WORLD GOLD COUNCIL

Foreign-reserve diversification for emerging-market central banks

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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Executive summary

In Q2 2009, central banks became net buyers of gold for the first time in two decades and have continued to purchase since then. Gold's lack of credit risk and market depth, and the fact that it is almost universally permissible in the investment guidelines of the world's central banks have made it an increasingly attractive investment alternative.[1] In addition, the deteriorating credit quality of government debt has been a catalyst for rising gold demand. Emerging-market central banks, which own on average approximately 4.6% of foreign reserves in gold – well below the 22% allocation of their developed-market counterparts[2] – have begun increasing their gold allocations. In 2012, as in years prior, a diverse group of central banks added to their gold reserves, including the central banks of Brazil, Russia, Mexico, Korea, the Philippines, Iraq, and Kazakhstan.

As these institutions picked up gold purchases, a natural question followed: what level of gold reserves is appropriate for emerging-market central banks? To answer this, we conducted a statistical analysis to determine optimal gold-allocation ranges for a foreign-reserve portfolio.[3] The study considered this question from multiple perspectives: it examined the appropriate allocation to gold when reserves are measured in US dollars and compared that to optimal allocations when foreign reserves are measured from a local-currency perspective. The study concentrates on nine different emerging-market currencies, including the Indian rupee, Singapore dollar, Brazil real, and Thai baht. Changing the numéraire, or currency in which assets are measured, is an important consideration since emerging-market central banks report their reserve asset performance in their domestic currency. As such, measuring foreign reserves in local currencies may be the most relevant benchmark for some of these institutions.

Our analysis shows that, when foreign reserves are measured in US dollars, optimal allocation to gold ranged between 4.6% and 7.0% for medium levels of risk, depending on portfolio mix. More importantly, we found that through the lens of local emerging-market currencies, optimal gold allocations were significantly higher than those from the US-dollar analysis. When viewed from a local perspective, optimal gold allocations increased to a range between 8.4% and 10.0%, almost four percentage points higher than the allocations suggested from a US-dollar perspective. This higher allocation to gold is not the result of gold's price appreciation over the past decade, as we used a conservative nominal price return of 4% for the analysis – compared to a historical 13.5%. Rather, it is a by-product of gold's low correlation to other assets, similar volatility across currencies, and a negative correlation to the US dollar.

As central banks reallocate their reserves and adjust their gold holdings to more optimal levels, we are likely to see a continuing trend of central-bank purchases. A four percentage-point increase to gold reserves among emerging-market central banks, based on the optimal allocations found in this study, could translate into an additional 6,000 tonnes of gold demand from the official sector.

1 For a comprehensive perspective on the size and depth of the gold market see our report *Liquidity in the global gold market,* April 2011.

2 IMF International Financial Statistics.

3 This research note contains a summary of the results in the study, which first appeared in *Optimal gold allocations for emerging-market central banks*, RBS Reserve Management Trends 2012 publication, as part of their Central Banking Publications journal. The full-length study can be found on our website, www.gold.org

Why consider a non-US dollar numéraire?

Past optimal-allocation studies have found a clear role for gold in central-bank reserve portfolios, although until now such studies have largely been confined to US-dollar-based portfolios.[4] However, a foreign-reserve manager could extend a US dollar-based optimisation to a domestic currency (non-US dollar) perspective in order to: 1) reduce the bias of their dollar-based analysis; 2) assess efficiency/robustness of the analysis in the domestic currency; and 3) consider how the changing nature of their domestic currency's relationship to the dollar may affect the results.

First, addressing the numéraire bias, the Reserve Bank of Australia has noted that a portfolio consisting of assets expressed in the study's numéraire would involve no currency risk and thus possess the lowest risk profile.[5] The results would lead to portfolio allocations biased to numéraire-denominated assets and, potentially, improper portfolio diversification.[6]

Second, reserve managers need to be mindful of their portfolio performance from a domestic-currency perspective. This may be due to concern or interest from government officials and the public in maximising profits, especially as central banks typically report foreign holdings in local-currency terms. It may also stem from the central bank's need to pay local-currency liabilities and/or rely on interest income or profits to sustain its operations.

Finally, a change in the numéraire in optimisation exercises helps reserve managers understand the potential changing role of their currency vis-a-vis other reserve currencies, with particular attention on the US dollar. A declining role for the US dollar as the primary reserve currency could lead to its increased volatility versus emerging-market currencies. This consideration is particularly relevant when changes to foreign-exchange policies lead to more flexible regimes. For example, moving from a fixed exchange rate (relative to the US dollar) to a more flexible regime will introduce greater volatility against the domestic currency and other reserve currencies. In this case, a domestic-currency analysis would be more fruitful, providing greater insight into how a foreign-reserve portfolio should evolve.

4 Several past studies have found some role for gold in a reserve asset portfolio with differing degrees of allocation. See: Scacciavillani and Saidi, *The case for gold as a reserve asset in the GCC* (Dubai: Dubai International Financial Centre, 2010); Natalie Dempster, *The importance of gold as a reserve asset*, World Gold Council, 2010; Carlos León and Daniel Vela, *Strategic asset allocation: non-loss constraints and long-term dependence*, in RBS Reserve Management Trends 2011, ed. R. Pringle and N. Carver (London: Central Banking Publications, 2011). Other studies have often excluded gold in their optimisation analysis for example: see Elias Papaioannou, Richard Portes and Gregorious, *Optimal currency shares in international reserves: The impact of the euro and the prospects for the dollar* (NBER Working Paper no.12333, June 2006).

5 Reserve Bank of Australia Foreign Reserves Management available from http://www.rba.gov.au/mkt-operations/mgmt-foreign-curr/perf-measuremt.html, accessed in December of 2011.

6 The analysis conducted in emerging-market currencies resulted in no significant allocation to any one particular asset/currency as was found in the US dollar analysis, with its bias toward US dollar assets.

Optimal allocations to gold

Methodology

The analysis concentrates on assets typically held by central banks in their foreign reserves. These include sovereign debt instruments from major markets such as US treasury and agency bonds, Japanese government bonds, German bunds, UK gilts and gold. Historical returns and volatility for primary reserve assets, over the period from 1998 to 2011, were measured in terms of the US dollar and the nine other emerging-market currencies **(Table 1)**. This period was selected to reflect a long history without including a period of unusual volatility in emerging-market currencies during the Asian financial crisis of 1997 and 1998. However, for the purpose of this analysis, and not to induce a price-appreciation-driven result, we assumed a more conservative 4% nominal annual return, compared to the 13.5% observed return between 1998 and 2011. This adjustment is consistent with gold's long-term nominal return and its 1%-2% historical spread to US inflation,[7] causing gold to exhibit the lowest information ratio, or return per unit of risk, of all of the reserve assets in the study. In other words, gold would appear to be a less desirable asset on a risk-adjusted basis.

Optimal portfolio allocations were found using Re-sampled Efficiency Optimisation, a methodology acknowledged by financial theorists to be more robust than classical mean-variance optimisation.[8] This study compares the results of an optimisation analysis conducted in two cases, based on: 1) US-dollar assumptions (return, volatility and correlations), and 2) nine selected emerging-market currencies. The nine currencies were selected based upon their prominence and the degree to which the currency is 'managed' by their respective central banks. For a detailed review of study methodology, please refer to *Optimal gold allocations for emerging-market central banks,* April 2012.

Results from a US-dollar perspective

The results of the US-dollar-numéraire analysis showed that a gold allocation improved risk-adjusted returns for low, mid and high levels of risk. The analysis suggested an optimal gold allocation from a dollar perspective ranged between 1.4% and 16.8%, with the mid-risk range between 4.6% and 7%, consistent with aggregate reserve allocations based on the IMF COFER data.

Table 1: Return and volatility of select reserve assets*

Assets	Return	Volatility
Barclays Capital US Treasury Aggregate	5.6%	4.8%
Barclays Capital US Agency Aggregate	5.5%	3.5%
J.P. Morgan German Bund Index (euro)	5.0%	3.7%
J.P. Morgan Japan Bond Index (yen)	2.0%	2.9%
J.P. Morgan UK Gilt Index (pound sterling)	5.8%	5.2%
Gold (London PM fix, US$/oz)	13.5%	16.5%
Gold inputs used for this study	4.0%	16.5%

*Computed using weekly return data from March 1998 to June 2011.

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

7 The selection of 4% is consistent with marginal outperformance of gold over inflation of between 1% or 2% over a long-term horizon against inflation, which is estimated to be between 2% and 3% in dollar terms.

8 Invented by Richard Michaud and Robert Michaud. US patents 6,003,018, 6,928,418, 7,412,414, 7624,060: Israel 138018. Worldwide patents pending. New Frontier Advisors LLC is a worldwide licensee.

In addition, despite gold's return being adjusted downward to 4%, gold's low correlation with other reserve assets resulted in the optimiser finding statistical significance in a gold allocation.[9] Finally, as illustrated in **Chart 1**, the lowest risk portfolio did, in fact, skew allocations toward dollar assets, allocating 92.2% of the portfolio to US agencies and US Treasuries, due substantially to their lower dollar-based volatilities.

Results from a domestic-currency perspective

The results of nine distinct optimisation analyses in emerging-market currencies show that allocations to gold are significantly higher in each currency examined relative to the allocation suggested by a US-dollar analysis. Indeed, optimising a typical emerging-market central-bank portfolio from a domestic-currency perspective for the sample of nine revealed that the US dollar-based optimisation consistently under-allocated to gold. The optimal gold allocation ranged from 2.4% to 25.8%, with a median gold allocation for the group of between 8.4% and 10%,[10] as outlined in **Chart 2**. In all currencies examined, reserve portfolios exhibited improved risk-adjusted returns when gold was added to the portfolio.

The stability of gold, and why higher allocations may be optimal

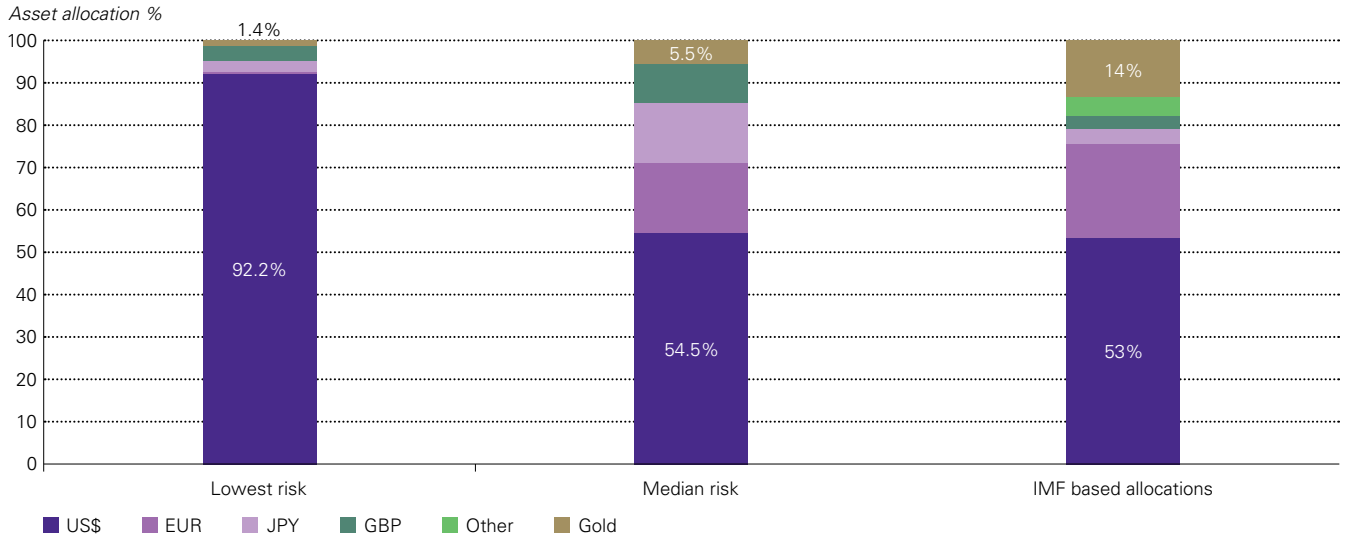
Another key finding was that gold exhibited relatively stable volatility when measured across a number of emerging-market currencies, in contrast to other primary reserve assets such as US Treasuries, European sovereign debt, Japanese JGBs, and UK gilts. This stability is underpinned by gold's negative correlation with the US dollar and supports higher optimal allocations to gold for most emerging-market central banks.

Comparing the optimal allocation to gold from a US dollar and domestic-currency perspective illustrates one of gold's intriguing qualities – and helps explain why, from a domestic-currency perspective, gold allocations should be higher in all nine currencies. The result is based on gold's behaviour, both as an asset and a currency. In US dollar terms, gold has the lowest information ratio and the highest volatility relative to all other reserve assets. However, when examined in each of these selected emerging-market currencies, gold's information ratio (while still the lowest) was far less affected by changes in the numéraire than other reserve assets.

9 Gold was statistically significant in 47 of 51 output portfolios at the 25% percentile level or at a 75% confidence level.

10 The majority of the results were significant at the 5% level. Furthermore, the minimum-risk portfolios for seven of the nine currencies were statistically significantly different from the minimum-risk portfolio conducted in US-dollar terms. Only the Korean-won and Polish-zloty portfolios were not statistically significantly different.

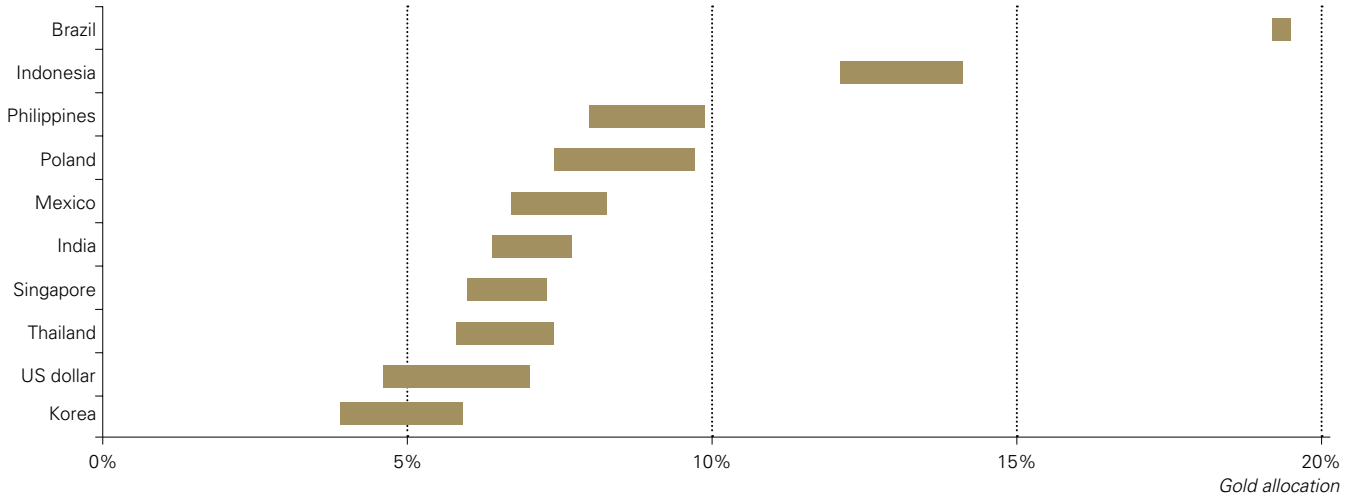
Chart 1: US dollar as numéraire – US-dollar bias in low risk portfolio versus median risk



*Foreign-reserves data as of Q3 2011. US agency bonds were constrained to a 25% maximum allocation.

Source: IMF data sourced from COFER, World Gold Council

Chart 2: Optimal gold allocation range by currency numéraire



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

In fact, the average change in gold's information ratio when rebased in a foreign currency was zero. Meanwhile, the average decline in return per unit of risk for US Treasuries was approximately 0.6 and almost one full point for US agencies. Thus, despite having the lowest information ratio in US dollar terms, gold's information ratio is more stable across all currencies due to its relatively stable volatility contributing to improved risk-adjusted returns in reserve portfolios. **Chart 3** illustrates gold's similar volatility across a variety of currencies compared to the increasing volatility of US Treasuries.

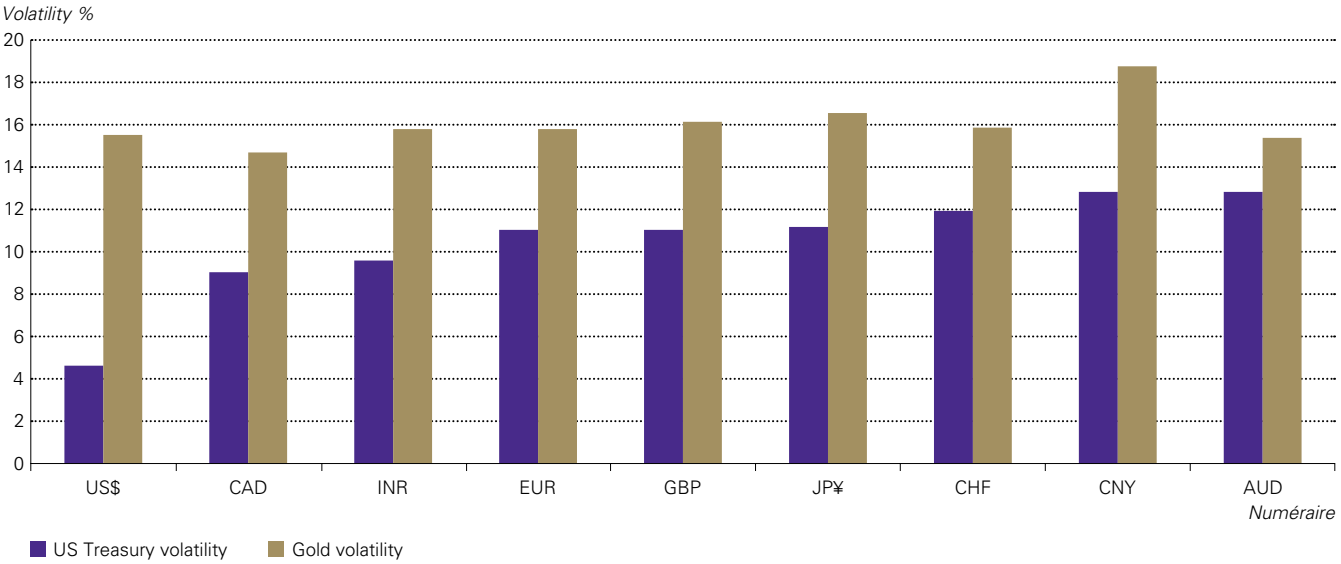
Gold's volatility is also significantly more stable than the volatility of other reserve assets in terms of the nine selected currencies. **Chart 4** shows changes in gold's volatility across emerging-market currencies compared to its US-dollar-based volatility, and illustrates that, on average, gold's volatility varied by only 1.7 percentage points. In addition, while sovereign debt is often considered a low-risk, low-volatility asset, the results of the study suggest it is much more volatile when considered from a non-US dollar perspective.

Gold's negative correlation with the US-dollar underpins its consistent volatility performance. Over the long term, gold has been negatively correlated to the US dollar, partly because gold's price is typically referenced in US dollar terms. The logic behind this phenomenon can be demonstrated as follows: when the Mexican peso appreciates against a weakening dollar, gold is likely to also appreciate given its negative relationship with the dollar, which means that the Mexican peso and gold will tend to move in the same direction – thus reducing the volatility of the Mexican peso/gold (MXNXAU)[11] pair. Gold's negative correlation with the US dollar is one of the reasons that many central-bank reserve managers consider it particularly attractive: it can serve as a hedge against dollar assets. Since 2000, gold has exhibited a -0.44 correlation coefficient with the trade-weighted US dollar index.[12]

Potential effect of central bank re-allocation on gold demand

Emerging-market central banks have an average allocation of approximately 4.6% to gold. A reallocation to the optimal levels shown in this analysis would represent at least a four percentage-point increase. In other words, assuming no growth in foreign-exchange reserves, emerging-market central banks need to almost double their gold allocation to achieve the optimal levels found in this study **(Chart 5)**. Thus, to increase gold allocations across all emerging-market central banks to an average 9% of total reserves, central banks would need to buy nearly 6,000 tonnes of gold – roughly 1.5 times the annual gold demand. This assumes that foreign-exchange reserves, which have grown by over 15% per annum over the past twelve years, stop growing. Factoring in a 15% growth in foreign reserves would increase gold demand by an additional 1,700 tonnes.[13] Clearly, central banks are unlikely to make any sudden or drastic redistribution of assets, but the results of this study and the continued interest from central banks for gold since 2009 are very supportive of significant ongoing demand from this sector.

Chart 3: Gold and US Treasury volatility in different currencies*



*Monthly return data from December 1987 – October 2012 used for this computation.
Barcap US Treasury aggregate index was used for US Treasuries and London PM fix for gold.

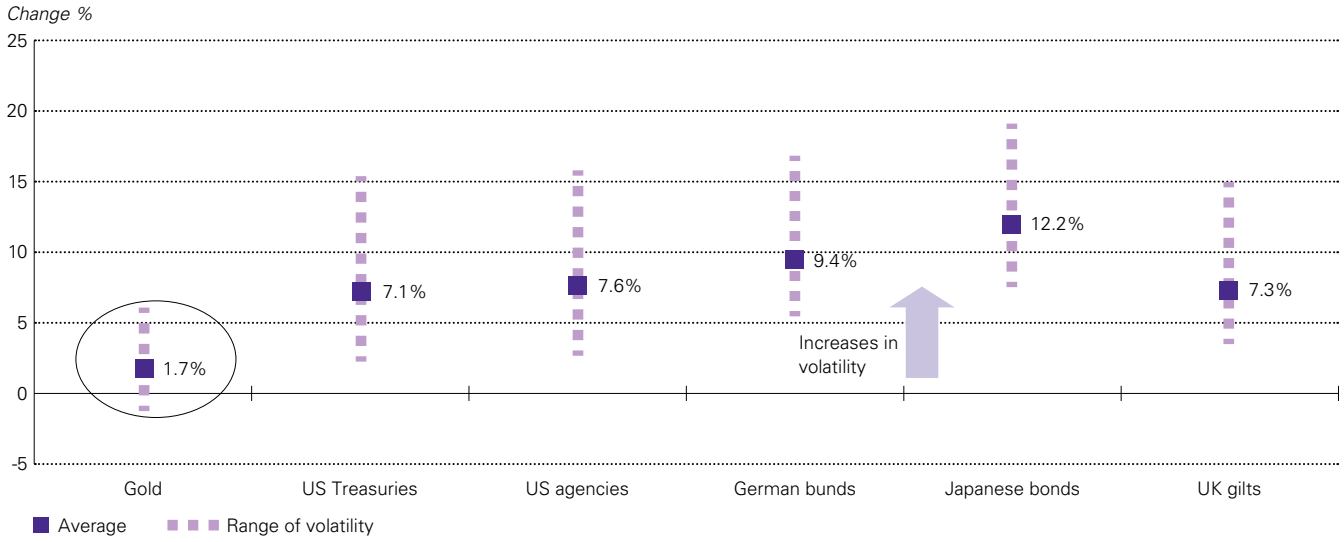
Source: Bloomberg, World Gold Council

11 MXNXAU is the common approach to quoting currencies, with MXN signifying Mexican peso and XAU signifying gold, thus gold in Mexican pesos.

12 Correlation computed utilising the daily gold price and dollar trade-weighted index sourced from Bloomberg, using monthly data between 2000 and 2011.

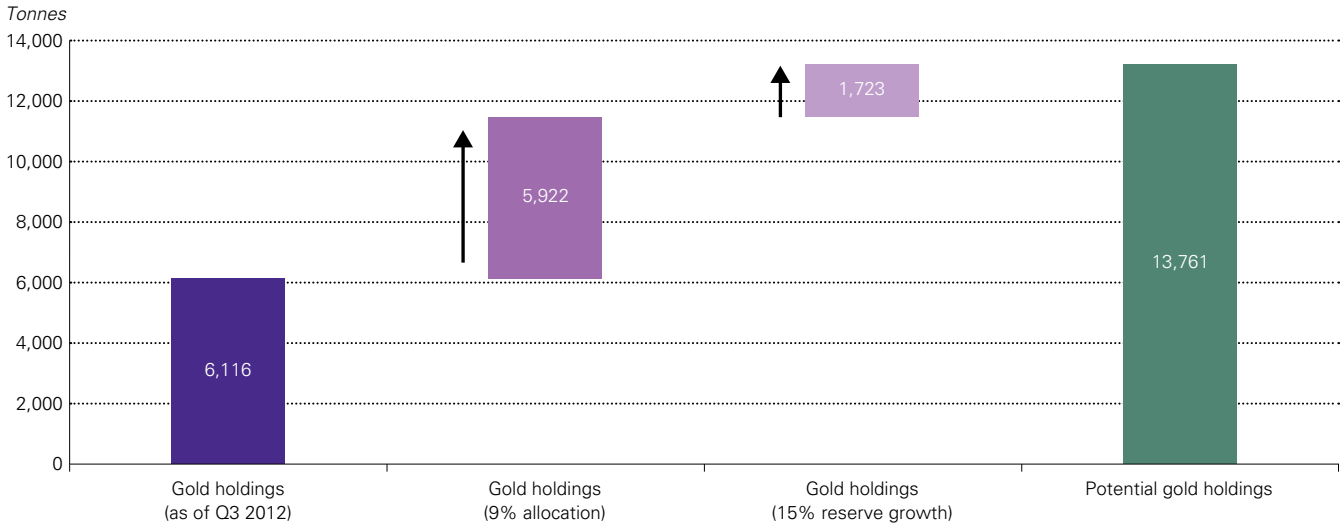
13 A detailed analysis of emerging-market central-bank reserves can be found in the Appendix.

Chart 4: Range of impact on volatility from translating assets into emerging-market currencies



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

Chart 5: Emerging-market central-bank potential demand*



*9% allocation is in the range of optimal gold allocation in non-US$ numéraires. 15% reserve growth is approximately equal to the current growth rate of FX reserves.

Source: IMF IFS, World Gold Council

Conclusion

Gold should form an integral part of a central bank's foreign-reserve portfolio, especially in emerging markets. The optimal allocation to gold is consistently higher when considered from a domestic-currency perspective, with a resulting mid-risk optimal allocation to gold of between 8.4% and 10% (compared with 4.6% to 7% in dollar terms). Additionally, including gold in the investment universe improved risk-adjusted returns for all nine emerging-market currency optimisations. Our analysis points to gold's consistent volatility across currencies, especially relative to that of other reserve assets, like sovereign debt. When comparing gold to these other reserve assets, reserve managers will already be aware of gold's liquidity and lack of credit risk, but may also benefit from conducting an analysis to complement their US-dollar-based strategies. We have shown that analysing a reserve portfolio from the perspective of emerging-market currencies can provide useful information to portfolio managers on the optimal composition of foreign reserves. In particular, we found that gold's optimal allocation, when seen from a domestic-currency perspective, is higher than suggested by a US-dollar analysis. As central banks re-allocate to reflect these optimal allocations in an environment of rising reserves, their gold purchases need to increase to keep pace.

Appendix

Table 2 : EM central-bank gold purchases (sales) in tonnes as a function of FX-reserve growth and average gold allocation*

Reserve growth	Average gold allocations							
	4%	4.6%	5%	6%	7%	8%	9%	10%
-15%	(1,532)	(875)	(385)	761	1,907	3,053	4,199	5,345
-12%	(1,378)	(700)	(194)	990	2,175	3,359	4,544	5,728
-9%	(1,225)	(525)	(3)	1,220	2,443	3,665	4,888	6,111
-6%	(1,072)	(350)	189	1,450	2,711	3,972	5,233	6,494
-3%	(919)	(175)	380	1,680	2,979	4,278	5,577	6,877
0%	(766)	0	572	1,909	3,247	4,584	5,922	7,260
3%	(613)	175	763	2,139	3,515	4,891	6,267	7,642
6%	(459)	350	955	2,369	3,783	5,197	6,611	8,025
9%	(306)	525	1,146	2,599	4,051	5,503	6,956	8,408
12%	(153)	700	1,338	2,828	4,319	5,810	7,300	8,791
15%	0	875	1,529	3,058	4,587	6,116	7,645	9,174

*Reserve growth is a total figure and does not represent growth per annum. This analysis assumes a steady gold price of US$1776/oz – which represents the London PM fix of 28 September 2012. FX and gold reserve data is as of Q3 2012.

Source: IMF, World Gold Council

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