Deutsche Bank
Research

Global | Commodities Precious Metals | Special Report | Date 1 June 2017

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Gold remains expensive insurance

Pinning down the paradoxical nature of gold

We contend that in order to determine whether gold is cheap or expensive, one must first define what gold actually is. At first glance this may seem simple, but gold can be many things to different people, which changes over time; ranging from a simple commodity to a store of value and even an insurance policy against global uncertainty. We find that the metal is full of paradoxes – as a commodity the metal is very scarce compared to others, but yet the market is always in a surplus. In trying to capture the various facets of gold, we have valued the metal against a number of metrics as well as developing our own simple regression model to determine the fair value.

Expensive by any number of measures…

At the current spot price of USD1,260 – 1,265/oz, gold screens as expensive against almost all other metrics. The average of nine metrics suggests that the fair value for gold is USD1,015/oz. At the bottom end of the range G7 per capita income (gold's affordability) would suggest a fair value of USD735 – 740/oz. At the upper end of the range and the only measure whereby gold looks cheap is treating gold as a reserve currency. Here the size of the big four central bank balance sheets (ECB, BoJ, PBoC and Fed) would suggest a fair value of USD1,650/oz. As a blunt gauge of relative value, this approach is okay, but the spread is too wide to be of any real use as a serious forecasting tool. Instead, we prefer to synthesize the main price drivers into a four factor regression model.

The current gold price suggests that heightened risk perceptions persist

Although the correlation coefficient on our model is 87%, there are very discrete periods when gold trades above the model forecast as well as below. Our interpretation is that when gold trades above, the market is going through a period of heightened risk perceptions, be it the expectation of a collapse in the global financial system or rampant inflation. Over the past 10 years, we have had an extended "bull market" period lasting 3 and half years and an equivalent "bear market" of 3 and a half years. Our model suggests that gold should be trading at USD1,185/oz, 6% below the current spot price. The current "premium" period for gold started in February 2016. We expect this environment to continue into 2018. Nevertheless, we retain our cautious to neutral view on gold with the Deutsche Bank house view on the model inputs pointing to a year end price of USD1,150/oz even when factoring in further political and financial uncertainty. Our Q4 price forecast is USD1,230/oz, which already incorporates a risk premium.

A short term insurance policy for those who want it

Although gold screens as expensive, there is a short term scenario (3 month) which would justify gold trading higher, in our view. In the near term, our US rates economist Dominic Konstam sees scope for the US 10-year bond yield to fall to 2% (before rising to 2.75% by year-end), as falling excess liquidity points to softer US growth momentum ahead. If we apply a US 10 year bond yield of 2%, a USD 2% weaker from current levels (not our FX strategist view) and the S&P500 down 5% from current levels, our fair value model points to a gold price of USD1,320/oz.

DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1. MCI (P) 083/04/2017.

A metal full of paradoxes

Pinning down the true nature of gold

Before we even try to value gold, we should try to pin down what gold actually is! At its simplest form and yes we are stating the obvious, gold is a shiny yellow metal, relatively scarce and mined from the earth's crust. Valuing the metal should then be just as easy? Gold is a simple commodity, governed by supply and demand, and valuing it should bear some relationship to the cost of digging it out of the earth? But it turns out; gold's nature is far more mercurial. Gold can be many things to many different people – a store of value, a financial asset, a medium of exchange, a currency, an insurance policy against disruptive events or global uncertainty and even a "*barbarous relic**" according to John Maynard Keynes. *(*As with any famous quote, there are suggestions that the term was not originally coined by Keynes himself, nor that he was actually referring to gold, but rather to the constraints of the gold standard at the time).* All of this means that finding an absolute valuation method which will be accepted by all is rather optimistic; and that the value of gold is more likely to be determined on a relative basis depending on the individual's perception of gold.

Whilst we contend that there is something of an art to valuing gold, we have used a more scientific framework to come up with that true fair value. There are flaws in any one of the individual approaches, and even averaging out the different approaches still seems like a bit of a cop out. However, in our table below the average of all the selected metrics would suggest that gold should trade around USD1,015/oz, with relative G7 per capita income valuing gold at USD735/oz, whilst the bloated size of the big four central bank balance sheets suggesting that gold should travel at USD1,648/oz. Our own simple four factor model points to a value of USD1,185/oz. Our conclusion is that gold is still trading at a premium versus a wide variety of metrics; 20% versus the average or 6% versus our fair value model. This suggests to us that the certainly through the lens of gold, there is a heightened perception of risk or uncertainty in the broader markets.

Figure 1: Assessing the "Fair value" of gold versus a variety of metrics

	Metric	May-17	% difference to spot
Econometric model	DB Commodity team four factor model	1,185	**-6%**
Gold as a store of value	In real terms (PPI)	735	-42%
Gold as a store of value	In real terms (CPI)	810	-36%
Gold as a store of value	Relative to per capita income	735	-42%
Gold as a store of value	Relative to the S&P500	991	-22%
Gold as a medium of exchange	Relative to the big four central bank balance sheets	1,648	30%
Gold as a commodity	Versus the global mining cost curve	1,240	-2%
Gold as a commodity	Versus copper	956	-24%
Gold as a commodity / inflation proxy	Versus crude oil	838	-34%
	Average	**1,015**	**-20%**

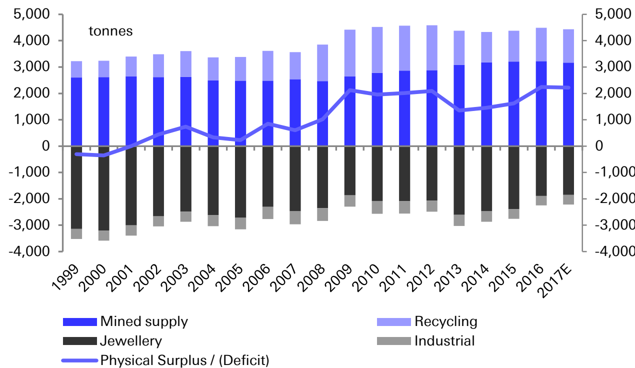
Source: Deutsche Bank

Gold as a commodity – scarce but always in surplus?

Many investors are uncomfortable with treating gold as a commodity in that gold is not "consumed" like other commodities – it is not eaten, or burned or forged as food, energy or industrial metals would be. At first glance the price of gold relative to the marginal producer on the cost curve would provide a perfect yardstick to determining the fair value of gold. There are however two

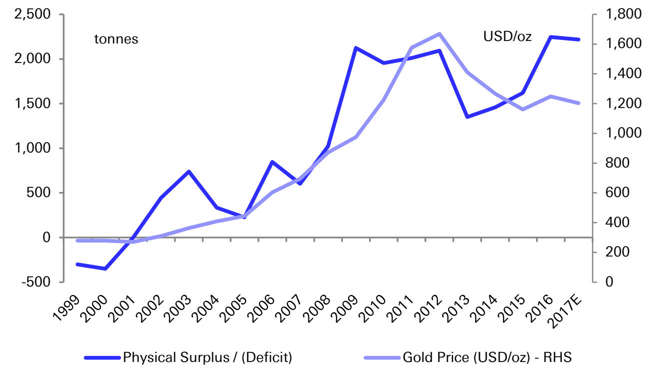
fundamental problems with this method. The first is that the conventional supply demand analysis does not work very well for gold. Partly due to its value and enduring nature (and high incentive to recycle), very little gold is actually consumed or lost every year. Thus every year, we add to the stocks of gold, with the industrial surplus being "consumed" by financial investors. We would argue that even the jewellery market is not "pure" consumption and the motivation is linked to a store of wealth.

Figure 2: The gold market has been in an industrial surplus since 2001…



Source: Deutsche Bank, GFMS, World Gold Council

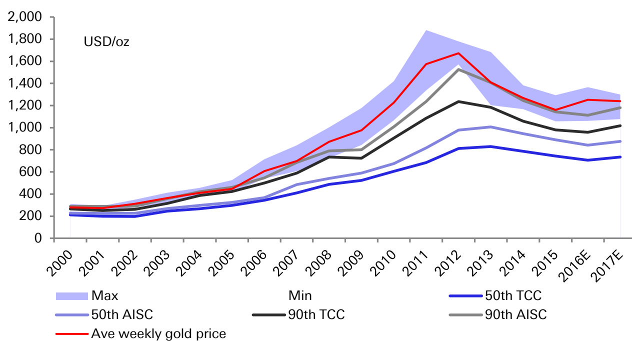
Figure 3: …and yet the gold price seems almost positively correlated to the annual surplus



Source: Deutsche Bank, GFMS, World Gold Council

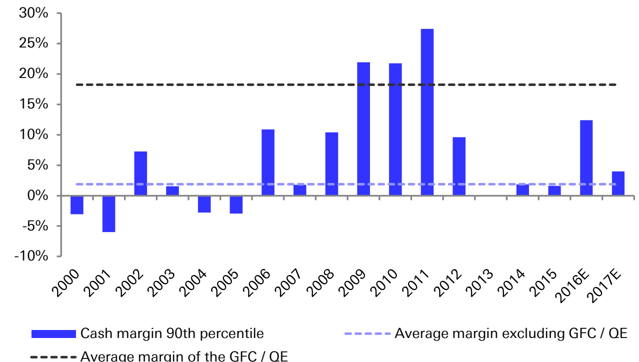
Gold's price trajectory relative to the marginal producer on the cost curve should be reasonable determinant of value. However, the mined supply of gold is relatively stable and only responds to pricing signals with a four to five year lag. Gold has been falling since 2012, the bump in 2016 notwithstanding and we only forecast mined supply to finally decline in 2017. It turns out, the gold miners are very good at adjusting their cost bases to the prevailing gold price, not least by targeting the richer parts of their ore bodies. The practice of "high grading" is much frowned upon in the industry, as certain less economic parts of the ore body may be sterilized thereby reducing the NPV of the mine. However, when faced with significant cash burn, many miners have little choice.

Figure 4: Gold price versus the cost curve: Beware of trying to glean spurious support levels. Costs adjust to the price.



Source: Deutsche Bank, Wood Mackenzie, Bloomberg Finance LP

Figure 5: The average cash (all in sustaining cost) margin of the 90th percentile gold miner versus the average weekly gold price – super normal margins post the GFC

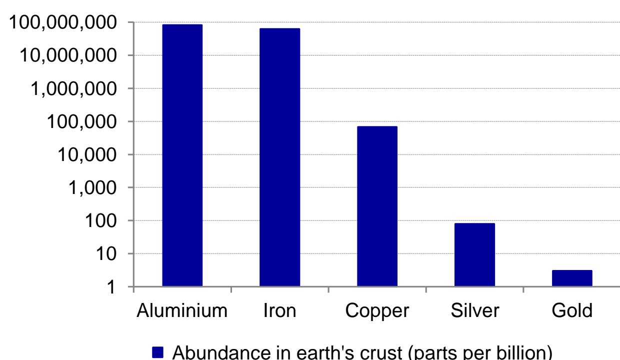


Source: Deutsche Bank, Wood Mackenzie, Bloomberg Finance LP

Our cost curve margin analysis would suggest that gold should trade anywhere between USD1,080/oz to USD 1,300/oz for 2017, with an average price around USD1,240/oz.

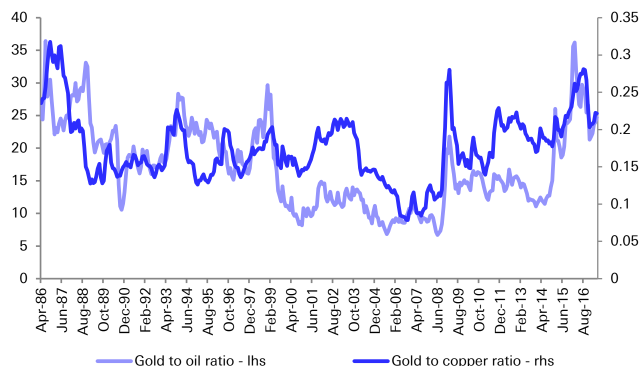
If indeed gold is a commodity, gold's perceived value relative to copper and oil should revert to a long run equilibrium level, based on the relative abundance of various commodities in the earth's crust. There is no doubt that gold is scarce relative to copper for instance (10,000x less abundant). However the perception of utility will vary according to global growth. In a high global growth environment, copper should be seen as more valuable relative to gold.

Figure 6: Gold's relative scarcity



Source: Deutsche Bank, USGS

Figure 7: Valuing gold versus crude oil and copper



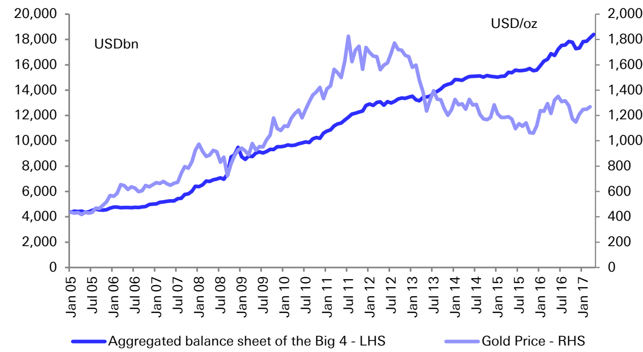
Source: Deutsche Bank, Bloomberg Finance LP

If we assume that gold reverts to the long run ratio of these two commodities, then at an oil price of USD50/bbl, gold should be trading at USD840/oz, and at a copper price of USD5,600/t, gold should be trading at USD960/oz. Gold remains expensive versus other commodities.

Gold as Money – a medium of exchange with little intrinsic value?

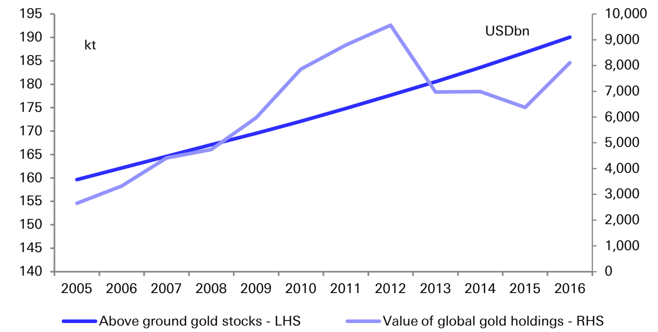
Gold is often seen as a medium of exchange and one that is officially recognized (if not publically used as such) in our view. Simply, gold is widely held by most of the world's larger central banks as a component of reserves. The ideal medium of exchange must balance the paradox of representing value while having little intrinsic value itself. Fiat currencies physically have no use other than that which is ascribed to them by government and accepted by the public. Arguably, gold is a purer form of money because it actually costs something to produce, compared to fiat currencies which cost very little. However, the concept of relative scarcity or abundance comes into play. If the rate at which fiat currencies have been printed exceeds that rate at which gold has been mined, then ceteris paribus, gold should become scarcer and rerate versus fiat currencies. Since 2005, central bank balance sheets have expanded nearly fourfold. In contrast the global above ground stocks of gold have expanded a mere 20%. The gold price has rerated accordingly, but not enough to keep the value of gold at parity with the global (big four central banks to be precise) money stock. The average ratio since 2005 between global money stocks and the value of global gold stocks is c.1.8x. In order for gold to get back to this level, the price should appreciate to USD1,648/oz, nearly USD300/oz above the current spot price.

Figure 8: The aggregate balance sheets of the big four* central banks has expanded nearly fourfold since 2005



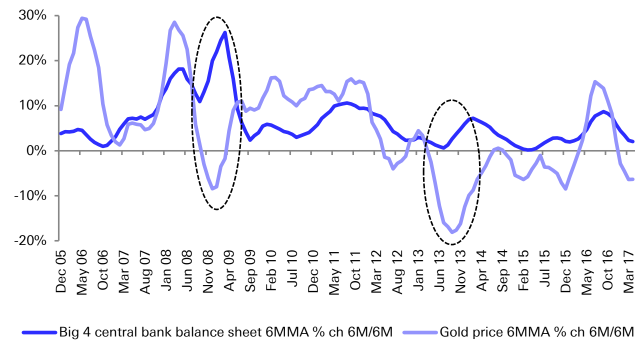
*Source: Deutsche Bank, Bloomberg Finance LP, *Fed, PBoC, BOJ and ECB*

Figure 9: In contrast Above ground gold stocks have expanded a mere 20%.



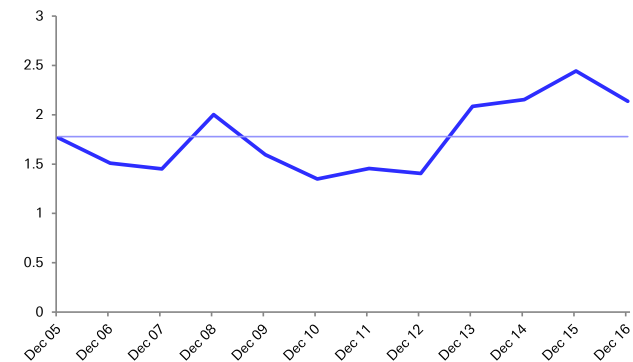
Source: Deutsche Bank, Bloomberg Finance LP

Figure 10: The gold price is sensitive to the rate at which Central Banks expand their balance sheets



Source: Deutsche Bank, Bloomberg Finance LP

Figure 11: The average ratio of the big four central banks balance sheet to the value of gold stocks is c.1.8x



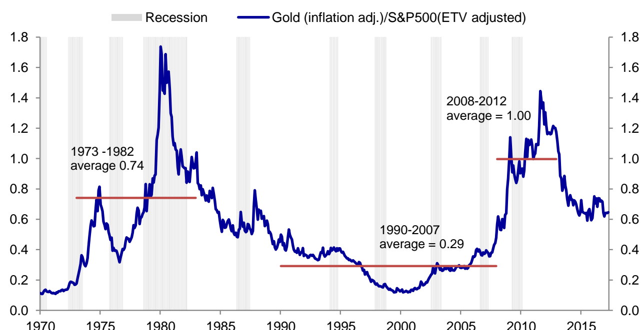
Source: Deutsche Bank, Bloomberg Finance LP

Gold as a store of value – capital appreciation but no yield

We all need ways to store the fruits of our physical or intellectual labour for use at a later stage. We all have our preferences, be it bricks and mortar, the equity markets or gold. It depends on your confidence in how well you believe your asset of choice will preserve and in many instances grow your wealth or capital. We have examined the level of the gold price in real terms i.e. versus US CPI, relative to the per capita income and versus an alternative financial asset, the US equity market.

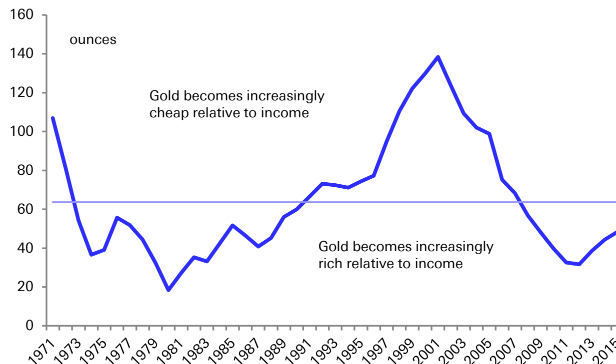
In terms of the relationship between gold and the S&P500, we have adjusted both for inflation and applied a further equity time value adjustment. Both should rise with inflation, but the S&P 500 should rise more and its retained and reinvested earnings should generate real EPS growth. We find that the adjusted gold to S&P500 ratio at 0.65x is still above its historical average of 0.54x. To bring this ratio back to its long run average would require the gold price to fall to USD990/oz. The average G7 per capita income since 1971 could buy just over 62 ounces of gold. Currently the average per capita income can purchase 47 ounces which implies that gold should trade at USD740/oz.

Figure 12: The adjusted Gold/ S&P 500 ratio – gold still looks overvalued



Source: Deutsche Bank, Bloomberg Finance LP

Figure 13: Gold relative to the G7 per capita income



Source: Deutsche Bank, Bloomberg Finance LP

The real gold price average since 1971 when the gold standard was relinquished in the US is USD735/oz in PPI adjusted terms and USD810/oz in CPI adjusted terms.

Figure 14: Gold prices in real terms (US CPI adjusted and US PPI adjusted)

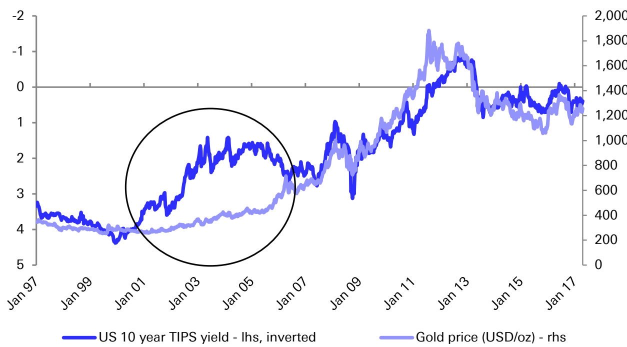
Source: Deutsche Bank, Bloomberg Finance LP

Distilling the drivers into a simple model – a non-yielding grudge purchase?

Gold is a non yielding asset for the average person. The exceptions are the Central banks who can lease out gold for a very modest return. Therefore the higher the opportunity cost of holding gold, the lower its perceived value should be. In a high interest rate (real interest rate) environment, gold's value should be perceived as lower given that the opportunity cost is higher. The only reason to hold gold then is for the anticipated price appreciation. The time when gold should appreciate in value is when global financial risk perceptions rise. Many investors perceive holding gold a bit like purchasing an insurance policy, and as we all know, insurance policies are a bit of a grudge purchase. There is no one measure that perfectly encapsulates global risk perceptions. We have used the US equity risk premium as a proxy, although volatility as measured by the VIX could have been an alternative.

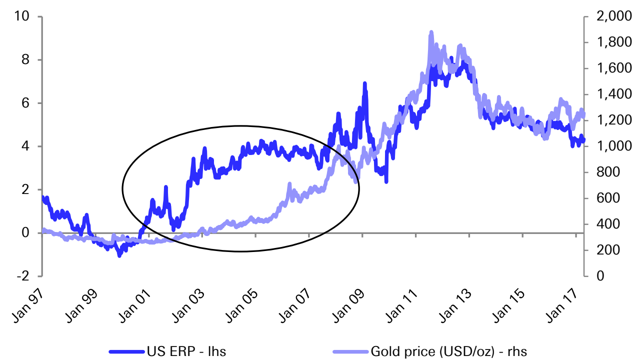
We continue to believe that the main drivers for the gold price are US real interest rates, specifically the US 10 year inflation adjusted bond yield; the US S&P equity risk premium; the USD and the weakest driver on a consistent basis, Central bank buying or selling. We could add a myriad of other variables such as M2 money supply, but we think this complicates the picture too much. This assertion does come with caveats, these four variables do not explain the gold price movements fully over all periods. The period 2001 – 2007 should have seen much higher gold prices according to both the US 10 year TIPS yield and the US equity risk premium. This period coincided with a sustained period of central bank selling which slowed down the recovery in the gold price in our view. We use the IMF holdings as a proxy as this is the one source that publishes data on a monthly basis.

Figure 15: The gold price has tracked the inverse movements of the US 10 year TIPS yield quite closely, especially over the past 10 years.



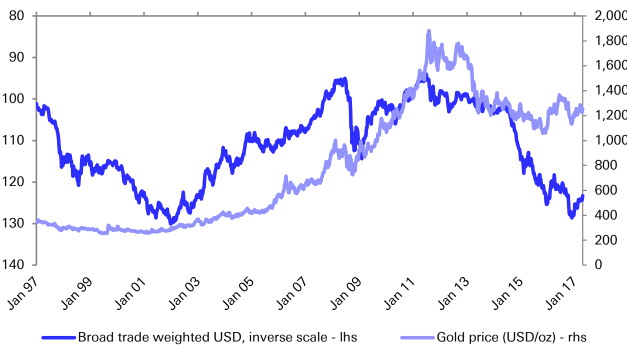
Source: Deutsche Bank, Bloomberg Finance LP

Figure 16: The gold price has also tracked the US equity risk premium fairly well. There are periods when there is quite a wide divergence.



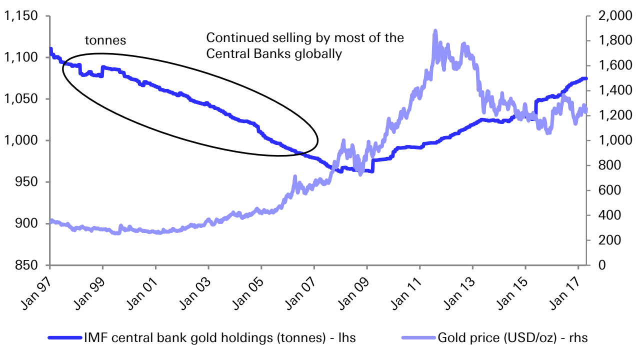
Source: Deutsche Bank, Bloomberg Finance LP

Figure 17: The USD has less explanatory powers with respect to gold. The change in the USD is perhaps more useful than the absolute level.



Source: Deutsche Bank, Bloomberg Finance LP

Figure 18: We use the IMF gold holdings as a proxy for the broader Central bank gold holdings. A sustained period of selling ended in 2008/09.

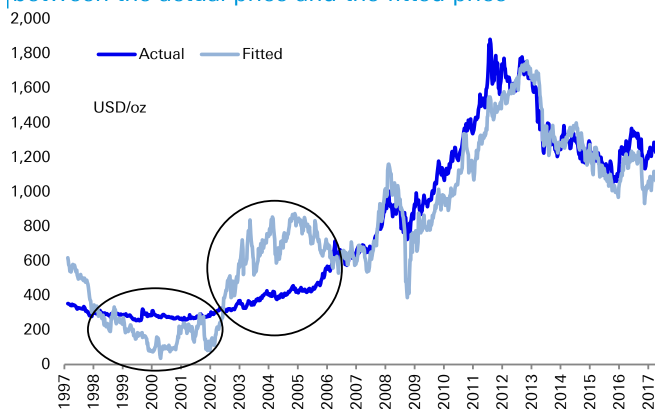


Source: Deutsche Bank, Bloomberg Finance LP

Our simple four factor model shows that there are periods when the gold price has deviated significantly from that which the four underlying drivers would suggest. In fact the model does not work very well in the period 1998 – 2008. This highlights the risk that the gold price may be driven by different factors over time. Over the last 10 years, there have been four distinct periods – two when gold has traded below the value suggested by the underlying drivers and

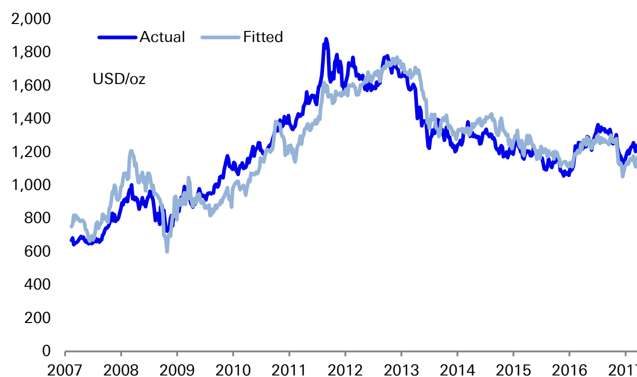
two when gold has traded above. There are a number of ways to interpret this in our view; firstly that during these periods, global risk perceptions were elevated or depressed, secondly that gold was a lead indicator to interest rates, inflation expectations and the equity market performance, or alternatively that the gold was simply in favour during certain periods (a bull market) and out of favour during others (a bear market).

Figure 19: Our 20 year four variable gold model does highlight two periods when there was a big divergence between the actual price and the fitted price



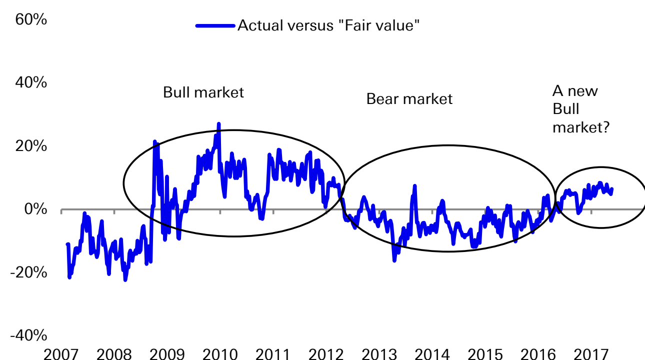
Source: Deutsche Bank, Bloomberg Finance LP

Figure 20: Our 10 year four variable gold model shows that gold is still expensive versus the underlying drivers



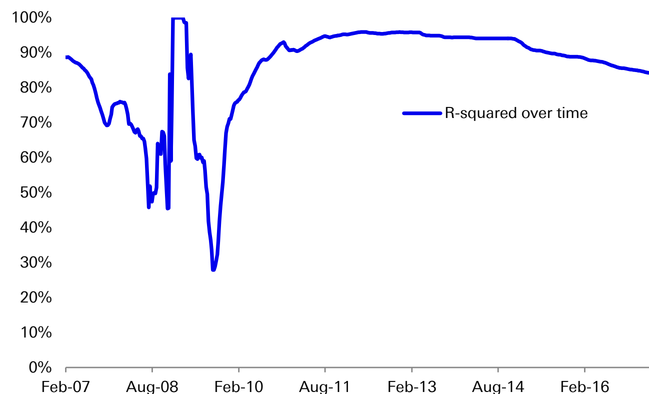
Source: Deutsche Bank, Bloomberg Finance LP

Figure 21: We note that in periods of a bull market, gold tends to trade above "fair value" and in a bear market gold tends to trade below.



Source: Deutsche Bank, Bloomberg Finance LP

Figure 22: The R-squared for our model is 87%, although we note that this faded over time.



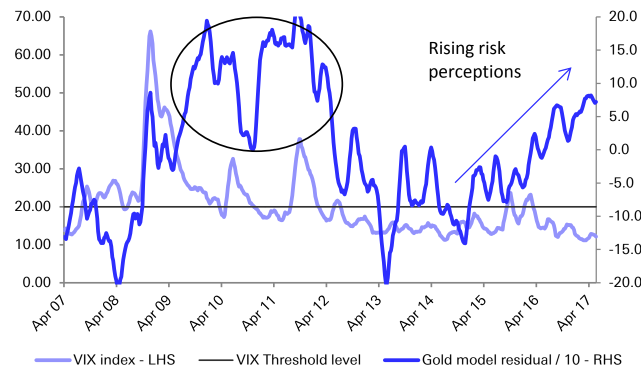
Source: Deutsche Bank, Bloomberg Finance LP

Gold as a measure of market uncertainty

In order to adjust for the current gap between the actual gold price and our model forecast, we have adjusted our model (yes all models have dummy variables to account for the periods when they don't quite work) for global risk perceptions. The adjustment we apply is simply a risk perceptions adjustment factor derived by plotting the model residual against the VIX index. We note that any significant period above 20 on the VIX index causes gold to trade above its "fair value". The scale we apply ranges from -20 to 20, with each point accounting for USD10/oz. This is the minimum and maximum range of the deviation. The current gap of USD80/oz or 8 on our scale would suggest an

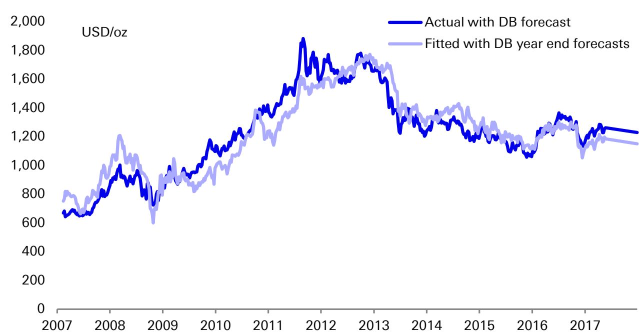
above average sense of risk or uncertainty in the market. If we apply the DB house view forecasts at year end for the US 10 year bond yield of 2.75%, a US 10 year break even of 2.15%, an S&P year-end target of 2600, IMF gold purchases of 5 tonnes and a USD up 7.6% versus the broad trade weighted basket, then gold should trade all the way down to USD1,031/oz. Even if we increase our risk perception index from 8 to 12, this brings us back to USD1,150/oz by year end. In the near term however, our US rates economist Dominic Konstam sees scope for the US 10-year bond yield to fall to 2% (before rising to 2.75% by year-end), as falling excess liquidity points to softer US growth momentum ahead. If we apply a US 10 year bond yield of 2%, a USD down 2% from current levels and the S&P500 down 5% from current levels, our fair value model points to a gold price of USD1,320/oz.

Figure 23: DB gold model residual versus the VIX index – any spike above 20 results in a period of the gold price trading above our four factor model fair value.



Source: Deutsche Bank, Bloomberg Finance LP

Figure 24: Plugging in the DB house forecasts into our gold model combined with rising uncertainty suggests that gold should trade lower into year end.



Source: Deutsche Bank, Bloomberg Finance LP

Appendix 1

Important Disclosures

*Other information available upon request

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