Is Gold Overpriced?

Sept 17, 2013

George N. Patterson
CIO
Quantamental Investments

Lingjie Ma
Director of Research
Quantamental Investments

BMO Global Asset Management
Based on

“Is Gold Overpriced?”

Lingjie Ma and George Patterson

Journal of Investing

Spring 2013, Volume 22, Number 1
Gold -- A truly unique asset

- Unlike other assets, gold truly is scarce.
- Few industrial uses even today.
- Unique supply & demand features due to hoarding & disposal.
- Most of the gold ever mined still exists in use today, in the form of jewelry or bullion. Jewelry can re-enter the market at the right price.
- Getting more difficult to find.
- Significant lead time to bring on new supply.
- Historical cornerstone of Central Bank reserves.
- Historical precedents in the manner in which it has been “used”.
We have gone from this...

Gold Price (USD / Oz) 1791 - 1967
To This...

Price of Gold (USD)
May 1968 - Aug 2013
Understanding the price of this asset

• Identify key drivers that capture the:
  - Macroeconomy
  - Monetary System
  - Financial markets
  - Other significant commodities – primarily Oil.

• Supply & Demand

• Identify proxies for these variables that:
  - Have the longest and most consistent time series.
  - Accurately capture the drivers that we consider.

• While economic data is reported with a lag, we can reverse the relationship to identify what the price of gold tells us about the current and future economy.
Key Findings

- Gold is not over priced in the recent period, except for a few months at the end of 2011.

- Very different result than if you apply a traditional ordinary least squares technique (OLS), which implies that gold has been over priced for some time.

- Strongest explanatory variables include:
  - Oil
  - US Dollar Index
  - Unemployment

- Evidence of gold being an inflation hedge is limited to a very specific time period.
Easy reserves have been mined...

We have gone from this approach

To this approach...
OLS vs. Quantile Regression

• Least squares captures how the mean of $y$ changes with $x$

• Sometimes a single mean response is not enough for various reasons:
  - Some investigations are interested in extreme values, such as how a treatment impacts the extremes of a distribution (ex: Low birth weight risk factors, Educational analysis).
  - The distribution of independent variable may be asymmetric about the mean.
  - Heteroscedasticity.

• Benefits of Quantile Regression
  - Developed as an complement to least squares regression with the explicit purpose of estimating rates of change in all parts of the distribution.
  - We can still connect with the results of more traditional regression approaches.
  - Permit one to also investigate the confidence interval in addition to the response.
  - More general than least squares – non parametric.
Ordinary Least Squares vs. Quantile Regression

**OLS:**

\[ y_i = \beta x_i + \varepsilon_i \]

\[ \hat{\beta} = \text{argmin} \sum_{i=1}^{n} (y_i - x_i \beta)^2 \]

**QR:**

\[ y(\tau) = x \beta(\tau) \quad 0 < \tau < 1 \]

\[ \hat{\beta}(\tau) = \text{argmin} \left[ \tau \sum_{y \geq \beta x} (y_i - \beta x_i) + (\tau - 1) \sum_{y < \beta x} (y_i - \beta x_i) \right] \]
### Key drivers / correlations

Pooled correlations between the price of gold & key variables in this study
April 1968 – March 2012

<table>
<thead>
<tr>
<th>Variable</th>
<th>Correlation with the Price of Gold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>0.876</td>
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<tr>
<td>Unemployment</td>
<td>0.462</td>
</tr>
<tr>
<td>DJIA</td>
<td>-0.021</td>
</tr>
<tr>
<td>TBILL</td>
<td>-0.196</td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.235</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.364</td>
</tr>
<tr>
<td>USD Index</td>
<td>-0.587</td>
</tr>
</tbody>
</table>
Hedge against a weak dollar? Yes!

US Dollar Index vs. Price of Gold
May 1968 - Dec 2012

Price of Gold, USD / Oz

USD Index

0 200 400 600 800 1000 1200 1400 1600 1800 2000

60 70 80 90 100 110 120 130 140 150
Correlated with oil? Yes!

West Texas Intermediate (USD/bbl) vs. Price of Gold (USD/Oz)
Inflation – The need for structural breaks

Real Inflation Rate (CPI) over Time

Inflation hedge? Not recently...

Inflation vs. Gold Price in different periods

- Inflation up to and including 1981
- Inflation after 1981
## Out of Sample - Economic Scenarios

<table>
<thead>
<tr>
<th>Economic Scenario</th>
<th>Real Inflation</th>
<th>Expected Inflation</th>
<th>Unemployment</th>
<th>Nominal GDP</th>
<th>T-bill yield</th>
<th>USD Index</th>
<th>WTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recession</td>
<td>3.32</td>
<td>1.54</td>
<td>8.91</td>
<td>3.9</td>
<td>0.04</td>
<td>71.16</td>
<td>98.06</td>
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<tr>
<td>Recovery</td>
<td>2.99</td>
<td>2.02</td>
<td>7.16</td>
<td>4.31</td>
<td>1.77</td>
<td>78.76</td>
<td>90.57</td>
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<tr>
<td>Median</td>
<td>2.65</td>
<td>2.49</td>
<td>5.4</td>
<td>4.71</td>
<td>3.49</td>
<td>86.36</td>
<td>83.08</td>
</tr>
<tr>
<td>Expansion</td>
<td>2.69</td>
<td>2.55</td>
<td>5.23</td>
<td>4.98</td>
<td>3.6</td>
<td>88.66</td>
<td>80.98</td>
</tr>
<tr>
<td>Boom</td>
<td>2.72</td>
<td>2.61</td>
<td>5.05</td>
<td>5.24</td>
<td>3.7</td>
<td>90.96</td>
<td>78.87</td>
</tr>
</tbody>
</table>
Out of Sample Economic Indicator

May 7th, 2013

June 27, 2013

Sept 17, 2013

recession    recovery    median    expansion    boom

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