

## The Aboveground Gold Stock: Its Importance and Its Size

**James Turk**

*with assistance from Juan Castañeda*



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## The GoldMoney Foundation

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The aim of the Foundation is to promote and support educational initiatives that expound the principles of sound money. Its scope is global. Thus, it is expected that over time the Foundation will become an influential addition to the well-established tradition of leadership in sound money that has been an important building block of GoldMoney Network Limited.

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## 1. Abstract

With the rising [gold price](#) this past decade, there has been some discussion about the size of gold's aboveground stock, but little recent analysis of it. To provide an accurate accounting of this stock and to explain its importance, I have therefore prepared this study for the GoldMoney Foundation. I would like to acknowledge, with sincere gratitude, the assistance of Juan Castañeda<sup>2</sup> of the University of Buckingham in the United Kingdom, who provided valuable research for this project.

Gold has been money since pre-history. Even though it does not actively circulate as currency today<sup>3</sup>, it is useful in economic calculation, one of the most important functions of money. Its monetary role is the principal reason gold is highly valued throughout the world.

The primary evidence that gold is money arises from the fact that it is accumulated. In other words, gold does not disappear like consumable goods. Gold's usefulness — and hence, its value — does not arise as an item of consumption. It arises from gold's monetary usefulness.

The purpose of this study is twofold. First, it examines the importance of gold's aboveground stock. Because it is money, its aboveground stock — or simply the “gold stock”, as it will be referred to hereafter — can be viewed as gold's M3. It is the world's total quantity of gold money.<sup>4</sup>

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<sup>2</sup> <http://www.goldmoney.com/author/juan-castaneda.html>

<sup>3</sup> Gold's use as currency has been impeded by government interference such as taxes as well as other means. For example, in the 20th century some governments made it illegal to own gold. Additionally, when a currency is overvalued compared to another, the undervalued one will disappear from circulation to be saved, which explains what is happening to gold, while the overvalued money continues to be used as currency. Thus, in contrast to Gresham's Law, it is not necessary for an “exchange rate [to be] set by law” for bad (overvalued) money to drive good (undervalued) money out of circulation. [http://en.wikipedia.org/wiki/Gresham's\\_law](http://en.wikipedia.org/wiki/Gresham's_law)

<sup>4</sup> Most, but not all of the gold in the aboveground stock has been fabricated into money, namely, coins, bars and high-karat jewellery, which is a monetary form particularly popular in Asia. Because gold is not consumed and is highly valued, gold in non-monetary uses can be recycled and fabricated into money. These applications should be considered as near-money and included in gold's M3.

The second goal is to analyse and determine the size of the gold stock. This study concludes that the gold stock is 155,244 tonnes, which is significantly less than the 171,300 tonnes widely reported. This difference of 16,056 tonnes at the current price of \$1700 per ounce has a nominal value of \$877 billion.

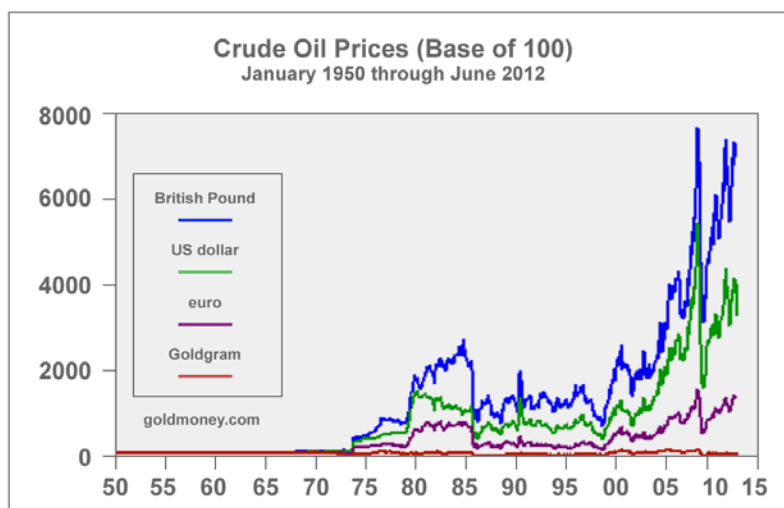
## 2. An introduction to gold

Gold is different from all other goods in one unique way. Everything we humans produce to improve our standard of living gets consumed and disappears. Soybeans and crude oil are clear examples. But even base metals like copper disappear in the sense that they are dispersed in millions of applications that are often thrown away rather than recycled when no longer useful. Given enough time and neglect, even a building will disappear.

In contrast, gold does not disappear. It gets accumulated, and as a consequence essentially all of the gold mined throughout history still exists. Each fragment of any size and however formed is part of the total stock. This stock grows and perdures because gold is useful, meaning it has value.

Gold's usefulness, however, does not arise from consumption like other goods. Rather, its usefulness comes from gold's unique attributes that enable it to excel in economic calculation. By measuring the value of goods and services effectively, and expressing this measurement as a price, gold is money. This point is made clear in the following chart, which presents a base-100 analysis of crude oil prices in terms of three national currencies and goldgrams.

Chart 1



The price of crude oil in terms of gold has been fairly consistent for the past 60 years. In other words, an ounce or a gram of gold can today buy basically the same amount of crude oil it bought anytime over the past six decades, a feat not matched by any national currency. The purchasing power of these currencies has been consistently eroding since the last remnants of the gold standard were abandoned in 1971.

So gold is accumulated because it is money. And indeed, most gold is held in monetary form: coins, bars and high-karat jewellery. People take great care to ensure that it is not lost because of its high value. Even a small piece of broken gold jewellery gets put in a lady's dresser drawer until it can be repaired or replaced. As a result, little gold has been lost through history. The amount lost in shipwrecks or from attrition when gold coins circulated from hand to hand is inconsequential.<sup>5</sup>

### 3. The importance of the gold stock

All prices are a function of supply and demand. Because it is accumulated and not consumed, the aboveground stock of gold is its supply.

The amount of newly mined gold each year is small compared with the existing stock. Therefore, annual mine production does not significantly impact the gold price,<sup>6</sup> i.e., its purchasing power (which is the correct expression because gold is money, not a consumable commodity).

Given that gold does not have different grades — the metal mined thousands of years ago is indistinguishable from that mined yesterday — all gold that is above ground is substitutable for newly mined gold. In other words, at some price, present owners of gold may choose to exchange their gold for a national currency or use their gold to purchase some good or service. When viewed this way, it is clear that gold functions like other monies, even though gold has unique attributes that differentiate it.

One of these is that gold is a tangible asset. Consequently, owners of gold do not have counterparty risk, which explains why gold is a well recognised safe-haven. Its status contrasts to all paper currencies as well as money on deposit in banks, the risks of which have been made clear by the ongoing financial crisis that began with the collapse of Northern Rock bank in the United Kingdom in 2007. Another unique attribute of gold is explained below.

### 4. Gold and the quantity theory of money

We know the quantity of various national currencies, whether M1, M2 or M3, the latter being the total stock of a particular currency. Because of this study, we now have a reliable measure of the gold stock — its M3. This knowledge is important because gold's M3 explains why the purchasing power of gold remains relatively constant over long periods of time, as illustrated

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<sup>5</sup> This study will ignore the amount of metal lost in shipwrecks or coin abrasion. Modern technology has allowed the recovery of metal from many ancient shipwrecks. What has not been recovered is inconsequential compared with today's total stock. Jacob (1831) measured the abrasion of actively circulating gold sovereigns and concluded that losses amounted to approximately 0.1% annually, and that this amount could be reduced by adding hardening alloys to a coin. Given that paper certificates were often used in place of coin and further, that much gold remained in uncirculated bar form, the historical loss from coin attrition is not significant, particularly when compared with the size of today's gold stock.

<sup>6</sup> See: "Does Gold Mining Matter" by Robert Blumen, <http://mises.org/daily/3593> See also: <http://www.goldmoney.com/podcast/robert-blumen-talks-to-james-turk-about-gold-supply-and-demand-dynamics.html>

in Chart 1 above. No national currency has matched gold's consistency in providing a stable purchasing power because gold's M3 grows approximately at the same rate as world population and new wealth creation,<sup>7</sup> which are key components critical to determining the supply and demand for money.<sup>8</sup>

With this study's new estimate, changes in gold's M3 can now be accurately compared with changes in the M3 of various currencies. The result will show the change in relative purchasing power of currencies in comparison with that of gold as explained by the quantity theory of money, which states that the "money supply has a direct, proportional relationship with the price level."<sup>9</sup> For example, when M3 of a currency grows faster than gold's M3, the former is being debased, and the price of gold in that currency (i.e., gold's purchasing power) will rise, assuming demand for both gold and the currency remain unchanged.

To facilitate this comparison, Table 1 presents several measures of the annual growth rate of the gold stock and the US dollar's M2 over different periods of time.<sup>10</sup>

**Table 1: A Comparison of Gold & M2 Growth Rates**

	Gold annual growth rate	M2 annual growth rate
<b>1946-2011</b>		
average	1.8%	6.8%
high	2.1%	17.3%
low	1.5%	0.4%
median	1.8%	6.3%
<b>1914-2011</b>		
average	2.0%	6.9%
high	3.1%	26.4%
low	1.5%	-15.6%
median	1.9%	6.5%
<b>1868-1913</b>		
average	2.3%	5.8%
high	3.5%	22.3%
low	1.4%	-4.2%
median	2.1%	5.9%
<b>1868-2011</b>		
average	2.1%	6.6%
high	3.5%	26.4%
low	1.4%	-15.6%
median	2.0%	6.3%

Source: © Thomson Reuters [April 2012]

<sup>7</sup> This point is explained in "The Barbarous Relic – It Is Not What You Think". See: Endnote ii, p14. <http://www.goldmoney.com/goldmoney-foundation/essays/barbarous-relic-it-is-not-what-you-think>

<sup>8</sup> The supply and demand for money is explained by Ludwig von Mises in *Human Action*. See: <http://mises.org/humanaction/chap17sec3.asp> and also "The Austrian Theory of Money" by Murray N. Rothbard, <http://mises.org/daily/5188/>

<sup>9</sup> [http://en.wikipedia.org/wiki/Quantity\\_theory\\_of\\_money](http://en.wikipedia.org/wiki/Quantity_theory_of_money)

<sup>10</sup> For the data used to prepare this table, see Appendix 3 and Appendix 5 respectively for gold and US dollar growth rates. M2 is used because the Federal Reserve stopped releasing M3 data in 2006. This point though does not detract from the comparison because M2 and M3 growth rates are usually similar.

Since 1946 the gold stock has grown on average about 1.8% per annum. The high and low growth rates over this 66-year period are 2.1% and 1.5% respectively. The median is 1.8%. These results contrast markedly to the growth rates in the M2 stock of US dollars. Its average annual growth rate over this same period is 6.8%, and ranges from a high of 17.3% to a low of 0.4%. Its median is 6.3%. Similar disparities result in other time periods.

Since the Federal Reserve began operating in 1914 to the present, the dollar's annual growth rate averaged 6.9%, more than three-times greater than gold. Starker still are the differences in their respective annual rates over this 98-year period. Gold's highest growth rate in any one year was 3.1%, compared with 26.4% for M2. The slowest gold grew was 1.5%, while in one year M2 dropped a staggering -15.6%.

Even with the exceptional increases in annual production resulting from the bonanza gold discoveries at the end of the 19th century, the gold stock after 1868 never grew more than 3.5% per year.

Milton Friedman's "k-percent rule" states that to control inflation, the money supply "should be increased by the central bank by a constant percentage rate every year, irrespective of business cycles."<sup>11</sup> Over the past six decades gold has come much closer than the Federal Reserve System to achieving this goal. Table 1 offers a clear example of the failure of central planning, while the result of gold's achievement is the consistency of its purchasing power as illustrated in Chart 1.

This consistency in the growth of the gold stock results from the fortuitous way in which gold is dispersed in the earth's crust. Over time gold has become more difficult to discover and mine, but advances in mining technology offset this hindrance. The economics of mining is another factor that contributes to this phenomenon of steady gold stock growth because gold is only mined when financially feasible.

In contrast to the natural factors that govern annual increases in the gold stock, which cannot be offset by human action, national currencies are subject to man-made forces, of which three stand out. First, political influence over a central bank has harmful consequences, usually manifested by the erosion or destruction of a currency from excessive monetary expansion — colloquially referred to as "money printing".

Second, the central bank may unwittingly follow misguided policies or simply make mistakes that result in inflation or deflation, both of which are considered disruptive to a market-based economy. Finally, fractional reserve banking creates a boom-bust cycle in economic activity.<sup>12</sup> Excessive bank credit extended during the boom is followed by contraction in the inevitable bust, resulting in the considerable volatility in the dollar's growth rates presented in Table 1.

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<sup>11</sup> [http://en.wikipedia.org/wiki/Friedman%27s\\_k-percent\\_rule](http://en.wikipedia.org/wiki/Friedman%27s_k-percent_rule)

<sup>12</sup> An in-depth analysis of this boom-followed-by-bust pattern, generally known as the "Austrian Theory of the Trade Cycle", can be found here: <http://mises.org/tradcycl/austcycl.asp>. The pernicious nature of fractional reserve banking is explained in two pamphlets by Murray Rothbard available at: <http://mises.org/books/whathasgovernmentdone.pdf> and <http://mises.org/rothbard/100percent.pdf>



In summary, the gold stock expands in a disciplined way that results in consistent annual rates of growth. In contrast, the willy-nilly increases/decreases in the stock of the dollar and other national currencies result in the fluctuating price levels and erosion of purchasing power as illustrated in Chart 1.

Having explained the importance of the gold stock, this study will now measure its size.

## 5. The world's gold stock has been overestimated

This study argues that the world's gold stock is less than generally believed. There are two reasons for this overestimation.

First, there are widely differing views about the size of the total 1492 stock. The year of Columbus's first voyage to the Americas is a logical starting point to calculate accumulated world gold production because it marks the beginning of relatively formal recordkeeping. Though records became increasingly accurate over time, they cannot possibly be exact. Some differences in the available data are inevitable, which is the second reason the gold stock has been overestimated, i.e., if high estimates of annual production are used to measure accumulated production.

To reach our new estimate of the world's gold stock, we analysed the available works that provide a measure of the 1492 stock and global accumulation since then. We found:

1. There has not been much interest in these topics since the First World War, which is generally considered to mark the end of the classical gold standard. Thereafter, academics and experts focused mainly on annual gold production rather than historic gold accumulation.
2. Many of the estimates before the 20th century do not provide the basic information needed to replicate or even evaluate the calculations made to reach those numbers, nor the assumptions and sources used. In many cases they are just unexplained *ad hoc* figures. The gold production estimates of A. Soetbeer (1892) are generally accepted<sup>13</sup> as the most accurate collection of data up to that date. We present this data, as reported in Magee (1910), in Appendix 3 to this report
3. The range of available 1492 estimates is exceptionally wide. They vary from 297 tonnes estimated by Velde and Webber (1998) to 17,665 tonnes calculated by Eeden (2008), who uses a methodology similar to that employed in Appendix 3. Given this wide range, there is no consensus on the size of the stock in 1492.

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<sup>13</sup>TePaske (2010) describes Soetbeer as a "German scholar" and states that his "estimates have remained conventional wisdom since they were published in 1892 until the present." TePaske references several works to support his conclusion and then uses Soetbeer's estimates in his study.

In light of the different estimates of the gold stock in 1492 as well as cumulative production since then, we propose herein our own estimate as explained in Section 8, which is 155,244 tonnes as of the end of 2011.

Our estimate is lower than the 171,300 tonnes provided by the Thomson Reuters GFMS (“GFMS”) data<sup>14</sup>, published under licence by the World Gold Council.<sup>15</sup> As the GFMS data is usually taken as the principal reference on this matter<sup>16</sup>, we conclude that a general perception exists which overstates the current stock. The amount of this overstatement is presented in Table 2.

**Table 2: Restatement of the World’s Gold Stock**

	Tonnes
1. World Gold Council/GFMS gold stock (end of 2011)	171,300*
2. Our new estimate of the gold stock (end of 2011)	155,244
3. Overstatement of the gold stock	16,056

\*Source: © Thomson Reuters GFMS [April 2012]

The overstatement is 16,056 tonnes, or 10.3%. It is more than five-times the current rate of annual production.

## 6. Analysing the GFMS estimate of the gold stock

In 2009 the World Gold Council published a reprint of Jastram (1977) with considerable additional material, including the GFMS estimate of historic gold production from 1493-2007 presented as an index. This new version did not provide GFMS’s evaluation of the 1492 total, but it can be calculated by subtracting the gold produced from 1493 to 2011 from 171,300 tonnes. We used data available in GFMS’s Gold Survey 2012 to update through 2011 and to calculate the production series provided in Jastram (2009). See our calculations in Appendix 1. By this methodology, GFMS’s 1492 estimate is 12,780 tonnes.

GFMS does not provide in Jastram (2009) or on its website the sources upon which it bases its 1492 estimate. Nevertheless, a search of available material reveals that Govett and Govett (1982) provide a 1492 figure of 12,729 tonnes, which is nearly identical to the GFMS number. The 0.4% difference between these two totals may simply be a rounding error, suggesting that GFMS may have relied on the Govetts’ work for its own estimate of the total stock in 1492. The Govetts’ estimation therefore requires closer examination.

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<sup>14</sup> See: [http://www.gold.org/about\\_gold/story\\_of\\_gold/numbers\\_and\\_facts/](http://www.gold.org/about_gold/story_of_gold/numbers_and_facts/). Where GFMS is mentioned in this report, in all instances it refers to Thomson Reuters GFMS.

<sup>15</sup> Based on the Thomson Reuters GFMS Index. It derived the 171,300 tonne estimate of the gold stock, which is published on its website. See: [http://www.goldmoney.com/documents/Gold\\_Survey\\_2012\\_Presentation.pdf](http://www.goldmoney.com/documents/Gold_Survey_2012_Presentation.pdf)

<sup>16</sup> The World Gold Council describes itself as “the global authority on gold and its uses and the first source of informed opinion and advice for stakeholders and decision makers.” See: [http://www.gold.org/about\\_us/what\\_we\\_do/](http://www.gold.org/about_us/what_we_do/). Its website and publications publish GFMS data. GFMS is frequently quoted in the media, contributing further to the widespread reliance upon its estimate of the gold stock.

The Govetts present a table showing gold production in six different epochs beginning in 3900BC and ending in 1492AD. They do not provide any information other than referencing as their source R. Rice (1981) “Gold exploration: Past and future”, Transactions of IMM Section A, Vol 90.

We reproduce below the Govetts’ table, but have added Columns F and G. The first is World Population, which then enables us to calculate the other addition, End of Epoch (goldgrams per capita).

**Table 3: Historical Gold Production**

A	B	C	D	E	F	G
	Epoch	# of Years	Total Epoch Production (tonnes)	Cummulative Production (tonnes)	World Population <sup>17</sup>	End of Epoch (goldgrams per capita)
3900-2000BC	Copper Age		920	920	27,000,000	34.1
2000-1200BC	Bronze Age		2,645	3,565	45,400,000	78.5
1200-50BC	Iron Age		4,120	7,685	166,019,900	46.3
50BC-500AD	Roman Empire		2,572	10,257	190,000,000	54.0
500-1000AD	Barbaric Age		934	11,191	265,000,000	42.2
1000-1492AD	Middle Age		1,538	12,729	419,000,000	30.4
<b>Total</b>		<b>5,392</b>	<b>12,729</b>			
2010				<b>168,482</b>	<b>6,830,586,985</b>	<b>24.7</b>

Whatever the sources and assumptions the Govetts have used to back their 12,729-tonne figure, it is very likely a big overestimation for the following reasons:

1. For each epoch goldgrams per capita is greater than in 2010. In the Bronze Age, gold grams per capita is more than three-times higher. These results seem improbable given the primitive mining techniques available, particularly before the Roman Empire, and what we know today about gold’s geology and rarity. Also, because little division of labour prevailed throughout these epochs, particularly in pre-history, the preponderant number of people focused upon daily subsistence by fishing and farming, with little time or capital available for mining. Also, where the nascent market economy in early history required the use of metal, silver was preferred. Thus, the limited resources available for mining would likely have been directed to silver.

<sup>17</sup> See Appendix 4.

2. The Govetts propose that average annual mine supply during the Roman Empire was 4.7 tonnes<sup>18</sup>, approximately the same level of production achieved 1,000 years later, which seems unlikely – the latter period obviously marking a more advanced stage in terms of population, mining, and monetary development. While Roman mining in some years may have reached, and maybe occasionally even exceeded 4.7 tonnes, it is not reasonable to conclude that this level of production was maintained annually for 550 years. Further, Brace (1910) refers to William Jacob (1831) as an “eminent authority” who “estimate that between 14 A.D. and the year 806 there was an actual decline in the stock of precious metals.”
3. The Govetts state that cumulative world gold output in 1850 is 15,000 tonnes. Subtracting from this amount their 1492 estimate would mean only 2,271 tonnes of production from 1493-1850, whereas Soetbeer records 4,752 tonnes mined during this period. It is a significant point that raises further questions about the reliability of the Govetts’ work.
4. Velde and Weber (1998) published a report for the Federal Reserve Bank of Minneapolis that estimated the gold stock in 1492 to be 297 tonnes. Further, they state that their number of 297 tonnes is close to the 300 tonnes estimated by Heinrich Quiring in *Geschichte des Goldes: die Goldenen Zeitalter in ihrer kulturellen und wirtschaftlichen Bedeutung* (Stuttgart: Ferdinand Enke Verlag, 1948), which indicates that their work is supported by other independent research. In this regard, in 1994 this author’s analysis of the 1492 stock was 309 tonnes based on information provided in Vilar (1976); see Turk (1994). Given that this estimate is based on another independent source, it provides further confirmation of the accuracy of Velde and Weber’s work.

When the above points are taken together, the evidence suggests that the Govetts’ calculation of the gold stock in 1492 cannot be relied upon. Their estimate of 12,729 tonnes is substantially above the 297 tonnes reported by Velde and Webber. Given the research capabilities available to Velde and Webber in their positions in the Federal Reserve System, and given that other independent analyses have produced similar results, it is reasonable to rely upon their estimate that the total stock in 1492 was 297 tonnes.

Because the GFMS figure is almost exactly the same as that of the Govetts, it cannot be relied upon either. Consequently, we can therefore conclude that the GFMS 2011 estimate of 171,300 tonnes is also inaccurate. It overstates the present size of the gold stock by beginning with too high a stock in 1492.

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<sup>18</sup>Total gold production of 2,572 tonnes during the Roman Empire divided by 550 years equals 4.7 tonnes of gold mined on average per annum.

## **7. Analysing the GFMS estimate of cumulative gold production**

GFMS estimates that 158,520 tonnes of gold were mined from 1493 through 2011. See our calculations of this GFMS appraisal in Appendix 1, where we present GFMS's index of cumulative gold production from 1493 through 2011. GFMS provides this index in which 1930 equals 100 in Jastram (2009).

Note that the GFMS index from 1493 to 1600 is unchanged at 1.0, meaning that annual gold production during this 107-year period is constant. Similarly, annual output remains unchanged from 1601 to 1700 at 1.4 on their index. This result is very unlikely. It also contrasts with Jastram (1972), which shows more variation in production during these periods. See Appendix 2, which marks the changes in each series up to 1800.

Note too that GFMS shows its index more than doubling from 1.4 in 1700 to 2.9 in 1701. This huge increase for a year in which there were no major gold discoveries is another unlikely event.

Therefore, we conclude that the index of historic gold production GFMS presents in Jastram (2009), which we present in Appendix 1, cannot be relied upon. We therefore present herein a different series of historic gold production based on several sources of available information.

## **8. Our estimate of historic gold production & the gold stock**

Our new estimate of historic gold accumulation from 1493 through 2011 is presented and explained in Appendix 3. It is 154,947 tonnes, which is 3,573 tonnes less than the GFMS calculation.

Adding this 154,947 tonnes of cumulative production since 1492 to the 297 tonnes then existing aboveground, we conclude that total stock at the end of 2011 is 155,244 tonnes.

## 9. Evaluating our estimate of historic gold production & the gold stock

To test the reliability of our work, we use world population to calculate in Table 4 below per capita annual historic gold production and gold stock.<sup>19</sup>

**Table 4: GoldMoney Foundation Estimate of Annual Production & the Gold Stock per Capita**

A	B	C	D	E	F
Year	World Population (millions)	GoldMoney Foundation estimate of annual production (tonnes)	GoldMoney Foundation estimate of the aboveground gold stock (tonnes)	Aboveground gold stock (goldgrams per capita)	Annual Production (goldgrams per capita)
1492	419		297	0.7	
1500	425	5.8	343	0.8	0.01
1600	545	7.2	1,050	1.9	0.01
1650	545	8.9	1,475	2.7	0.02
1700	640	11	1,964	3.1	0.02
1750	824	25	2,844	3.5	0.03
1800	981	20	3,857	3.9	0.02
1850	1,244	88	5,040	4.1	0.07
1860	1,270	190	7,005	5.5	0.15
1870	1,309	177	8,777	6.7	0.14
1880	1,398	162	10,452	7.5	0.12
1890	1,516	179	12,073	8.0	0.12
1900	1,634	384	15,228	9.3	0.23
1910	1,754	685	20,918	11.9	0.39
1920	1,888	503	27,322	14.5	0.27
1930	2,073	647	33,113	16.0	0.31
1940	2,300	1,288	42,908	18.7	0.56
1950	2,528	838	51,782	20.5	0.33
1955	2,768	917	56,102	20.3	0.33
1960	3,036	1,150	61,309	20.2	0.38
1965	3,351	1,411	67,873	20.3	0.42
1970	3,697	1,448	74,930	20.3	0.39
1975	4,074	1,221	81,618	20.0	0.30
1980	4,442	1,262	87,917	19.8	0.28
1985	4,844	1,530	94,927	19.6	0.32
1990	5,280	2,180	104,257	19.7	0.41
1995	5,692	2,230	115,447	20.3	0.39
2000	6,086	2,590	127,847	21.0	0.43
2005	6,456	2,470	140,427	21.7	0.38
2006	6,531	2,370	142,797	21.9	0.36
2007	6,606	2,350	145,147	22.0	0.36
2008	6,681	2,280	147,427	22.1	0.34
2009	6,756	2,460	149,887	22.2	0.36
2010	6,831	2,560	152,447	22.3	0.37

<sup>19</sup> See Appendix 4 for the full data series and sources of world population.

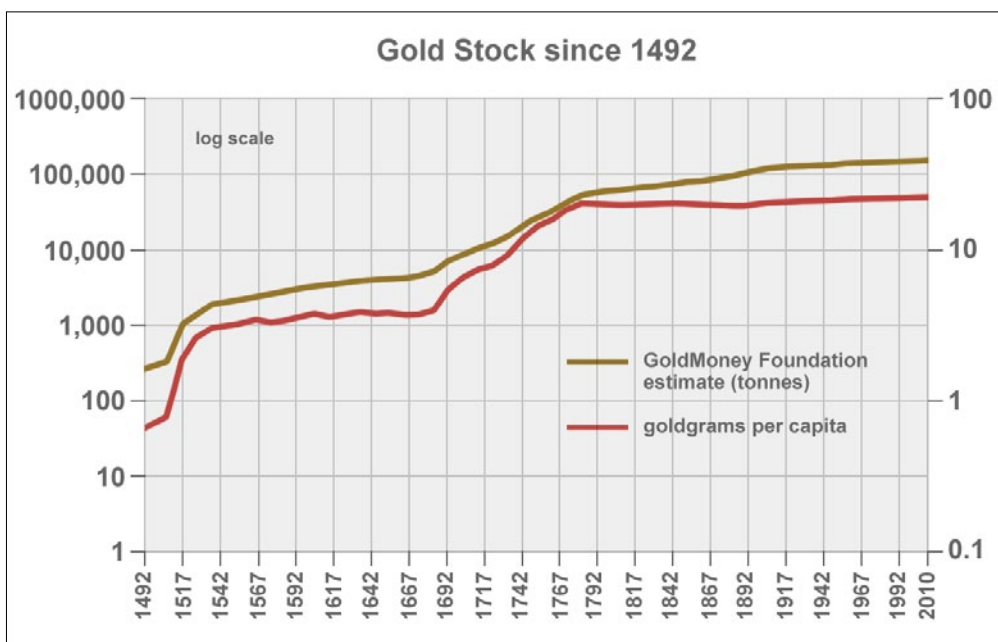
Column F shows increasing annual gold production per capita up to modern times, which is logical and to be expected. As the division of labour develops over time along with the market economy, efficiencies in mining as well as new technologies allow a gradual increase in this figure. However, after the exceptional increases in annual output resulting from the 19th century gold discoveries in California, Australia, South Africa and the Yukon are absorbed, per capita production once again increased slowly.

Similarly, the per capita gold stock in Column E grows gradually until the gold finds of the 19th century. It then increases through the first half of the 20th century as the impact from these exceptional discoveries accumulates over time. The growth in per capita gold then slows markedly in the second half of the 20th century for two reasons.

First, there have not been any major discoveries — let alone a series of them — like those of the 19th century. Second, the gold stock in 1850 was 5,040 tonnes. The new gold found back then therefore resulted in a relatively large percentage increase in the gold stock. In 1950 total stock was 51,760 tonnes, or more than 10-times bigger than 100 years earlier. As a result, a bonanza resource of the size that created the California gold rush would only have one-tenth the impact in 1950. The impact would be even lower today because the gold stock, which on average has been compounding at 1.8% per annum, has risen three-fold over the last six decades.

The per capita analyses in Table 4 can be logically explained. As a consequence, the GoldMoney Foundation estimates of annual production and cumulative gold stock can be relied upon.

**Chart 2**



## **10. Conclusions**

### **A. The size of the gold stock**

Our estimate of the 1492 gold stock is 297 tonnes, which is the calculation of Federal Reserve analysts Velde and Webber. Using this estimate as the starting point, we add to it the annual production data available from various sources, as explained in Appendix 3.

According to the World Gold Council, which is using Thomson Reuters data, the world's gold stock as of December 2011 was 171,300 tonnes. Our research provides a reasonable analytical framework to suggest that the gold stock as of December 2011 is 155,244 tonnes, meaning that Thomson Reuters GFMS overestimates the existing stock by 16,056 tonnes, or 10.3%.

Given that data provided by the World Gold Council is usually taken as the principal reference on this matter, we conclude that a general perception exists which overstates the current gold stock. The amount of the overstatement is more than five-times annual production, and at the current price of \$1,700 per ounce has a nominal value of \$877 billion.

### **B. The importance of the gold stock**

The 155,244 tonnes comprising the world's gold money stock is gold's M3. Changes in it compared with the supply of national currencies facilitate comparisons of relative purchasing power as explained by the quantity theory of money.

These comparisons show that gold maintains its purchasing power over time because the gold stock expands in a disciplined way, with the result that its annual percentage increases are remarkably similar, even over hundreds of years. These fairly consistent annual rates of growth are the goal of Milton Friedman's "k-percent rule". Thus, the quantity theory of money explains why gold maintains its purchasing power over long periods of time.

In contrast, the stock of national currencies is volatile. Increases/decreases in annual growth rates are the result of man-made factors that cause this volatility in the money stock, which result in fluctuating price levels and the erosion of purchasing power.

### **C. Gold is money**

Even though it does not actively circulate as currency anymore, gold continues to fulfil two important functions of money. It is useful in economic calculation, and it preserves purchasing power over long periods of time.

Gold is not a consumable commodity. Like the dollar, euro, pound and other monies, gold has purchasing power, which can be used to acquire goods and services. Thus, gold's value arises from its usefulness as money.



It is sometimes said that gold is volatile, given its swings in price. What might appear to be the case in the short-term does not hold true over longer periods of time, as is clear from Chart 1.

To explain this point, imagine yourself in a small rowboat in a rough ocean looking at the shore. From that perspective, the land appears to be bobbing up-and-down, but of course it is the waves rocking the boat that cause the volatility. Most people today do not recognise that when holding national currencies, they are in the rowboat, while looking at the steady rock onshore that is gold.

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**An Endnote from James Turk** — The conclusions above should not be taken as an endorsement for the return of the Classical Gold Standard that more or less prevailed from its creation by Sir Isaac Newton circa 1700 to the start of World War I in 1914. Though it provided a monetary system that better preserved the purchasing power of national currencies than the system prevailing today, I support the principle of competing currencies.

This free-market based system gives individuals and businesses the choice to use alternative currencies developed by private enterprise that circulate in parallel without legal restrictions, taxes or other government impediments thwarting their circulation. If implemented, this system would enable an unfettered gold to once again freely circulate as currency, re-establishing for it this important monetary function.

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## Appendix 1

### Thomson Reuters GFMS Historic Gold Production & Gold Stock

The data GFMS provides in Jastram (2009) is an index of historic gold production from 1493 through 2007. The index ranges from 1.0 to a high of 408.2, with 1930 equal to 100. This data is provided below in Column B.

GFMS does not provide in Jastram the weight of gold mined in 1930, or any other year. So it is not possible to calculate from this one source GFMS's estimate of historic gold production. We therefore include in Column C GFMS's report of annual production provided in its *Gold 2012* survey.

Using the production data in 2002 from this report, we then use the index in Jastram to calculate annual mine output from 1493 through 2002 (Column D). Column E then includes GFMS's annual data through 2011 to complete the series. Thus, according to GFMS, total mine production from 1493 through 2011 equals 158,520 tonnes.

GFMS states that the gold stock at the end of 2011 is 171,300 tonnes<sup>20</sup>. Subtracting from this amount its estimate of historic production, we can determine that GFMS's 1492 stock figure is 12,780 tonnes.

To see the complete table, please click on the link below:

<http://www.goldmoney.com/documents/goldmoney-gold-stock.xls>

\* Source: © Thomson Reuters GFMS [April 2012]

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<sup>20</sup> See: [http://www.goldmoney.com/documents/Gold\\_Survey\\_2012\\_Presentation.pdf](http://www.goldmoney.com/documents/Gold_Survey_2012_Presentation.pdf)

## **Appendix 2**

### **Thomson Reuters GFMS Gold Production Index Compared to Jastram (1977)**

The GFMS gold production index appears in Jastram (2009). The GFMS index differs markedly to the original index calculated by Jastram in 1977. Changes in the data up to 1800 are noted.

**To see the complete table, please click on the link below:**

**<http://www.goldmoney.com/documents/goldmoney-gold-stock.xls>**

\*Source: © Thomson Reuters GFMS [April 2012]

### **Appendix 3**

#### **The GoldMoney Foundation's new estimate of historic gold production & gold stock**

There are several estimates of historic gold production. Unfortunately, most of these series cover just a short period.

The only continuous series from 1493 to modern times is contained in the two Jastram books, one of which is presented in Appendix 1. Jastram (1977) is presented below.

The other series presented below show the limited data available. Nevertheless, it is possible to construct from this data a series showing annual output from 1493 through 2011. We have done this by taking the average of the high and low estimate of the different series for each year, which is presented in Column M. The GoldMoney Foundation estimate of annual production from 1493 to 2011 is 154,947 tonnes.

The following provides additional information:

- (1) Jastram (1977) provides only an index of production. To translate this index into weights of metal, we assume production in 1493 is 5.8 tonnes, which is Soetbeer's estimate as presented in Magee (1910).
- (2) In order to complete the series, we used the GFMS estimate of annual mining output in 2011. We were unable to locate data for this one year from other sources.

To obtain the present stock, we add our calculation of cumulative production from 1493 to the Velde and Webber estimate of 297 tonnes existing in 1492. Thus, the GoldMoney Foundation's estimate of the gold stock as of December 2011 is 155,244 tonnes.

The availability of data prior to the 18th century is scarce. We calculate that the weight of gold produced up to the discovery of gold in California in 1849 was 4,576 tonnes, which is only 2.9% of the current total. So even if the data prior to the 18th century were off by say, as much as 20%, the impact on the present stock would not be significant.

**To see the complete table, please click on the link below:**

<http://www.goldmoney.com/documents/goldmoney-gold-stock.xls>

**Appendix 4**  
**World population**

The estimates of world population used herein are available on Wikipedia at the following link:  
[http://en.wikipedia.org/wiki/World\\_population\\_estimates](http://en.wikipedia.org/wiki/World_population_estimates)

**To see the complete table, please click on the link below:**

<http://www.goldmoney.com/documents/goldmoney-gold-stock.xls>

**Appendix 5**  
**US dollar M2 money stock, 1867-2011**  
**(Annually in billions)**

Data for US dollar M2 from 1867 to 1958 is available at:

<http://research.stlouisfed.org/wp/2003/2003-006.pdf>

Data for US dollar M2 from 1959 to 2011 is available at:

<http://research.stlouisfed.org/fred2/data/M2SL.txt>

**To see the complete table, please click on the link below:**

<http://www.goldmoney.com/documents/goldmoney-gold-stock.xls>

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