Gold performance analytics: correlation and volatility calculations

One, three and five year correlation matrices

Calculations are based on weekly data (end of week), using underlying daily data. The US dollar gold price is converted into LCU for each non-US market, as are other commodity prices and price indices. This means that each matrix is country/market specific (there is a set of one year, three year and five year correlation matrices for each country/market covered).

Currency conversions for countries such as France and Germany that belonged to EMU:

The US dollar/local currency exchange rate is converted to Euros using the irrevocable Euro Exchange Rate (see box below) until 4th January 2000, when the Euro was introduced, whereafter the Euro is used as the local currency unit.

=	BEF	40.3399
=	DEM	1.95583
=	ESP	166.386
=	FRF	6.55957
=	IEP	.787564
=	ITL	1936.27
=	LUF	40.3399
=	NLG	2.20371
=	ATS	13.7603
=	PTE	200.482
=	FIM	5.94573

The table is taken from the special section on the EUROPA Web site of the European Union devoted to the conversion to the Euro, where further information is available in all official EU languages. Source: http://www.ecb.int/euro/intro/html/index.en.html

Cash series that give returns as annualised percentages (i.e. CDs and treasury bills) are converted to weekly percentage returns using the following formula:

$$r_w = e^{\frac{r_y}{52}} - 1$$

This is derived from the formula for compound growth, with the initial sum set equal to 1.

Weekly returns for all other series are defined as the log price change, i.e.:

$$\ln P_t - \ln P_{t-1}$$

Correlation matrices are generated using the Excel correlation function (CORREL), which uses Pearson's product moment coefficient (sample covariance of X and Y divided by the product of the standard deviation of each series). Where correlation coefficients are tested for significance, the test statistic used is based on Fisher's transformation, namely:

$$z = \frac{1}{2}\log\left(\frac{1+r}{1-r}\right),$$

where **log** corresponds to the natural log and ***r*** represents the sample correlation coefficient. Under the null hypothesis of no correlation, ***z*** follows a normal distribution with mean 0 and standard deviation equal to:

$$1/\sqrt{N-3}$$

where ***N*** is the number of observations used to compute the correlation coefficient.

Statistical significance and critical values:

	α = 0.05		Critical value for ρ	
	***z*α (one tail)**	***z*α (two tails)**	**One tail**	**Two tails**
260 weeks (5 years)	1.645	1.96	0.110	0.122
156 weeks (3 years)	1.645	1.96	0.133	0.158
52 weeks (1 years)	1.678	1.96	0.240	0.280

No correlation:
If the absolute value of the correlation coefficient is less than the critical **rho** value for a two-tailed test, then the correlation coefficient is not significantly different from zero at the 5 per cent level of significance (the null hypothesis of no correlation cannot be rejected).

Negative correlation:
If the value of the correlation coefficient is less than the negative value of the critical **rho** value for a one-tailed test, then the correlation is negative, using a 5 per cent level of significance (the null hypothesis that **rho** is less than zero can be rejected).

Positive correlation:
If the value of the correlation coefficient is greater than the positive value of the critical **rho** value for a one-tailed test, then the correlation is positive, using a 5 per cent level of significance (the null hypothesis that **rho** is greater than zero can be rejected).

Rolling correlation series
Charts show the correlation between weekly percentage returns of each set of two series for the 52 week period prior to the date shown on the horizontal axis. This provides a more dynamic picture of how the correlations have changed over time, as well as insight into how gold can provide valuable diversification during financial stress periods. The relevant critical values using a 5 per cent level of significance are those for 1 year in the table above.

Volatility

Volatility statistics reported here refer to the annualized historical volatility of each series. This is calculated using the following formula:

$$\sigma(\ln P_t - \ln P_{t-1}) \times \sqrt{260}$$

This is the annualised standard deviation of the daily log price change, and is reported as a percentage.