Gold and Fear

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Investment Strategy Advisor, Man Group, plc

January 30, 2017
Credits

• Based on my joint research, *The Golden Dilemma*, with my long-time coauthor, Claude Erb

• Along with our recent 2017 paper, *The Golden Constant*
Buffett 2012

- What motivates most gold purchasers is their belief that the ranks of the fearful will grow. During the past decade that belief has proved correct. Beyond that, the rising price has on its own generated additional buying enthusiasm, attracting purchasers who see the rise as validating an investment thesis. As “bandwagon” investors join any party, they create their own truth – for a while.”
Gold is a very underowned asset, even though gold has become much more popular. If you ask any central bank, any sovereign wealth fund, any individual what percentage of their portfolio is in gold in relationship to financial assets, you'll find it to be a very small percentage. It's an imprudently small percentage, particularly at a time when we're losing a currency regime.
Goals

• Lots of stories ... very little scientific research
• Is gold a reliable hedge for various “fears”? 
• How should we think about the “fair price” of gold? 
• What role – if any – does gold play in a well diversified portfolio?
1. Fear of Inflation

Many reasons to fear future unexpected inflation

Global official reserves of paper currency have exploded relative to gold:

Central bank balance sheets have expanded aggressively:

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1. Fear of Inflation

Many reasons to fear future unexpected inflation

**Peak Value**
Fed officials are trying to decide when to reduce the value of the central bank’s holdings

- $5 trillion
- 4 trillion
- 3 trillion
- 2 trillion
- 1 trillion
- 0 trillion (recession)

Federal Reserve balance sheet

$4.45 trillion

Note: Weekly data, not seasonally adjusted

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*As of Jan. 25, 2017  Source: St. Louis Federal Reserve  THE WALL STREET JOURNAL.
1. Fear of Inflation


Harvey: Gold and Fear 2017
1. Fear of Inflation

1975-2012 (Annual)


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1. Fear of Inflation

The real price of gold

High

Average real price of gold

Monthly real price

Low
1. Fear of Inflation

The nominal price of gold

Expected gold price based on highest real price

Expected gold price based on average real price

Based on lowest real price

Current gold price

$2,096

$840

$353
1. Fear of Inflation

**Opinion: Gold has no business being this expensive**

Published: Feb 3, 2016 8:46 a.m. ET

Both inflation and investor sentiment suggest the precious metal ought to be cheaper

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**Gold still overvalued**
The ratio of gold's price to the Consumer Price Index

Source: Claude Erb
1. Fear of Inflation

Current real price = 5.50
1. Fear of Inflation

Data source: Economic History (www.eh.net)
1. Fear of Inflation

<table>
<thead>
<tr>
<th></th>
<th>U.S Army Captain</th>
<th>Roman Centurion</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>$50,497</td>
<td>$52,085</td>
<td>0.00%</td>
</tr>
<tr>
<td>Price of Gold</td>
<td>$1,350</td>
<td>$1,350</td>
<td></td>
</tr>
<tr>
<td>Ounces of Gold</td>
<td>37.41</td>
<td>38.58</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

*Roman salaries from time of Emperor Augustus, 27BC-AD14
Centurion Pay=3,750 Denarii; 1 (gold) Aureus=25 Denarii;
Aureus=7.85 grams (24ct); 31.103 grams/toz
1. Fear of Inflation

Bottom Line

• Not effective short-term hedge of unexpected inflation
• Not effective long-term (10-year) hedge
• May be effective over very, very long-term
• May be effective in hyperinflationary situation -- assuming real price of gold stable
2. Fear of Currency Depreciation

Two ways to think of currency hedge

1. *If I hold gold, it protects me against unexpected currency fluctuations*
   - For example, if dollar depreciates by 10% against the yen and gold increases by 10%, I am protected

2. *If I hold gold, it protects me against currency debasement (will return to this)*
   - Could be slow debasement or large (massive printing), e.g. large gold demand in the Confederate States of America
2. Fear of Currency Depreciation

Should be straight line if gold is a good inflation hedge

Data sources: IMF, Bloomberg. All times series normalized to an initial value of 1.0.
3. Is Gold like a Bond?

• Perhaps the same people buying gold at $1,900 were also locking in -2% 10-year real yields
• Another possible fear trade: rates are low that is bad news for the economy and gold may be attractive to some
3. Is Gold like a Bond?

Sept. 6, 2013.
Non-Farm Payrolls
Announcement:
Unemployment rate drops to 7.3% (lowest in 5 years).
Consistent with the Federal Reserve (September 18) potentially reducing QE.
Yields up -- Gold down

Data source: Bloomberg
3. Is Gold like a Bond?

Sept. 18, 2013.
FOMC No Taper Announcement:
Federal Reserve to continue bond buying (QE) program. Yields down -- Gold up

Data source: Bloomberg
3. Is Gold like a Bond?

Dramatic drop in intraday T-bond yield (Treasury flash crash): yields down -- Gold up

Data source: Reuters
3. Is Gold like a Bond?

Nov. 6, 2015.

*Unexpected 100,000 increase in NFPs*

*Increase probability of December Fed tightening. Rates up-Gold down.*
3. Is Gold like a Bond?

February 7, 2016.
Rates fall – gold rises.

Data source: Reuters
3. Is Gold like a Bond?

Beware of history ....

Data source: Bloomberg

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3. Is Gold like a Bond?

Beware of history ....

Data source: Bloomberg
Harvey: Gold and Fear 2017
3. Is Gold like a Bond?

If you live by the sword, you die by the sword...

- If you believe that gold will act like a bond, then a return to 4% interest rates means sub $1,000 gold
4. Is Gold a Safe Haven?

The Hoxne Hoard

Source: http://www.britishmuseum.org/explore/highlights/highlight_objects/pe_prb/t/the_hoxne_hoard.aspx
4. Is Gold a Safe Haven?

The Hoxne Hoard “Un-Safe Haven”

Source: [http://www.britishmuseum.org/explore/highlights/highlight_objects/pe_prb/t/the_hoxne_hoard.aspx](http://www.britishmuseum.org/explore/highlights/highlight_objects/pe_prb/t/the_hoxne_hoard.aspx)
4. Is Gold a Safe Haven?

"When Timur sacked Aleppo and Damascus in 1400, it didn't help to have your savings in gold. You lost your life and your gold."

Faber (2009)
4. Is Gold a Safe Haven?

Data sources: Bloomberg and Ibbotson Associates

If S&P<\(-10\%)$, Gold \(-7\%) return
4. Is Gold a Safe Haven?

Gold “stash” hard to move around

<table>
<thead>
<tr>
<th>Dollar Amount</th>
<th>$1,200</th>
<th>$1,400</th>
<th>$1,600</th>
<th>$1,800</th>
<th>$2,000</th>
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<td>$1,000,000</td>
<td>57</td>
<td>49</td>
<td>43</td>
<td>38</td>
<td>34</td>
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<tr>
<td>$2,000,000</td>
<td>114</td>
<td>98</td>
<td>86</td>
<td>76</td>
<td>69</td>
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<tr>
<td>$3,000,000</td>
<td>172</td>
<td>147</td>
<td>129</td>
<td>114</td>
<td>103</td>
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<td>$4,000,000</td>
<td>229</td>
<td>196</td>
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<td>153</td>
<td>137</td>
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<td>$5,000,000</td>
<td>286</td>
<td>245</td>
<td>215</td>
<td>191</td>
<td>172</td>
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<tr>
<td>$6,000,000</td>
<td>343</td>
<td>294</td>
<td>257</td>
<td>229</td>
<td>206</td>
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<tr>
<td>$7,000,000</td>
<td>401</td>
<td>343</td>
<td>300</td>
<td>267</td>
<td>240</td>
</tr>
<tr>
<td>$8,000,000</td>
<td>458</td>
<td>392</td>
<td>343</td>
<td>305</td>
<td>275</td>
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<tr>
<td>$9,000,000</td>
<td>515</td>
<td>441</td>
<td>386</td>
<td>343</td>
<td>309</td>
</tr>
<tr>
<td>$10,000,000</td>
<td>572</td>
<td>490</td>
<td>429</td>
<td>381</td>
<td>343</td>
</tr>
</tbody>
</table>
4. Is Gold a Safe Haven?

For Brazil 1980-2000, the real price of gold fell by -70%.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cruzeiro/USD</td>
<td>65.50</td>
<td>5,362,500,000,000</td>
<td>81,870,229,007.63</td>
<td>251.28%</td>
</tr>
<tr>
<td>Gold (USD)</td>
<td>589.75</td>
<td>272.25</td>
<td>0.46</td>
<td>-3.79%</td>
</tr>
<tr>
<td>Gold (Cruzeiro)</td>
<td>38,628.63</td>
<td>1,459,940,625,000</td>
<td>37,794,268,499.07</td>
<td>237.96%</td>
</tr>
<tr>
<td>Inflation Index (IMF)</td>
<td>86.50</td>
<td>11,092,888,909,767.90</td>
<td>128,238,525,233.73</td>
<td>259.25%</td>
</tr>
<tr>
<td>Real Price Ratio</td>
<td>446.56</td>
<td>131.61</td>
<td>0.29</td>
<td>-5.93%</td>
</tr>
</tbody>
</table>

But -70% is better than -100% (holding local currency).
4. Is Gold a Safe Haven?

VIX, the Traditional “Index of Fear”

No correlation, with real or nominal price of gold.

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4. Is Gold a Safe Haven?

The Policy Uncertainty Index: The New Fear Index

Strong correlation, 0.66 with real or nominal gold

Harvey: Gold and Fear 2017
4. Is Gold a Safe Haven?

Policy Uncertainty Index: The New Fear Index

But...

• Given the current value of the PUI, the price of gold should be $800/toz
5. Supply and Demand

Supply

• 171,300 metric tons mined since start of civilization
• Entire world stock would be a 67 foot cube
• USGS estimates 51,000 mts likely still in ground – so 76% of potential has already been mined

http://www.gold.org/about_gold/story_of_gold/numbers_and_facts/
5. Supply and Demand

Supply

• About 2,500 mts mined every year
• 80% of world supply mined since 1900 (1.5% increase per year)
• Given USGS estimates of remaining gold, about 20 years supply.
5. Supply and Demand

Annual Global Mine Production and the Total Supply of Gold

Data source: U.S. Geological Service and World Gold Council
5. Supply and Demand

![Sectoral Gold Holdings](image)

Estimated Above Ground Stocks of Gold
(Metric Tons)

Jewelry: 90,000
Private investment: 40,000
Central Banks: 30,000
Fabrication: 20,000
Other: 5,000


Harvey: Gold and Fear 2017
5. Supply and Demand

5. Supply and Demand

Chinese FX Reserves in Tons of Gold

If China used FX Reserves to buy gold they would take 1/3 of world supply

Data sources: Bloomberg
Harvey: Gold and Fear 2017

Note: 32,150.75 troy oz in metric tonne
5. Supply and Demand

World Official Gold Reserves
Source: IMF International Financial Statistics, World Gold Council

![Graph of World Official Gold Reserves]

Data source: World Gold Council
http://www.gold.org/statistics#reserves-statistics

Harvey: Gold and Fear 2017
5. Supply and Demand

Official gold holdings peaked at about 20,000 metric tons following Roosevelt’s Executive Order 6102 outlawing private ownership of gold.


Data source: World Gold Council

Harvey: Gold and Fear 2017
5. Supply and Demand

Central Bank Gold Reserves, January 2017

5. Supply and Demand

Change In Gold Reserves March 2000 to September 2016

Excludes 63 countries where |change| < 10 mt (which includes U.S. -5.3)

Harvey: Gold and Fear 2017

Data source: World Gold Council (Quarterly Gold and FX Reserves 4Q 2011)
5. Supply and Demand

![Graph showing ETF and similar products gold holdings in tonnes by region as of 30-Dec-16](image)

Source: Respective ETP providers, Bloomberg, LBMA, World Gold Council

Notes: Gold holdings are as reported by the ETP/ETC issuers. Where data is unavailable, holdings have been calculated using reported AUM.

Data source: World Gold Council (Quarterly Gold and FX Reserves 4Q 2011)
5. Supply and Demand

### BRIC Central Bank Gold Reserves

<table>
<thead>
<tr>
<th></th>
<th>2010 GDP (US $ Billions)</th>
<th>2010 Population (Millions)</th>
<th>2010 Central Bank Gold Reserves (m tons)</th>
<th>2010 Gold/GDP Ratio</th>
<th>2010 Gold/Pop. Ratio</th>
<th>Estimated Reserves if move to US (m tons)</th>
<th>Estimated Reserves if move to US (m tons)</th>
<th>Estimated Reserves if move to CH (m tons)</th>
<th>Estimated Reserves if move to CH (m tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>14,582</td>
<td>317.6</td>
<td>8,133</td>
<td>0.56</td>
<td>25.61</td>
<td>8,133</td>
<td>8,133</td>
<td>28,957</td>
<td>43,464</td>
</tr>
<tr>
<td>Switz.</td>
<td>524</td>
<td>7.6</td>
<td>1,040</td>
<td>1.99</td>
<td>136.85</td>
<td>292</td>
<td>195</td>
<td>1,040</td>
<td>1,040</td>
</tr>
<tr>
<td>Brazil</td>
<td>2,088</td>
<td>199.5</td>
<td>34</td>
<td>0.02</td>
<td>0.17</td>
<td>1,165</td>
<td>5,109</td>
<td>4,146</td>
<td>27,302</td>
</tr>
<tr>
<td>Russia</td>
<td>1,480</td>
<td>140.4</td>
<td>811</td>
<td>0.55</td>
<td>5.78</td>
<td>825</td>
<td>3,596</td>
<td>2,939</td>
<td>19,214</td>
</tr>
<tr>
<td>India</td>
<td>1,729</td>
<td>1,316.3</td>
<td>558</td>
<td>0.32</td>
<td>0.42</td>
<td>964</td>
<td>33,709</td>
<td>3,433</td>
<td>180,139</td>
</tr>
<tr>
<td>China</td>
<td>5,879</td>
<td>1,382.2</td>
<td>1,054</td>
<td>0.18</td>
<td>0.76</td>
<td>3,279</td>
<td>35,397</td>
<td>11,673</td>
<td>189,157</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>11,630</td>
<td></td>
<td></td>
<td>14,659</td>
<td>86,139</td>
<td>52,188</td>
<td>460,316</td>
</tr>
<tr>
<td>BRIC Only</td>
<td></td>
<td></td>
<td>2,457</td>
<td></td>
<td></td>
<td>6,233</td>
<td>77,811</td>
<td>22,191</td>
<td>415,812</td>
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<tr>
<td>CBGA Years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>188</td>
<td>49</td>
<td>1033</td>
</tr>
</tbody>
</table>

Data sources: World Gold Council, International Monetary Fund and Bloomberg

Harvey: Gold and Fear 2017
## 6. Gold in Asset Allocation

<table>
<thead>
<tr>
<th></th>
<th>&quot;Global&quot; Market Capitalization (US $ Trillions)</th>
<th>&quot;Global&quot; Market Capitalization (Share of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Available Gold</td>
<td>Available Gold</td>
</tr>
<tr>
<td></td>
<td>All Gold</td>
<td>Central Bank &amp; Investment</td>
</tr>
<tr>
<td></td>
<td>Only Investment</td>
<td>Only Investment</td>
</tr>
<tr>
<td>Global Equity</td>
<td>$51.40</td>
<td>$51.40</td>
</tr>
<tr>
<td>Global Fixed Incom</td>
<td>$41.20</td>
<td>$41.20</td>
</tr>
<tr>
<td>Gold</td>
<td>$9.14</td>
<td>$3.40</td>
</tr>
<tr>
<td>Total</td>
<td>$101.74</td>
<td>$96.00</td>
</tr>
</tbody>
</table>

| Required Tons of Gold    | 171,300                                        | 63,614                                          | 33,588 |
| Percent of Existing Gold Stock | 100%                                          | 37%                                            | 20%    |
| CBGA-like Annual Purchases (Years) | 417                                            | 155                                            | 82     |
| Likelihood               | Impossible                                    | Impractical                                    | Unlikely |

Data sources: Bloomberg, Barclays

Harvey: Gold and Fear 2017
Conclusions

1) If you fear a burst of inflation, gold will be an unreliable hedge. Gold is too volatile.

2) Gold appears to hold its value over the long-term, i.e. centuries.

3) If you believe the real price of gold is constant, the gold price should be $800.

4) Gold currently acting like a bond. If it continues to and interest rates go to 4%, the price of gold would drop below $1,000.

5) Maybe gold could offer protection against a worldwide disaster – but who knows, it has never been tested.
Conclusions

6) Gold is unrelated to VIX but positively correlated with the Policy Uncertainty Index. However, PUI implies a price of gold of $800 today.

7) Given limited production, emerging markets could exert a substantial upward pressure on price. Supposedly, Indians have hoarded 20,000 mts.

8) Gold has a role in a diversified commodity portfolio.

9) If all investors held gold in terms of its weight in “market portfolio”, substantial upward pressure on price

10) Beware of technological change
Conclusions

- Near-earth asteroid Eros might have 125,000 mts (*Science*, 2009)
**Harvey: Gold and Fear 2017**

### Asteroid 162385 (2000 BM19)

**Composition**
- Platinum
- Nickel

**Upcoming Approaches**
- Jan 21, 2014: 0.425 AU
- Jan 16, 2014: 0.415 AU
- Jan 24, 2016: 0.163 AU
- Oct 03, 2007: 0.475 AU
- Feb 23, 2018: 0.499 AU
- Jan 23, 2021: 0.479 AU
- Jan 22, 2021: 0.489 AU
- Jan 13, 2023: 0.305 AU
- Oct 10, 2024: 0.424 AU
- Feb 23, 2025: 0.354 AU
- Jan 18, 2026: 0.301 AU

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### Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Overall Score</th>
<th>Value ($)</th>
<th>Est. Profit ($)</th>
<th>Accessibility Score</th>
<th>Class</th>
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</thead>
<tbody>
<tr>
<td>2000 BM19</td>
<td>O</td>
<td>2,438,169</td>
<td>37.77 trillion</td>
<td>7.25 trillion</td>
<td>6.859</td>
<td>ATE</td>
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<tr>
<td>Vishnu</td>
<td>O</td>
<td>1,986,264</td>
<td>37.81 trillion</td>
<td>5.29 trillion</td>
<td>5.920</td>
<td>APO (PHA)</td>
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<tr>
<td>1989 UQ</td>
<td>B</td>
<td>643,937</td>
<td>12.98 trillion</td>
<td>1.78 trillion</td>
<td>5.939</td>
<td>ATE (PHA)</td>
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<tr>
<td>Heracles</td>
<td>O</td>
<td>339,566</td>
<td>36.63 trillion</td>
<td>2.35 trillion</td>
<td>3.929</td>
<td>APO</td>
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<tr>
<td>1988 XB</td>
<td>B</td>
<td>267,159</td>
<td>12.85 trillion</td>
<td>1.37 trillion</td>
<td>4.816</td>
<td>APO (PHA)</td>
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<tr>
<td>2001 CC21</td>
<td>L</td>
<td>229,212</td>
<td>5.65 trillion</td>
<td>849.88 billion</td>
<td>6.108</td>
<td>APO</td>
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<tr>
<td>Poseidon</td>
<td>O</td>
<td>217,813</td>
<td>37.49 trillion</td>
<td>2.05 trillion</td>
<td>3.063</td>
<td>APO</td>
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<tr>
<td>1997 RT</td>
<td>O</td>
<td>201,123</td>
<td>37.49 trillion</td>
<td>2.01 trillion</td>
<td>2.993</td>
<td>AMO</td>
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<tr>
<td>2000 CE59</td>
<td>L</td>
<td>196,959</td>
<td>5.13 trillion</td>
<td>733.29 billion</td>
<td>5.797</td>
<td>APO (PHA)</td>
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<tr>
<td>Phaethon</td>
<td>B</td>
<td>182,505</td>
<td>12.79 trillion</td>
<td>1.93 trillion</td>
<td>2.859</td>
<td>APO (PHA)</td>
</tr>
<tr>
<td>1994 AH2</td>
<td>O</td>
<td>134,766</td>
<td>35.85 trillion</td>
<td>1.53 trillion</td>
<td>4.148</td>
<td>APO (PHA)</td>
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<tr>
<td>1999 KV4</td>
<td>B</td>
<td>113,672</td>
<td>12.46 trillion</td>
<td>855.68 billion</td>
<td>3.573</td>
<td>AMO</td>
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<tr>
<td>Anteros</td>
<td>L</td>
<td>108,724</td>
<td>5.23 trillion</td>
<td>569.22 billion</td>
<td>4.703</td>
<td>AMO</td>
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<tr>
<td>2002 EA</td>
<td>L</td>
<td>104,012</td>
<td>5.19 trillion</td>
<td>517.92 billion</td>
<td>4.644</td>
<td>APO</td>
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<tr>
<td>1999 JV6</td>
<td>Xc</td>
<td>75,503</td>
<td>1.44 trillion</td>
<td>249.54 billion</td>
<td>6.403</td>
<td>APO (PHA)</td>
</tr>
<tr>
<td>Nio</td>
<td>C</td>
<td>63,637</td>
<td>&gt;100 trillion</td>
<td>9.60 trillion</td>
<td>1.471</td>
<td>MBA</td>
</tr>
<tr>
<td>2002 AL31</td>
<td>X</td>
<td>61,505</td>
<td>1.52 trillion</td>
<td>228.13 billion</td>
<td>5.867</td>
<td>APO</td>
</tr>
<tr>
<td>1992 BF</td>
<td>Xc</td>
<td>56,226</td>
<td>1.64 trillion</td>
<td>205.38 billion</td>
<td>5.067</td>
<td>ATE</td>
</tr>
<tr>
<td>2000 CO101</td>
<td>Xc</td>
<td>53,095</td>
<td>1.43 trillion</td>
<td>195.38 billion</td>
<td>5.711</td>
<td>APO (PHA)</td>
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<tr>
<td>1996 FG3</td>
<td>C</td>
<td>51,672</td>
<td>1.62 trillion</td>
<td>173.38 billion</td>
<td>6.303</td>
<td>APO (PHA)</td>
</tr>
<tr>
<td>Pyla</td>
<td>X</td>
<td>47,041</td>
<td>&gt;100 trillion</td>
<td>29.54 trillion</td>
<td>1.330</td>
<td>MBA</td>
</tr>
</tbody>
</table>
What if the greatest discovery of natural resources didn’t take place on Earth?

There are near-limitless numbers of asteroids and more being discovered every year. More than 1,500 are as easy to reach as the Moon and are in similar orbits as Earth. Asteroids are filled with precious resources, everything from water to platinum. Harnessing valuable minerals from a practically infinite source will provide stability on Earth, increase humanity’s prosperity, and help establish and maintain human presence in space.

OUR VISION

Planetary Resources is bringing the natural resources of space within humanity’s economic sphere of influence, propelling our future into the 21st century and beyond. Water from asteroids will fuel the in-space economy, and rare metals will increase Earth’s GDP.

Asteroids are the low-hanging fruit of the Solar System. There are close to 9,000 near-Earth asteroids, and nearly 1,000 more are discovered every year.

Low cost commercial robotic spacecraft will explore asteroids and determine their position, composition, and accessibility of resources.

Asteroid mining will allow the delivery of resources to the point of need, be it a fuel depot orbiting the Earth, or elsewhere in the Solar System.
Conclusions

- Fritz Haber, Nobel Prize, Chem 1918
- Proposed paying Germany’s WWI reparations by extracting gold from ocean water
- Gold in ocean is 6 parts per trillion or 6 kg for 1 km³
- Oceans = 1.37 billion km³
- Gold in oceans = 8.22 million metric tons
- Value = $423 trillion at $1,600 per troy oz