIEFORE 4 (7%)	SIEFORE 3 (7%)	SIEFORE 2 (4%)
2006 peso fall	28/02/2006	31/05/2006	1.7%	-8.1%	24.0%	1.84%	1.91%	0.98%
Financial crisis	30/05/2008	31/03/2009	-39.0%	-37.2%	42.4%	5.42%	4.94%	2.77%
EU sovereign debt crisis I	30/04/2010	30/06/2010	-4.4%	-5.1%	10.8%	0.97%	0.87%	0.42%
EU sovereign debt crisis II	31/12/2010	30/09/2011	-10.0%	-12.6%	28.5%	2.75%	2.51%	1.31%
2012 peso fall	30/03/2012	31/05/2012	-1.9%	-12.2%	5.0%	0.45%	0.35%	0.06%
Cumulative						**11.44%**	**10.58%**	**5.53%**

Reference notes are listed at the end of this article.

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

Optimal allocations based on expected returns

Using lower expected returns resulted in statistically significant weights for gold between 1% and 3%.

The expected returns outlined in **Table 3** were more conservative than the historical returns. This partly reflects the huge decrease in interest rates worldwide. Gold received one of the lower expected return assumptions of 0.2%, taking into consideration its lack of yield. As a result, gold had one of the lowest information ratios of the assets in consideration. However, despite this great disadvantage, gold received statistically significant non-zero allocations as a result of its low correlation to other assets.

Gold had an optimal allocation of 2.7% for SIEFORE 4, 3.1% for SIEFORE 3 and 1.4% for SIAFORE 2 (**Chart 5a**). More importantly, however, these allocations were statistically significant at the 75% level across the entire efficient frontier and significant at the 90% level across the vast majority of the efficient frontier (**Chart 5b**).

Chart 5: (a) Even with low expected returns, gold's optimal weight remains nonzero, (b) with statistically significant results

Weight (%)

Gold weight (%)

Portfolio

Portfolio number

Legend:
- Gold (MXN/oz)
- Commodities
- Mexico equities
- US equities
- Global equities
- US Treasuries
- US corporates
- Global treasuries ex US
- Mexico sovereign (US$)
- Mexico sovereign (MXN)
- Mexico corporates
- Mexico linkers
- Mexico cash

SIEFORE 4   SIEFORE 3   SIEFORE 2
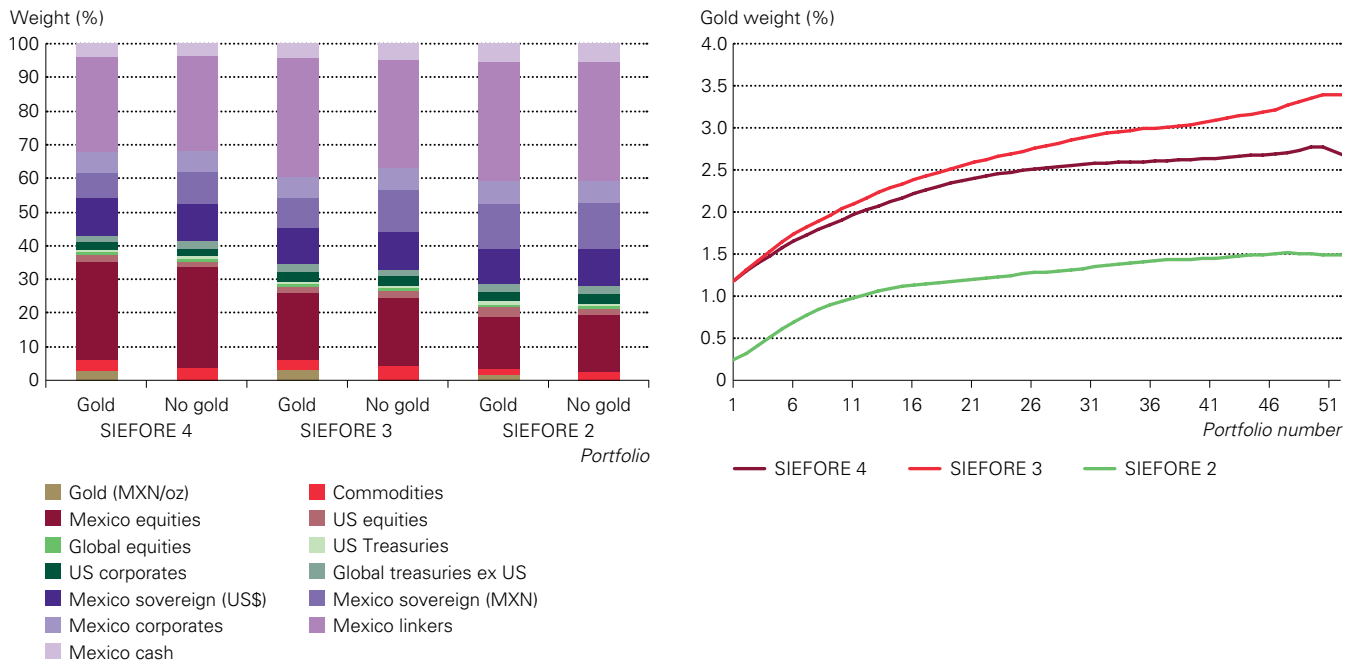
Reference notes are listed at the end of this article.

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

Conclusion

Gold is an integral foundation asset that could help Mexican pension plan participants to achieve their retirement goals.

Gold can play an integral role in successful defined contribution retirement strategies around the world. In particular, looking at the role of gold in Mexican pension portfolios, we find that it provides many of the same important benefits, even under the comprehensive asset constraints set forth by the Mexican pension fund regulator. Over the time period we considered, gold was able to boost returns while reducing risk by lowering volatility, reducing VaR and diminishing portfolio peak-to-trough draw-downs. Gold allocations between 1% and 7% were also able to reduce losses during periods of tail risk events. Even assuming a set of lower return assumptions, gold was still able to provide a material benefit as a result of its unique portfolio attributes. Even with an expected real return of just 0.2%, gold allocations between 1% and 3% were all statistically significant at levels between 25% and 10% across the efficient frontier.

References

Table 1: Defined-contribution portfolios are subject to multiple constraints set by the regulator (CONSAR)

Figures in the table are all maximum constraints except for constraints for inflation-linked bonds (Udibonos).

Chart 1: (a) Mexican equities and gold outperformed most asset classes in Mexican-peso terms (b) but they also had higher volatility

(a) Return figures shown are annualised returns computed using monthly return data from December 2003 to April 2013. Nominal effective peso is an index of the relative strength of the peso against various other currencies.

(b) Volatility figures shown are annualised and computed using monthly return data from December 2003 to April 2013.

Chart 2: Gold's correlation to other assets is typically low

Correlations are computed based on monthly returns from December 2003 to April 2013. All the assets are denominated in Mexican pesos.

Chart 3: The average Mexican pension fund portfolio is fairly conservative

Portfolio shown in the chart is a rough approximation of the theoretical average of the four different SIEFORE pension portfolios. Some assets were excluded due to data limitations.

Table 2: Gold improved risk-adjusted returns of the average pension portfolio

Portfolio performance calculated using monthly data from December 2003 to April 2013.

Table 3: Two scenarios under consideration: one using historical performance and the other based on market expectations

All figures are annualised and all assets are denominated in Mexican pesos.

Chart 4: (a) Optimal portfolios contain a significant gold allocation, (b) as gold expands the efficient frontier

The re-sampled efficient frontiers shown in the chart is based on the portfolio of SIEFORE 4.

Table 4: Gold significantly reduced risk across all pension portfolios where gold and commodities are permitted

Daily data was used to compute the figures in the chart. The maximum number of daily breaches allowed by CONSAR is 26 form the last 1,000 observations. Portfolio returns, volatilities, VaR and pullback figures are computed using daily data from December 2003 to April 2013.

Table 5: Portfolios with gold outperformed during tail-risk events

The minus sign in the 'MXN/US$' column denotes a depreciation of the peso relative to the US dollar.

Chart 5: (a) Even with low expected returns, gold's optimal weight remains nonzero, (b) with statistically significant results

(a) Gold's expected return of 0.2% was considerably lower than the average return assumption of 1.7% for the other assets in the portfolio. Given this handicap, the evidence of statistically significant non-zero returns is indicative of gold's superior diversification benefits.

(b) 90% and 75% lower and upper bounds represent the confident interval around the gold allocation which is represented by the green line. Gold allocations were taken from the SIEFORE 4 optimisation using expected returns. If the lower bound is above zero, this is an indication that gold's allocation is statistically significant.

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