WORLD GOLD COUNCIL

Central bank diversification strategies:
Rebalancing from the dollar and euro

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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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Executive summary

Central banks have begun to reduce reserve portfolio allocations to US dollars and euros in favour of alternative reserve assets. A portfolio optimisation analysis concludes that gold, with its lack of credit risk and deep and liquid market, is one of the most attractive alternatives in this diversification process. Accordingly, building gold reserves in tandem with new alternatives is an optimal strategy as these markets need time to develop and allocations to gold remain largely below optimal levels.

The financial crisis and subsequent sovereign debt crisis have heightened reserve manager attention to the need for increased diversification, in particular, away from dollar and euro assets. Furthermore, while the dollar is still the primary global currency – its long-term supremacy is less certain. As such, central banks are actively looking to diversify their reserve portfolios and specifically reduce allocations to US dollars and euros.

Despite limited availability and convertibility of its currency, China's rise in the global economy has forced central banks to seriously consider renminbi denominated assets. Meanwhile, in a world of deteriorating credit, countries like Canada, Australia and Switzerland, all with AAA credit ratings, stand out as potential reserve investment alternatives.

Against this backdrop, this paper examines the trend of diversification in reserve asset management away from the US dollar and euro in order to better understand how central banks should approach allocation decisions at the margin.

This analysis is premised on the assumption that central banks retain 65% of their reserve assets in dollars and euros and find the most optimal asset mix for the remaining 35%. The analysis examines traditional assets like Japanese yen, British pounds, and gold, all of which have been consistently held by most central banks over the past several decades. It adds to this traditional list Chinese, Canadian, Australian, Swiss, and Danish denominated high quality assets that are among the preferred alternative reserve assets for central banks. These assets have produced strong returns in recent years and are supported by healthy economic fundamentals.

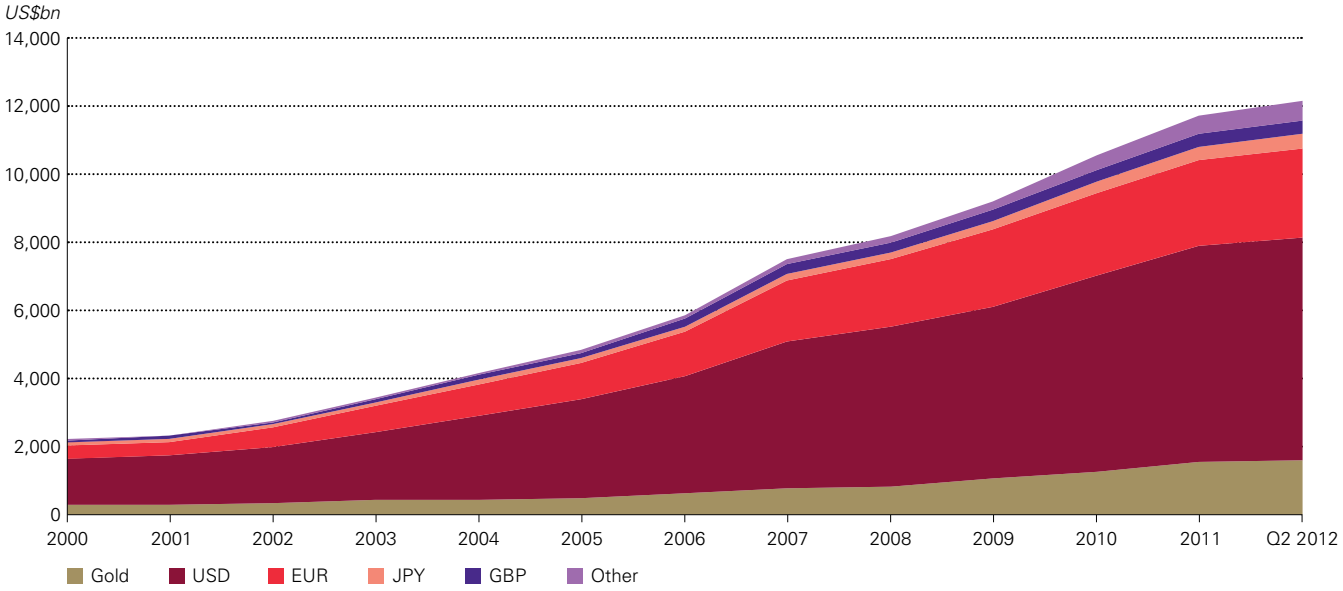
Purely through portfolio optimisation analysis of these assets, renminbi, gold and Australian dollar assets emerge as the most important for diversification. However, given the limited size of Chinese and Australian sovereign debt markets, gold emerges as the dominant asset for diversification with optimal allocations to gold of approximately 8%.

Diversification of Traditional assets

In recent years, emerging market central banks have been accumulating reserves at a record pace. The global statistics compiled by the IMF, also commonly referred to as the 'IMF COFER data', show that official reserves for all central banks have grown from US$2tn in 2000 to greater than US$12tn in 2012, a span of only 12 years. Official reserves primarily consist of US dollar and euro denominated assets and gold. To a lesser extent, central banks also hold allocations to other traditional reserve assets denominated in Japanese yen and British pounds. **Chart 1** illustrates changes in reserve asset size and composition over time. While these aggregate figures include reserve assets for both emerging market and developed economy central banks – the vast majority of reserves and reserve growth are from the emerging economies.[1]

Given the rapid growth in reserves, emerging market central banks are increasingly questioning their large US dollar and euro allocations and exploring opportunities for diversification. Accelerating the drive for diversification are historically low global interest rates, which translate to a higher cost of maintaining reserves, and the uncertainty over US and European fiscal outlooks. Furthermore, emerging market central banks also recognise the growing role of emerging markets in global growth and are interested in shifting investments toward these economies as they play an ever more important role globally.

Chart 1: Offical sector foreign exchange reserves and gold



Source: IMF COFER, IFS statistics, World Gold Council

1 Data on reserve composition is not available for emerging market central banks; however, as they account for a significant amount of total reserves – trends for the aggregate group of all central banks can still be a strong proxy.

Signs of diversification are already apparent

Between 2000 and 2012, global central banks shifted away from US dollar denominated assets as the US dollar's share of total reserves declined from 62% to 54% **(Charts 2a and 2b)**. Some of this shift, or rebalancing, has been into euro denominated assets, which explains the rise in euro allocations during this period. However, anecdotal evidence suggests that euro allocations may have plateaued as the European sovereign debt crisis has encouraged reserve managers to reduce euro allocations.

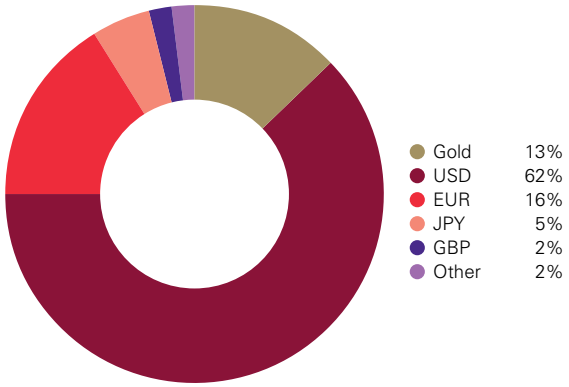
With incremental euro allocations falling out of favour, central banks have been exploring various other assets. Supporting this point, the IMF data shows that the share of "other" currencies in reserve composition has tripled in absolute terms since 2008. Canadian dollar (CAD), Australian dollar (AUD), Swiss franc (CHF), Danish kroner (DKK) and Chinese renminbi (CNY) are among the currencies in which emerging market central banks are increasingly investing.[2] This development has prompted the IMF to include CAD and AUD in its regular reporting beginning in 2013;[3] a measure that highlights the growing role of these currencies as reserve assets.[4] In line with this diversification trend, central banks have also become net buyers of gold, as of 2010, after a period of nearly two decades of net sales.

Traditional vs Alternative reserve assets

The remainder of this paper makes the distinction between two categories of assets or currencies: **Traditional reserve assets** and **Alternative reserve assets.** Traditional reserve assets include US dollar, euro, gold, British pound, and Japanese yen denominated assets. These assets distinguish themselves from the other currencies/assets as each of these assets had an allocation of greater than 1% of global total reserves over the past ten years and all have been core official reserves for many years. These assets share the high quality attributes that meet the safety, liquidity, and return requirements of central bank reserve managers. Furthermore, these assets are typically already approved in the investment guidelines for almost all central banks.

Traditional reserve assets will be compared against **Alternative reserve assets** that include Australian, Canadian, Chinese, Danish, and Swiss denominated instruments. These assets had less than 1% allocations or were not delineated in the IMF COFER data as they have been less commonly held among central banks. While CHF denominated assets have historically had a presence in reserve asset management, allocations have been minimal in recent years, averaging 0.2% since 1995 and thus, Swiss assets were included as Alternative reserve assets.

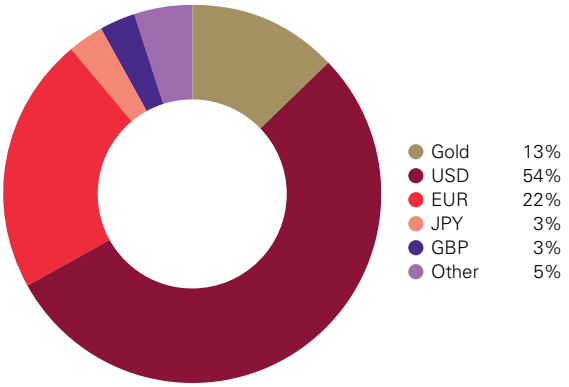
Chart 2a: Breakdown of total official reserves (as of 2000)



Note: Totals may not equal 100% due to rounding.

Source: IMF COFER statistics, Q2 2012

Chart 2b: Breakdown of total official reserves (as of 2012)



Source: IMF COFER statistics, Q2 2012

2 Reserve management data and publications from the central banks of China, Russia, Korea, South Africa, Malaysia, Hong Kong, India, Turkey, Hungary, Poland and Mexico were analysed for details regarding reserve asset allocation.

3 Wall Street Journal, *IMF Mulling Inclusion of AUD, CAD in Official Forex Reserves,* November 2012.

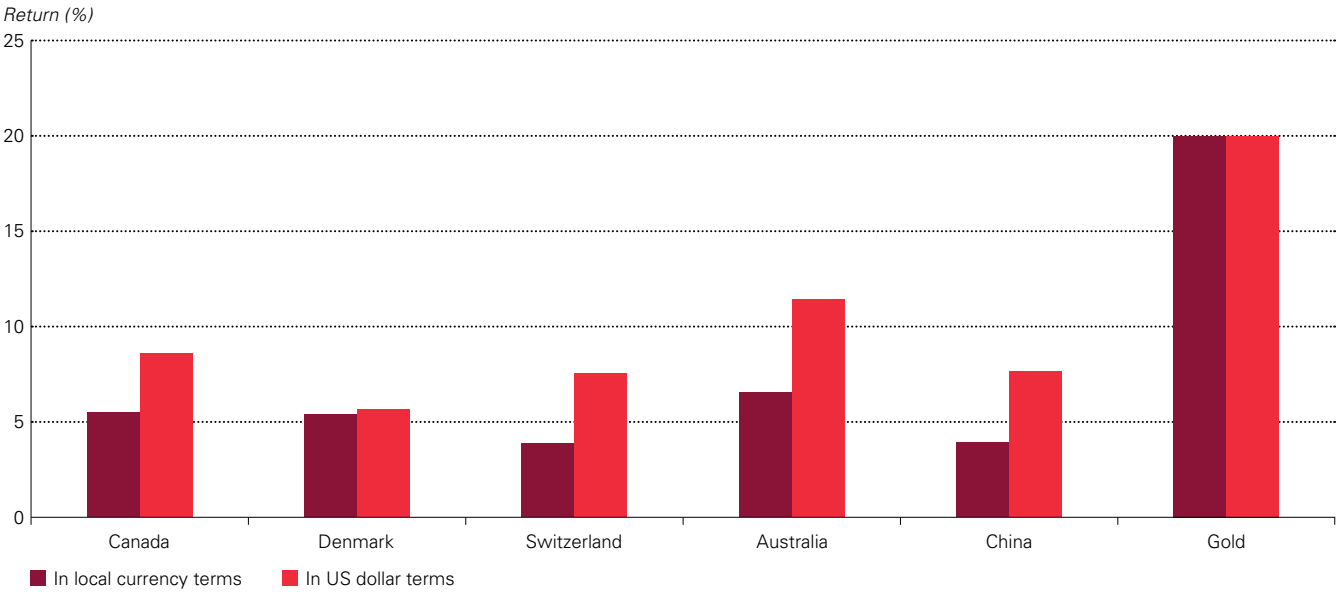
4 COFER data currently only includes the following currencies: USD, EUR, GBP, JPY, CHF and other.

The role of Alternative reserve assets

Alternative reserve assets[5] provide a variety of benefits for reserve managers, particularly in terms of relative safety and reserve diversification. In a world of deteriorating credit quality, countries like Canada, Australia, Denmark and Switzerland, all with AAA credit ratings, stand out as countries with strong potential as reserve asset currencies due to their high quality. These countries have long held top credit ratings and have recently been reaffirmed by the major rating agencies.

The pool of Alternative reserve assets also brings prospects for greater returns than those available in US dollar and euro denominated assets. US and European long-term treasury yields have averaged less than 3% over the past five years, which suggests returns are unlikely to surpass the carrying costs associated with official reserves. Meanwhile, rapid growth in China and other emerging markets is driving broad-based investor interest in higher yielding securities. In Australia and Canada, a strong commodity sector and healthy economic fundamentals support much higher yields than those available in the US and Europe. Returns are further enhanced by strong currencies, with US dollar denominated returns in these Alternative markets benefiting from foreign exchange appreciation against the US dollar. **Chart 3** illustrates returns for these Alternative assets in local currency and US dollar terms, illustrating the positive impact that foreign exchange appreciation has had on total returns when measured in US dollars.

Chart 3: Annualised returns for alternative reserve assets



Note: Weekly data from January 2005 to October 2012.

Source: Barclays Aggregate treasury indices, Bloomberg, World Gold Council

5 Defined as assets denominated in Canadian dollar (CAD), Australian dollar (AUD), Swiss franc (CHF), Danish krone (DKK) and Chinese renminbi (CNY).

The Alternative reserve assets are also drawing attention due to their low correlations with Traditional reserve assets. **Table 1** summarises the correlations between Alternative and Traditional reserve assets and shows that there are no strong correlations between these 'new' assets and the Traditional ones – adding to their diversification strengths. As these assets are not highly correlated to Traditional reserve assets, they can help to provide diversification by remaining stable should Traditional reserve assets decline.

Table 1: Correlation matrix of Traditional and Alternative reserve assets

	Traditional reserve assets						Alternative reserve assets				
	US Treasuries	US Agencies	Germany	Gold	UK	Japan	Australia	Canada	China	Denmark	Switzerland
US Treasuries		0.91	0.30	0.04	0.29	0.56	-0.09	-0.01	0.07	0.31	0.34
US Agencies	0.91		0.36	0.07	0.34	0.52	0.05	0.15	0.08	0.36	0.36
Germany	0.30	0.36		0.43	0.63	0.39	0.54	0.50	0.21	0.98	0.78
Gold	0.04	0.07	0.43		0.30	0.17	0.38	0.38	0.17	0.40	0.42
UK	0.29	0.34	0.63	0.30		0.21	0.47	0.44	0.11	0.62	0.51
Japan	0.56	0.52	0.39	0.17	0.21		-0.06	0.00	0.15	0.38	0.45
Australia	-0.09	0.05	0.54	0.38	0.47	-0.06		0.72	0.01	0.54	0.38
Canada	-0.01	0.15	0.50	0.38	0.44	0.00	0.72		0.02	0.49	0.36
China	0.07	0.08	0.21	0.17	0.11	0.15	0.01	0.02		0.21	0.14
Denmark	0.31	0.36	0.98	0.40	0.62	0.38	0.54	0.49	0.21		0.76
Switzerland	0.34	0.36	0.78	0.42	0.51	0.45	0.38	0.36	0.14	0.76	

Note: Based on weekly returns from January 2005 to October 2012.

Source: Barclays Aggregate treasury indices, LBMA

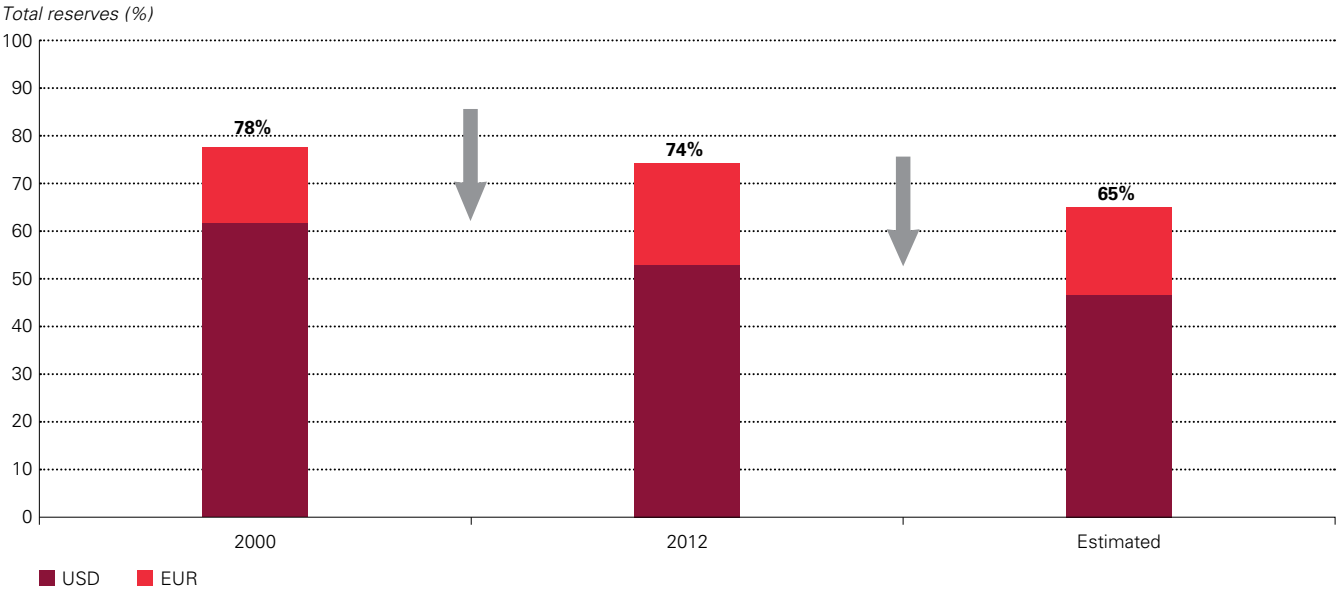
Portfolio optimisation including Alternative reserve assets

Previous research by the World Gold Council[6] has examined optimal allocations to Traditional reserve assets for emerging market central banks. This study expands upon the analysis by using portfolio optimisation to determine optimal allocations when Alternative reserve assets are considered.

This analysis is premised on the assumption that central banks seek to reduce allocations to US dollar and euro denominated assets as they may currently perceive themselves as over-allocated. It assumes central banks will reduce their combined allocation to US dollars and euros from the current 74% down to 65%. **Chart 4** shows that in 2000 allocations to US dollars and euros amounted to 78% and declined to 74% by 2012. Assuming this trend continues, a typical emerging market central bank may then seek to reduce its combined US dollar and euro allocation to 65%,[7] leaving the remaining 35% to be allocated to other reserves assets.

With the assumption that 65% of the portfolio must be allocated to US dollars and euros (47% and 18%, respectively),[8] the analysis proceeds by examining the optimal assets for the remaining 35% of the reserve portfolio. The assets that are available for this 35% consist of the remaining pool of Traditional assets (gold, British pound, and Japanese yen assets) and the Alternative reserve assets. Under these assumptions, the remaining non-dollar and non-euro assets are examined directly against each other.

Chart 4: Historical and estimated USD and EUR denominated reserve assets



Source: IMF COFER, World Gold Council

6 RBS, *RBS Reserve Management Trends 2012: Optimal gold allocation for emerging-market central banks*, April 2012 and World Gold Council, *The importance of gold in reserve asset management,* June 2010.

7 There is no reference to a time period during which US dollar and euro allocations decline. Instead, the analysis only assumes that there is a desire by central banks to reduce these allocations over time.

8 The split between US dollars and euros is based on the observed split between US dollars and euros in 2012 from the IMF COFER data.

Methodology, data, and assumptions

Optimisation method: In order to analyse this data, New Frontier Advisors' (NFA) patented portfolio optimiser, which is based on a re-sampled efficiency optimisation technique, was used. The Michaud Re-sampled Efficient Frontier™ has been acknowledged by Harry Markowitz, founder of modern risk-adjusted return portfolio theory, to be more effective and robust than classical mean-variance optimisation.[9] In particular the re-sampled portfolio results tend to be more robust and less reliant on the accuracy of return and volatility assumptions.

The results presented in this analysis are those of middle-level risk, which reflect the mid-point of the lowest and highest risk portfolios on the re-sampled efficient frontier, with risk defined as volatility. Re-sampling was based on 1,000 simulations of the efficient frontier.

Asset volatility and correlations: **Table 2** lists the return and volatility assumptions used for the assets in the study. Weekly data from Barclays Capital Aggregates from January 2005 to October 2012 was used to determine estimates for volatility and correlations between reserve assets. More current and frequent data was selected in order to capture the more recent experience of the Alternative reserve assets.

Asset returns: As past performance of both gold and fixed-income securities over the last 14 years would not be appropriate forward looking measures (for example US Treasuries returned 5.2% during this period), this study instead used an average of the 'Yield to Worst' values calculated by Barclays Capital from the period August to October 2012, which was the time period during which this study was conducted. The return assumption for gold was conservatively reduced to 2%, with the assumption that it would at a minimum perform at the level of the long-term inflation target of the Federal Reserve.

Table 2: Asset inputs and historical returns and volatility

	Alternative assets						Traditional reserve assets				
Model inputs	**Canada**	**Denmark**	**Switzerland**	**Australia**	**China**	**Gold**	**US Treasuries**	**US Agencies**	**UK**	**Germany**	**Japan**
Projected returns (Yield-to-Worst)	1.6%	0.9%	0.4%	2.9%	3.3%	2.0%	0.9%	1.0%	1.7%	0.9%	0.6%
Volatility	10.0%	10.5%	12.0%	13.6%	8.9%	20.0%	4.4%	2.7%	11.1%	10.3%	11.3%
Information ratio	0.2	0.1	0.0	0.2	0.4	0.1	0.2	0.4	0.2	0.1	0.1

	Alternative assets						Traditional reserve assets				
Historical returns and volatility	**Canada**	**Denmark**	**Switzerland**	**Australia**	**China**	**Gold**	**US Treasuries**	**US Agencies**	**UK**	**Germany**	**Japan**
Annualised average return	8.6%	5.6%	7.5%	11.4%	7.6%	20.0%	5.3%	4.8%	5.0%	5.2%	6.0%
Volatility	10.0%	10.5%	12.0%	13.6%	2.3%	20.0%	4.4%	2.7%	11.1%	10.3%	11.3%
Information ratio	0.9	0.5	0.6	0.8	3.3	1.0	1.2	1.7	0.4	0.5	0.5

Note: This analysis has added 6.6 percentage points of volatility to Chinese treasury returns, which assumes the currency would have at least the same volatility as a developed economy currency. This figure was chosen as it is the average increase in volatility for Traditional reserve assets when translating the asset's volatility from local terms to US dollar terms (See box on page 15 for more details). References to country name denote origin of reserve assets.

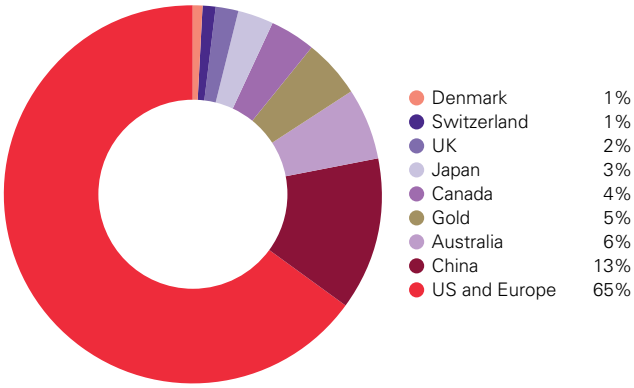
9 See Harry M. Markowitz interview with Richard O. Michaud, *Journal of investment management, Volume 9, No. 4, 2011, 1–9.* JOIM Conference Series San Diego, 6 March 2011, Conference Summaries.

BlueSky: applying no restrictions to the analysis

The results of the first optimisation analysis showed that Australian, Chinese, and gold assets played the most prominent roles in the remaining 35% of the optimal emerging market central bank portfolio. This means that based on the return, volatility, and co-variance inputs, these assets emerged as the most important to include for reserve managers, with 13% of the portfolio allocated to Chinese assets, 6% to Australian assets, and 5% to gold.

In this "BlueSky" scenario, the only constraint applied was to limit the US dollar and euro holdings to an aggregate 65% of the portfolio, with 47% fixed for US dollars and 18% fixed for euros. Under this constraint, Alternative reserve assets stood out in importance from the other reserve assets from a portfolio optimisation perspective. Observing the return assumptions used for the analysis, as expected China and Australia commanded the highest recommended allocations given their leading respective 3.3% and 2.9% yield inputs. Importantly, despite gold's conservative yield input of 2%[10] and higher volatility (20%), the model suggested a significant allocation given gold's strong portfolio diversification properties. Furthermore, allocations to Alternative reserve assets such as Australian, Chinese and even Canadian treasuries received greater allocations than Gilts or JGBs, their Traditional asset counterparts. Finally, the Alternative reserve assets denominated in DKK and CHF had the smallest allocations in the optimal portfolio. **Chart 5** illustrates the allocations for each asset class. Based on this first test, it is evident there is a clear role for Alternative assets in the diversification process.

Chart 5: BlueSky scenario: Optimal allocations given no constraints



*65% allocation to US and Europe comprised of 48% USD and 18% EUR denominated assets.
Note: Optimal allocations for median levels of risk given 65% allocation to USD and EUR.

10 See box on page 7 for more details.

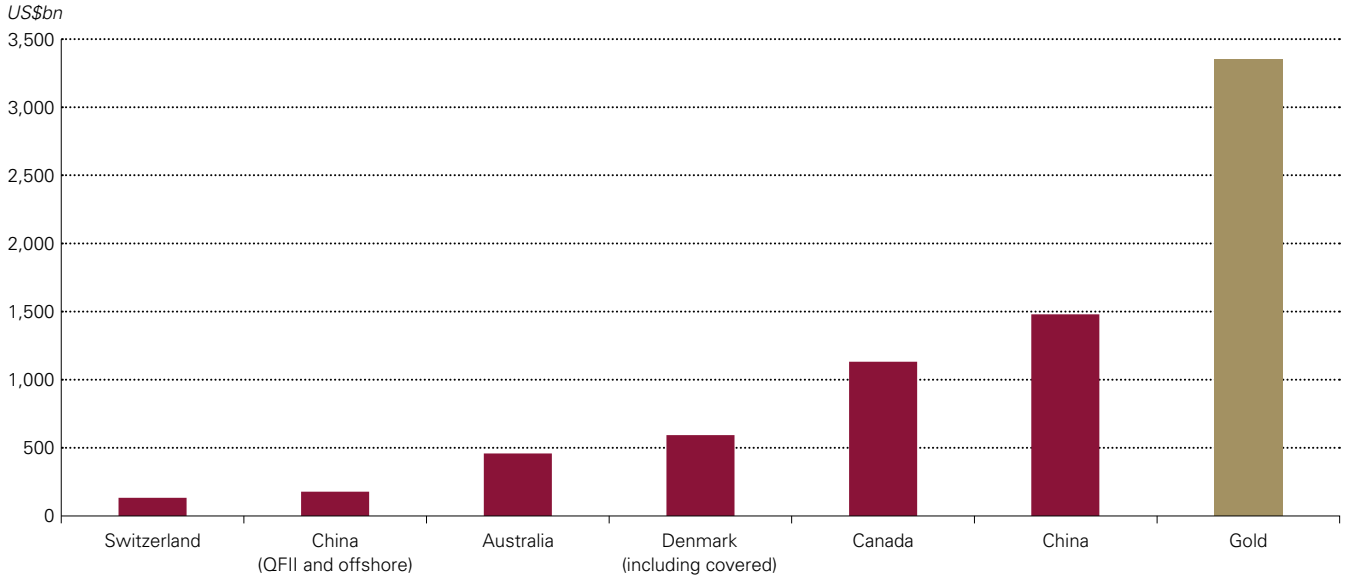
Drawbacks to Alternative reserve assets

While thus far the analysis has provided both qualitative and quantitative evidence that Alternative reserve assets have an important role in reserve portfolios, there are two aspects of these assets that may raise caution with many central banks. Issues related to (A) market depth and size, and (B) the positive correlations these assets have with risk assets are examined separately in this section.

Market size and availability

As central banks manage large pools of official reserves, large and deep markets are required to avoid having significant market impact when transacting. **Chart 6** depicts the individual market sizes of Alternative and Traditional reserve assets, and shows that the Alternative reserve assets are all quite small markets with none larger than US$1.5tn. Moreover, the largest of these, the Chinese treasury market, is difficult for foreigners to access. Foreign investors must be part of the Qualified Foreign Institutional Investor (QFII) programme which currently consists of approximately 13 central banks and sovereign related entities.[11] Due to the limited availability of renminbi assets, a US$180bn revised market size is assumed which is based on QFII availability and off-shore deposits in Hong Kong (See **Chart 6** and the box on Page 15 for more details).

Chart 6: The market size of alternative reserve assets and gold



Note: Gold stock is calculated as gold held by private investors and the official sector as estimated by Thomson Reuters GFMS (62,500 tonnes) multiplied by the average 2012 London PM fix gold price (US$53.6mn per tonne).

Source: BIS, CSRA, HKMA, J.P. Morgan, World Gold Council

11 See box on page 15 for more discussion of limited availability of renminbi assets.

Adjusting optimisation analysis for market size

In the prior section, the first optimisation analysis examined the optimal allocation to both Traditional and Alternative reserve assets with the assumption that 65% of the portfolio would remain dedicated to US dollar and euro allocations; the analysis conducted in this "BlueSky" scenario had no additional constraints. In order to improve the study, a second optimisation analysis constrained the Alternative reserve assets by their individual market size to adjust for asset availability.[12]

If the results from the first optimisation analysis were to be implemented across all central banks, there would need to be a collective allocation to Chinese and Australian reserve assets of US$1.6tn and US$720bn respectively, both of which are greater than the actual market sizes of US$1.5tn and US$460bn. Thus, the second optimisation analysis, which takes into account market size, allows for a more realistic solution based on existing market factors.

In order to calculate the constraint level applied to each asset, a size cap for each market was estimated based on the ratio of outstanding market size to total reserves outstanding (US$12.3tn), as outlined in **Table 3**.

Table 3: Market sizes and allocation constraints

Assets	Market size (US$bn)	Cap
Non-traditional		
Switzerland	US$134	5%
Australia	US$460	5%
Denmark (including covered)	US$593	5%
Canada	US$1,134	10%
China	US$1,485 (US$180bn investable*)	5%
Traditional		
UK	US$1,524	15%
Gold	US$3,437	30%
Europe	US$9,314	100%
US	US$10,521	100%
Japan	US$12,143	100%

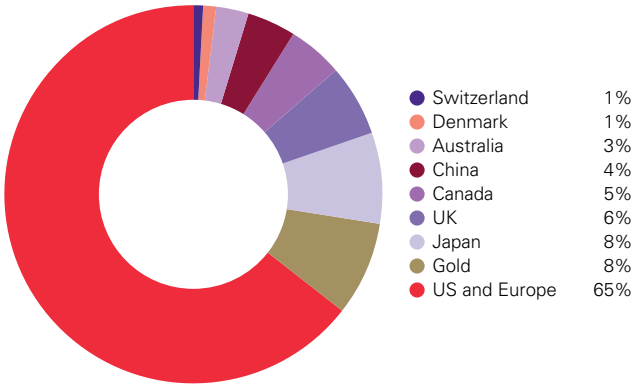
*See box detailing the Chinese reserve asset market on page 15 for more details.

Source: BIS, China Securities Regulation Commission, Hong Kong Monetary Authority, J.P.Morgan, World Gold Council

12 The analysis continued to assume that central banks would reduce their combined USD and EUR holdings from 74% to 65%.

"Market" scenario results: Accounting for market size
The results of this revised analysis, which will be referred to as the "Market" scenario, confirm there is a role for Alternative assets, with Canadian, Chinese, and Australian assets being allocated at 3 to 5 percentage points of the 35% diversification portfolio. However, these allocations are significantly lower than the first analysis as they take into account actual market availability of these assets. The size limitation of Alternative reserve assets actually re-emphasizes the role Traditional assets may need to play in diversification. In the "Market" scenario optimisation, there is a greater allocation to Traditional assets such as gold, JGBs and Gilts than under the "BlueSky" scenario **(Chart 7)**. In fact, the Traditional reserve assets take centre stage in the diversification process with gold leading the way.

Chart 7: Market scenario: Optimal allocations given market size constraints



Note: Optimal allocations given 65% allocation to USD and EUR.
Total may not equal 100% due to rounding.

This second portfolio optimisation analysis confirms the important role of gold as an asset for diversification, as it commands a dominant position in the 35% allocation pool when accounting for market size. Its presence in the diversification portfolio was closely matched by JGBs at nearly 8% of the reserve portfolio. Thus, the constrained optimisation analysis suggests that while there is a role for Alternative reserve assets in the diversification process, it is tempered considerably by market size constraints. Accordingly, the results suggest gold and Traditional reserve assets should receive more consideration from reserve portfolio managers.

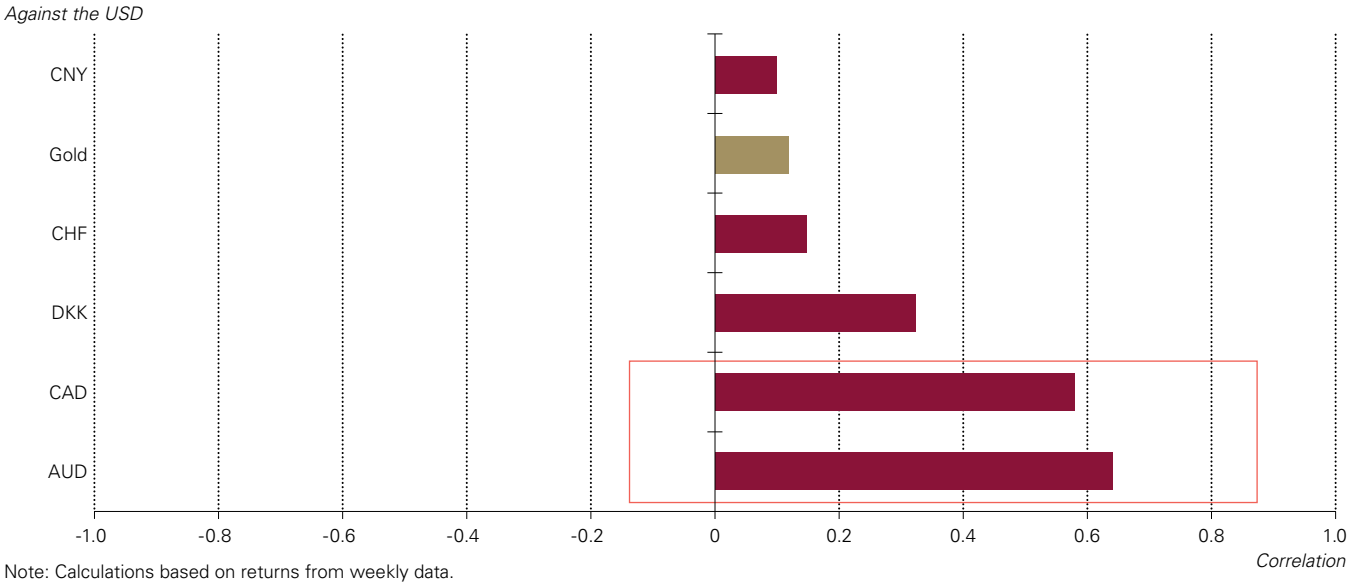
Alternative assets positively correlated with other risk assets

Another drawback to consider with these Alternative reserve assets is the stronger correlation they exhibit with risk assets. Given part of the strength of the Alternative assets is related to economic growth and commodity sector strength, these assets also carry risks that are associated more broadly with economic cycles. These pro-cyclical qualities are in large contrast to Traditional reserve assets that act as safe havens and are often considered countercyclical.

In order to examine the behaviour that Alternative and Traditional reserve assets exhibit against other risk assets, this study examined the correlations of long-term returns for the underlying currencies as more data points are available for currencies than for reserve assets. Over the 13 years from January 2000 to October 2012, the Australian and Canadian currencies exhibited strong, positive correlations with the MSCI World Index of 0.64 and 0.58, respectively **(Chart 8a)**.

Meanwhile, the Traditional reserve currencies illustrated in **Chart 8b** had no significant correlations with this global equity index. Furthermore, examining conditional correlations shows that when risk assets have experienced extremely negative events, these Alternative reserve currencies tend to move in tandem.

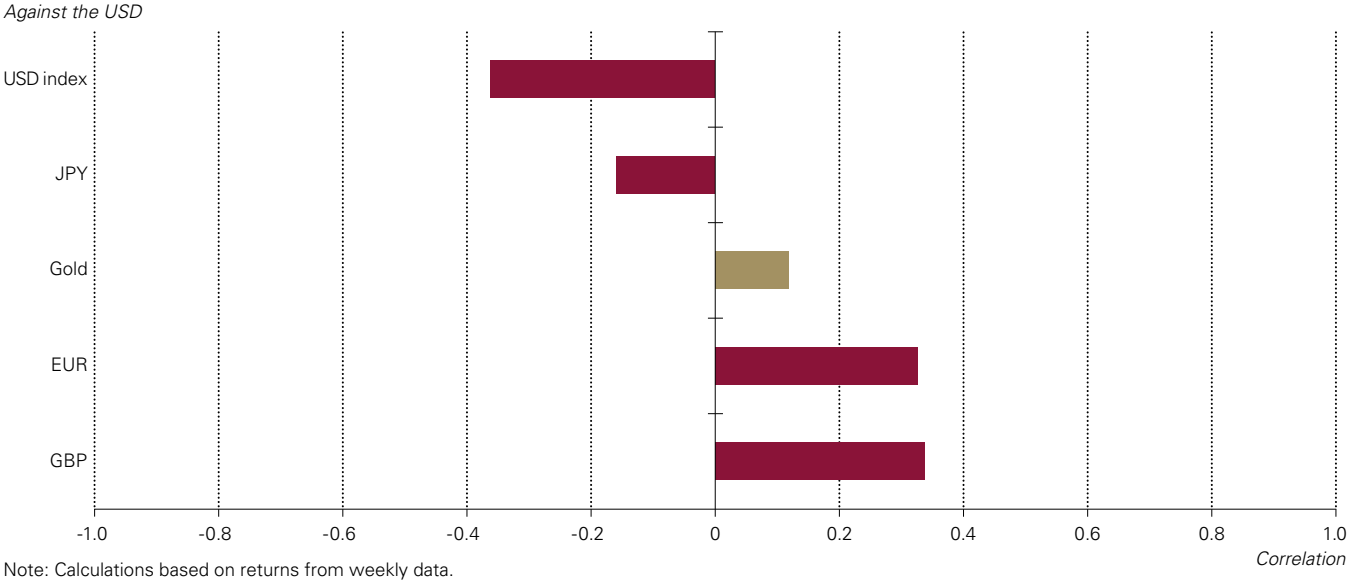
Chart 8a: Correlation between MSCI World Index and reserve currencies (January 2000 – October 2012)



Note: Calculations based on returns from weekly data.

Source: Bloomberg, World Gold Council

Chart 8b: Correlation between MSCI World Index and reserve currencies (January 2000 – October 2012)



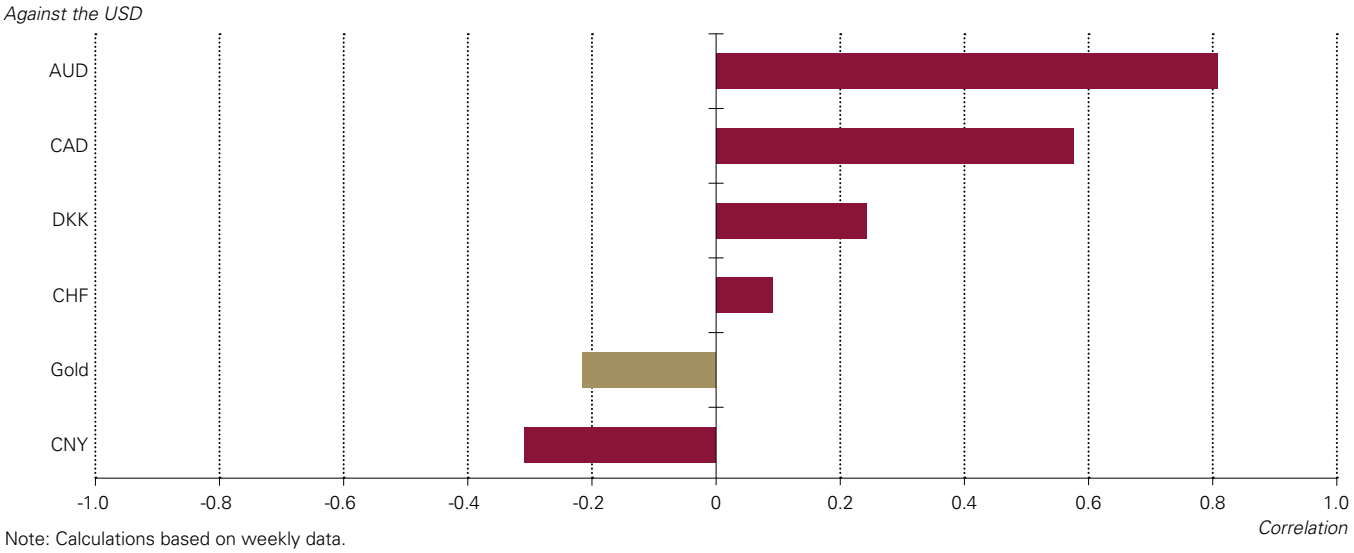
Note: Calculations based on returns from weekly data.

Source: Bloomberg, World Gold Council

Examining instances when the MSCI World declined by two standard deviations or more, the study found that there was a correlation between the MSCI World and the Canadian dollar and Australian dollar of 0.58 and 0.80, respectively. As such, when markets are rapidly declining and central banks may find it necessary to sell reserve assets, they might expect to incur losses. This is in direct contrast to gold, the price of which tends to rise when the MSCI World is declining in one of these more extreme events, as indicated by its -0.22 correlation **(Charts 9a and 9b)**.

Finally, Australian and Canadian assets are also susceptible to commodity cycles. The correlation between both of these currencies and the S&P GSCI commodity index is approximately 0.55, which is higher than all the other reserve assets including gold (a commodity itself). In fact, a research report conducted by the World Gold Council illustrated that while gold is technically a commodity, its financial characteristics are considerably different from most other commodities.[13]

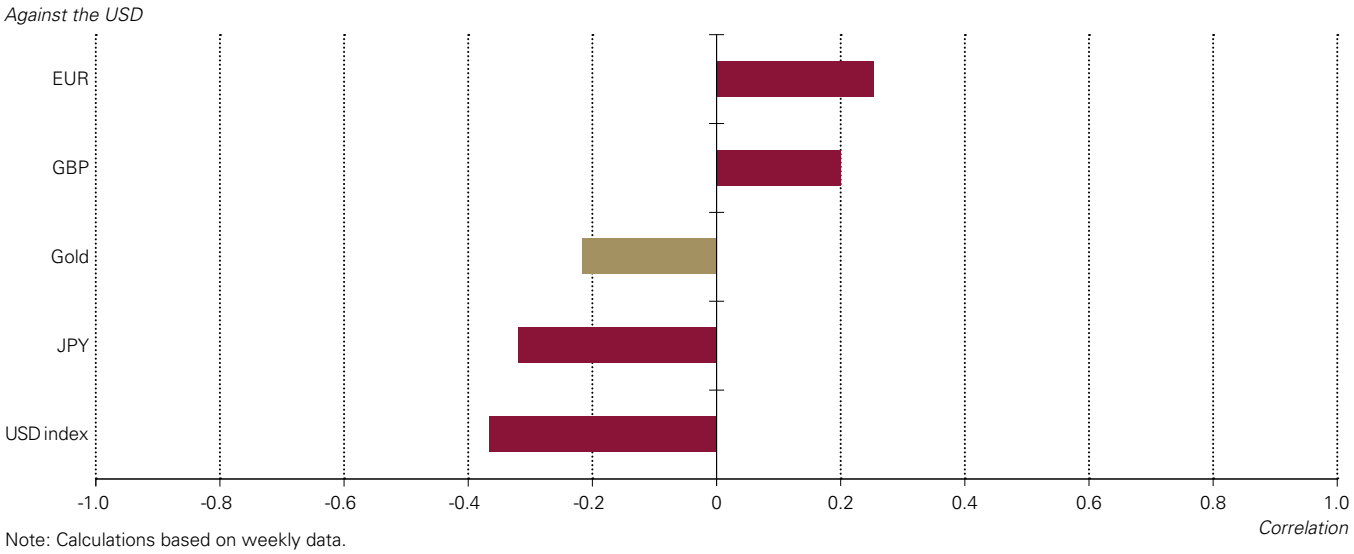
Chart 9a: Correlation when MSCI World Index declines by two standard deviations (January 2000 – October 2012)



Note: Calculations based on weekly data.

Source: Bloomberg, World Gold Council

Chart 9b: Correlation when MSCI World Index declines by two standard deviations (January 2000 – October 2012)



Note: Calculations based on weekly data.

Source: Bloomberg, World Gold Council

13 World Gold Council, *Gold: a commodity like no other*, April 2011.

Challenges with investing in the renminbi

While there is little question regarding China's growing role in the global economy, there is also significant uncertainty regarding its foreign exchange policies. There are two elements to this uncertainty. First, while the currency has gradually been made more flexible since 2005, it remains tightly controlled and is allowed to fluctuate in a narrow range only. Thus, China's fixed exchange rate policy leads to uncertainty regarding the currency's outlook. Investors in CNY must consider the possibility that the currency appreciates or depreciates meaningfully should China move toward a more flexible exchange rate policy.

Examining only the historical data without an appreciation of this policy would lead reserve managers to be attracted to these assets for their low volatility.[14] Moreover the steady appreciation of the renminbi since 2005 has magnified returns in US dollar terms, adding to its attractiveness. However, a more flexible exchange rate policy would at a minimum have an impact on the volatility of Chinese assets. In dollar terms, the volatility of Chinese treasuries is just 2.3% since 2005, compared with an average of 8% for Traditional reserve assets. If more currency volatility is introduced, the question remains whether the volatility of CNY-denominated assets will rise to levels similar to those of Traditional reserve assets or even those of emerging market assets, which are higher at 15% to 20%. This analysis has added 6.6 percentage points of volatility to Chinese treasury returns, which assumes the currency would have at least the same volatility as a developed economy currency. This figure was chosen as it is the average increase in volatility for Traditional reserve assets when translating the asset's volatility from local terms to US dollar terms.

Limited market access for foreigners

The second source of uncertainty pertains to the accessibility of the market for Chinese reserve assets. As of September 2012, there was US$1.3tn outstanding in Chinese treasury bonds and another US$241mn in central bank bonds. This study assumed that only US$180bn of the approximately US$1.3tn total market is available publicly, which is the sum of the US$80bn available through the Qualified Foreign Institutional Investor programme and Hong Kong offshore deposits. This resulted in a maximum allocation to Chinese treasuries of 5% in the optimal allocation analysis in this paper. The investable Chinese treasury market is small as the Chinese government does not have as much outstanding debt as the US or Japan, but it is effectively even smaller due to restrictions on foreign investors.

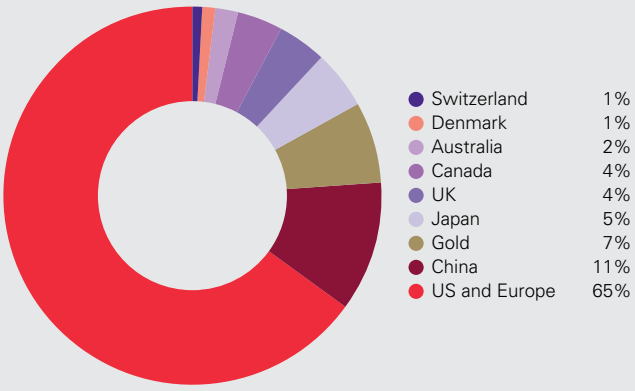
Qualified Foreign Institutional Investors (QFII)
Foreign investors, including central banks, may participate directly in Chinese markets through the Qualified Foreign Institutional Investor (QFII) programme. As of October 2012, there were 192 institutions in the programme, including 13 central bank or sovereign-related entities. In April 2012, Chinese authorities announced that the quota for total participation by foreigners would be raised to US$80bn from US$30bn.[15] Participation by individual institutions is further limited to US$1bn. In order for central banks and sovereign wealth funds to participate in the QFII programme, they must have been in existence for over two years, and assets under management must be in excess of US$500mn. QFII investors may invest in stocks, bonds and warrants traded on exchanges, fixed-return products traded in the inter-bank bond market, securities investment funds, stock index futures and other financial instruments permitted by the CSRC.[16]

Hong Kong deposits
Investors interested in acquiring renminbi denominated assets may also turn to the offshore market in Hong Kong. Hong Kong has been at the forefront of RMB internationalisation, offering a fully-deliverable offshore renminbi (referred to as CNH) market that gives foreign investors access to renminbi assets. The Hong Kong Monetary Authority estimates the CNH deposit base is nearly US$100bn (CNH600bn) and growing rapidly.[17]

China liberalisation scenario

The analysis in this paper also considered a scenario in which Chinese markets became more accessible to foreigners. Under this scenario the cap of 5% applied to allocations to Chinese assets was lifted to 15% to account for complete availability of the US$1.5tn in government bonds. The results of this optimisation analysis show that Chinese treasuries become the dominant asset in the optimal portfolio due to their low volatility, appreciation against the US dollar and low correlation with Traditional reserve assets **(Chart 10)**. Gold would continue to have a strong presence at nearly 7%, exceeding all other assets in this scenario.

Chart 10: Allocations for diversifying assets in China liberalisation scenario



Note: Barclays Treasury Aggregates.
Source: World Gold Council

14 As was confirmed by the optimisation study in this analysis.

15 China Securities Regulatory Commission, *QFII Investment quota to be increased by 50bn US Dollars,* April 2012; available from http://www.csrc.gov.cn/pub/csrc_en/OpeningUp/RelatedPolices/QFII/201212/t20121210_217805.htm

16 China Securities Regulatory Commission, *Provisions on issues concerning the implementation of the administrative measures for securities investment made in China.*

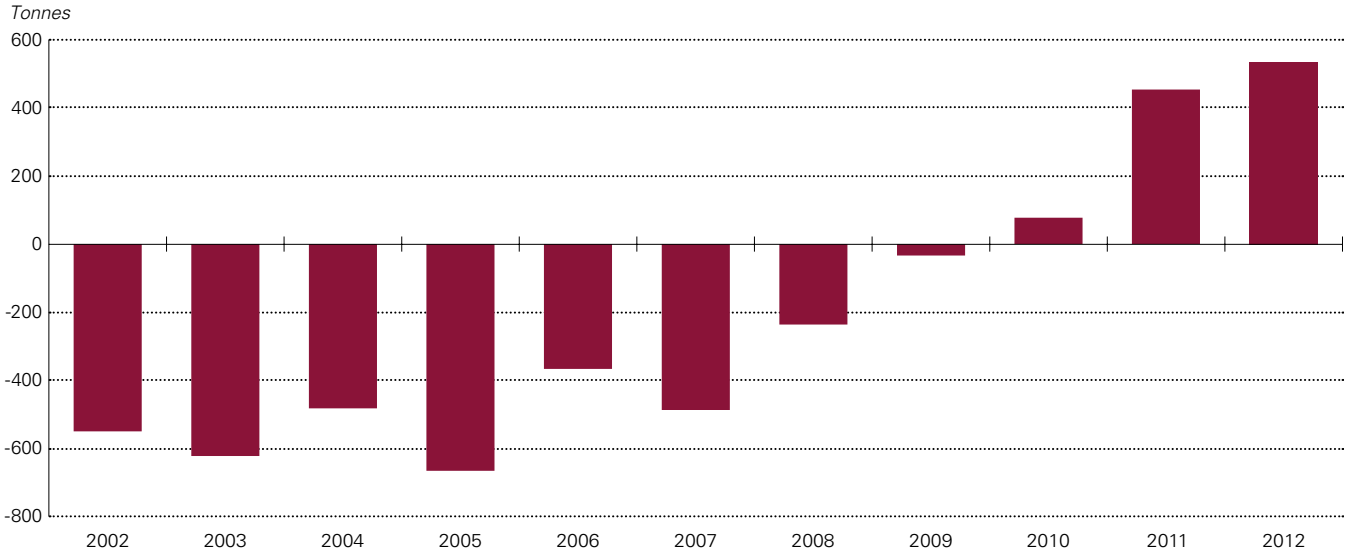
17 Hong Kong Monetary Authority, *Hong Kong: The Premier Offshore Renminbi Business Centre,* March 2012.

A renewed relevance for gold

This analysis is premised on the basis that central banks are looking for alternatives to diversify portfolios that are overwhelmingly allocated to US dollars and euro assets. Through portfolio analysis, this paper shows that Alternative reserve assets that previously had a limited role should be considered by central banks as part of this diversification process. The paper also illustrates the renewed relevance of several Traditional assets – in particular gold.

Gold has a long history as a reserve asset for central banks. During the days of the gold standard, gold was the reserve asset backing a nation's fiat currency. Since the end of the classical gold standard and the subsequent gold exchange standard, gold has remained an important part of reserve portfolios for central banks, but quietly fell out of favour as interest bearing sovereign debt in the US and Europe took on greater importance in the 1990's and 2000's. More recently, central banks have become net buyers of gold as of 2010 **(Chart 11)**.

Chart 11: Net official sector transactions



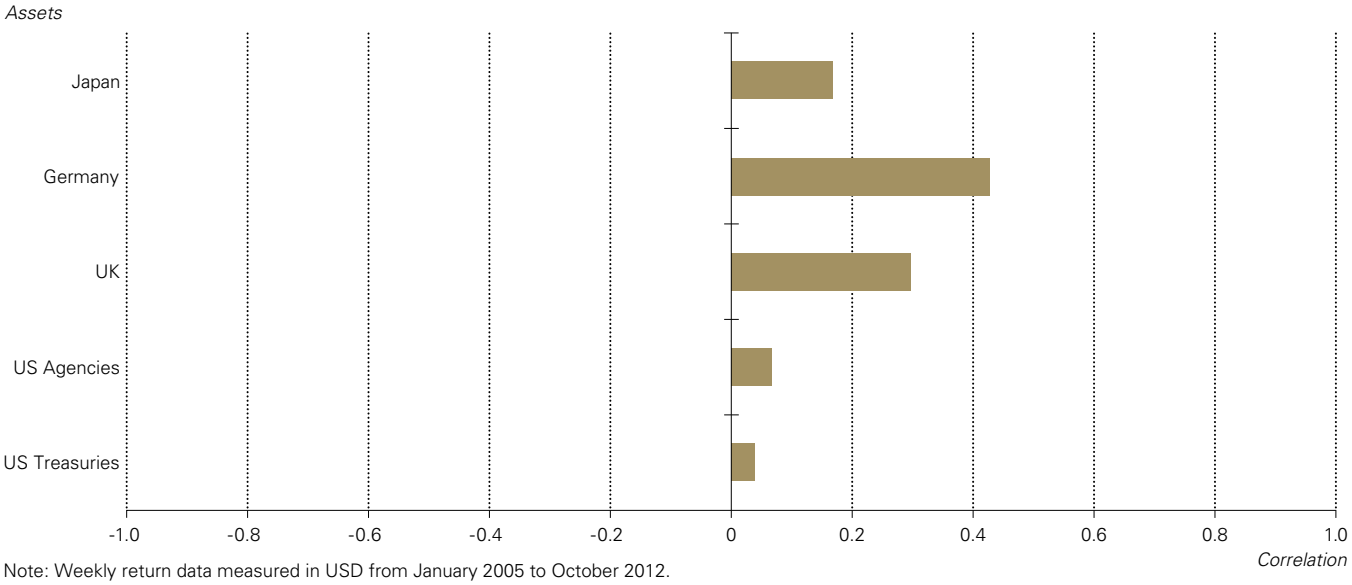
Source: Thomson Reuters GFMS, World Gold Council

This paper has highlighted reasons why central banks have turned to gold in reserve portfolios. Gold is statistically uncorrelated with Traditional and Alternative reserve assets **(Chart 12)**, which allows it to provide significant diversity to a portfolio and which is the primary reason it is one of the most important assets that central banks should consider when diversifying out of the US dollar and euro.

This paper also illustrates that due to the large size of the gold market, at approximately US$3.2tn, central banks have sufficient access to gold for large investments.

This study did not factor in several important qualities of gold, namely its lack of credit risk and its liquidity as measured by trading volume. While reserve assets tend to be of high credit quality, they still represent an obligation of a sovereign and carry some measurable level of default risk. In fact, as central banks have long investment horizons, the marginal sovereign default risk that does emerge over time is relevant for them. On the other hand, gold has no credit risk when held in an allocated bank account or in physical form in a central bank vault. This quality has not been taken into consideration in the quantitative models presented thus far.

Chart 12: Correlation of weekly returns between gold and reserve assets

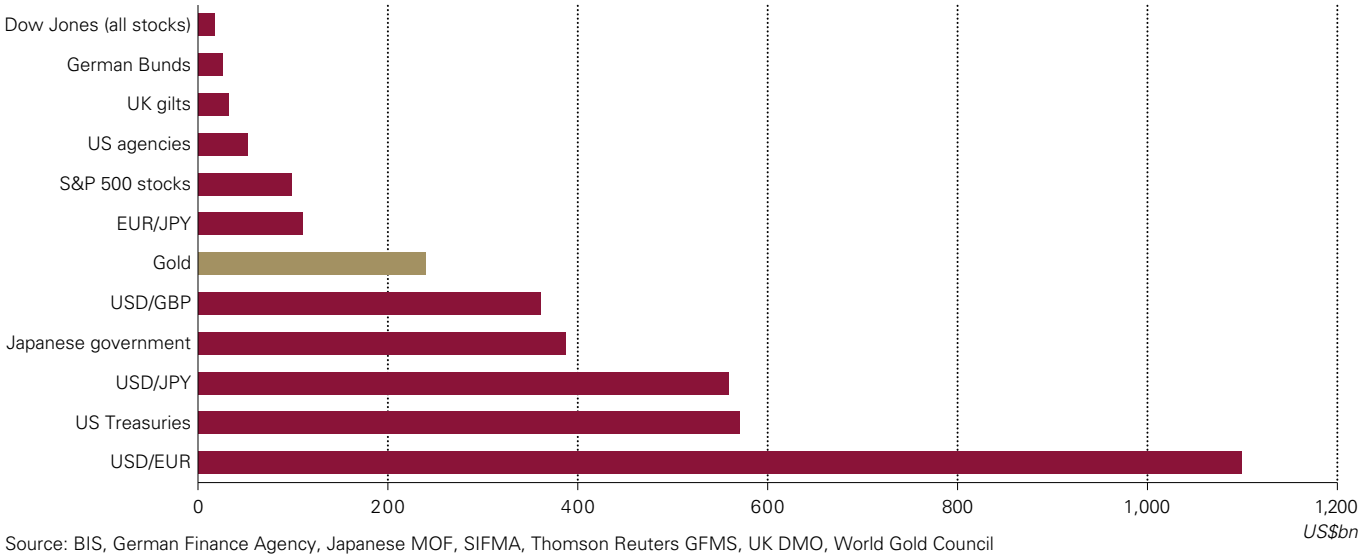


Note: Weekly return data measured in USD from January 2005 to October 2012.

Source: World Gold Council

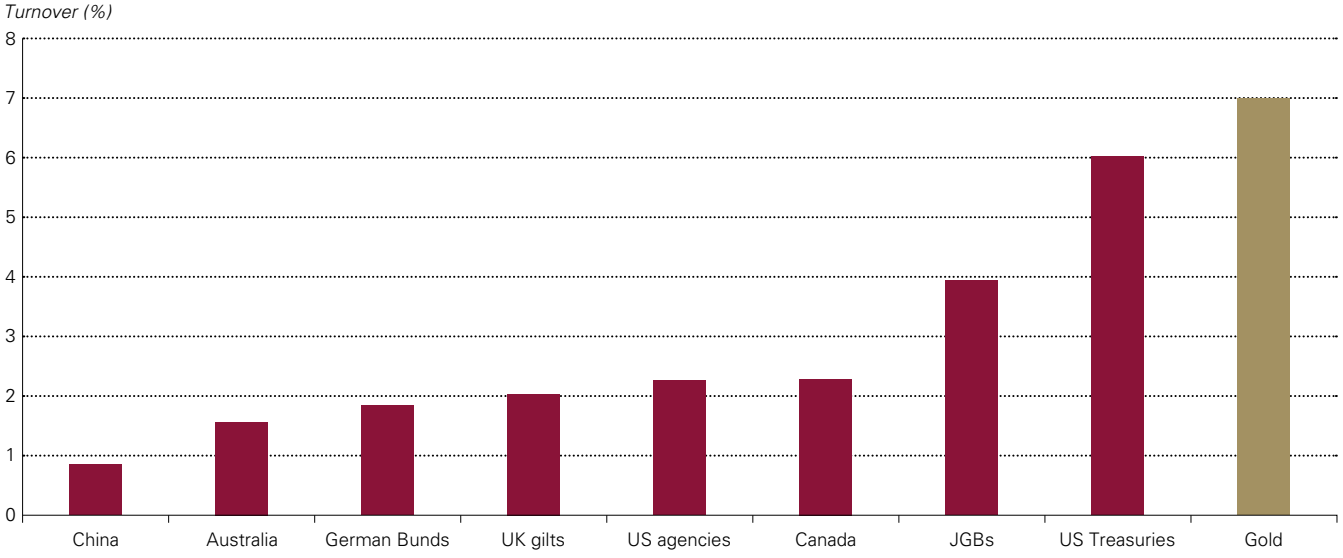
Furthermore, with regard to liquidity, gold's average daily trading volume is estimated to be US$240bn, as measured by a dealer survey conducted by the LBMA[18] **(Chart 13)**. In comparison to other large assets and currencies, gold emerges as one of the most frequently traded, following only major currency pairs, US Treasuries and Japanese government bonds. Gold's liquidity when measured against the size of its market is even more robust with roughly 7% turnover, which exceeds all other reserve assets **(Chart 14)**. Gold's deep liquidity is attributed to its global nature and its role as both a currency and an asset with multiple uses.

Chart 13: Average daily volume in US dollars for various assets



Source: BIS, German Finance Agency, Japanese MOF, SIFMA, Thomson Reuters GFMS, UK DMO, World Gold Council

Chart 14: Average daily turnover (average daily trading volume/market size)



Source: Asian Development Bank, Department of Finance Canada, German Finance Agency, Japanese MOF, SIFMA, Thomson Reuters GFMS, UK DMO, World Gold Council

18 LBMA, Loco London Liquidity Survey, April 2011.

Summary

As central banks look to reduce dollar and euro exposure, Traditional reserve assets such as gold can play an important role alongside alternatives such as Chinese, Canadian, Australian, Swiss, and Danish denominated assets.

Chinese assets, gold, and Australian treasuries emerge as the most important assets for diversification when conducting a portfolio optimisation exercise focused on optimising Alternative assets outside of the US dollar and euro. However, when market size and access constraints are considered, gold emerges as the dominant asset for diversification with a median suggested optimal allocation of 8% in US dollar terms. Overall, the study concludes that gold, with its lack of credit risk and highly liquid market, is one of the most attractive alternatives in this diversification process. The study results suggest it would be prudent for reserve managers to build gold reserves alongside Alternative reserves, as Alternative markets need time to develop and allocations to gold remain largely below optimal levels.

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