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Global

Global Economics View

Gold: a six thousand year-old bubble revisited

- Gold is a fiat commodity currency (with insignificant intrinsic value).
- Bitcoin is a fiat virtual peer-to-peer currency (without intrinsic value).
- Gold and Bitcoin are costly to produce and store.
- Gold as an asset is equivalent to shiny Bitcoin.
- Central bank fiat paper currency and fiat electronic currency are socially superior to gold and Bitcoin as currencies and assets.
- There is no economic or financial case for a central bank to hold any single commodity, even if this commodity had intrinsic value.
- Forbidding a central bank from ever selling any gold it owns reduces the value of those gold holdings to zero.

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Gold: a six thousand year-old bubble revisited[1]

Introduction

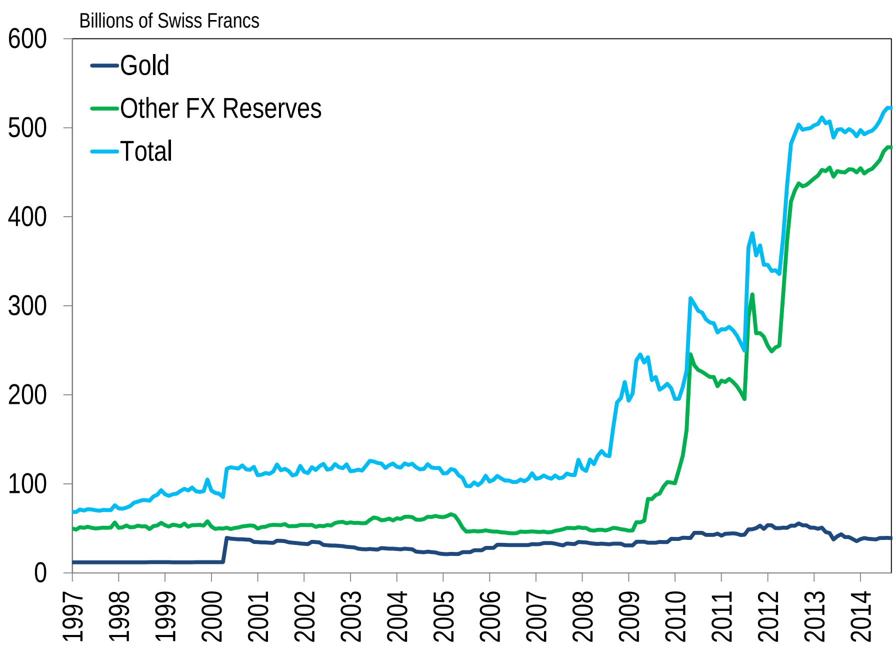
Swiss 'Save our Swiss gold' referendum imminent:

- **SNP to hold 20% of assets (16% of GDP) in gold**
- **SNP gold never to be sold**

On November 30th, 2014, the Swiss will vote in a referendum on a popular initiative 'Save our Swiss gold' (henceforth the Gold Initiative). If the Gold Initiative passes three consequences follow: (1) the Swiss National Bank (the SNB) must hold at least 20% of its assets as gold, (2) the SNB has to repatriate the 30% of its official gold stock that is now held abroad by the Bank of England and Bank of Canada and has to physically hold all its gold in Switzerland, and (3) the SNB may never sell any gold again.

Figure 1 shows the total assets of the SNB, its gold reserves and its other foreign exchange reserves, the sum of foreign currency investments, the reserve position with the IMF and international payment instruments. There is a break in the series for the value of the gold holdings and for total assets: as of 2000, gold holdings have been priced at market value. Until 1999, they were valued at the official parity price of CHF 4,596 per kilogram.

Figure 1. Swiss National Bank Gold, Foreign Exchange and Total Assets, 1997-2014



Source: Swiss National Bank and Citi Research

As can be seen from **Figure 1**, the balance sheet of the SNB has exploded in size since it began to lean against the appreciation of the Swiss Franc by active foreign exchange interventions early in 2009. Its balance sheet at the end of September 2014 stood at 522 bn Swiss Francs, about 83% of annual GDP. On that same date, the value of its gold reserves was about 39 bn Swiss Francs, about 7.5% of the value of its total assets. That represented 1,040 metric tonnes of gold, almost 129

[1] This note updates and extends a blog I wrote in 2009, titled: Gold – a six thousand year-old bubble, Willem Buiter's Maverecon (http://blogs.ft.com/maverecon/2009/11/gold-a-six-thousand-year-old-bubble/#axzz3K6tsGzEG)

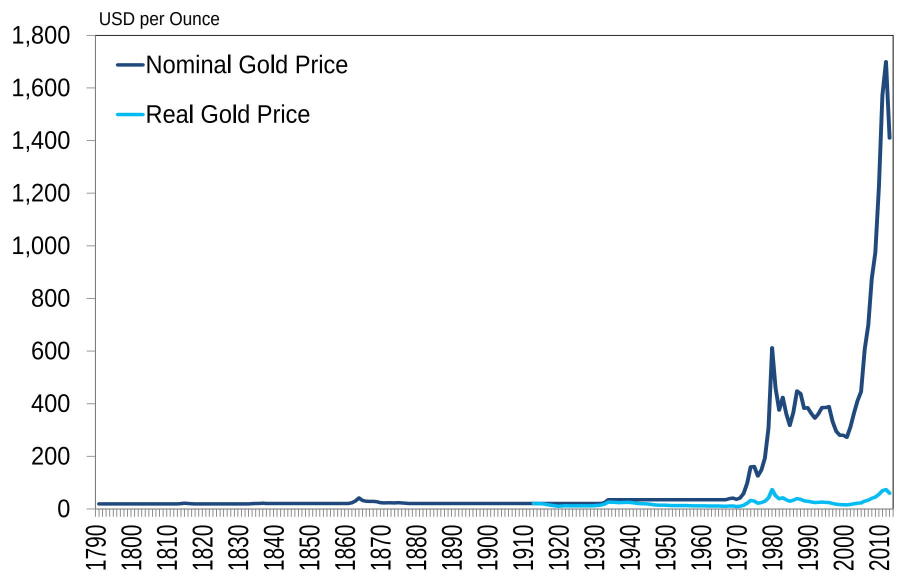
grams (4.5 oz.) per capita. In 2000, the SNB held 2,500 tonnes of gold and it has also been the biggest national seller since.

If the gold initiative passes, the SNB would have to purchase at least 1,733 metric tonnes of gold to meet the 20% threshold by 2019 (based on end-of September 2014 SNB balance sheet size and gold price). The world's annual production of gold is likely to be around 3000 metric tons in 2014.

Price of gold, like any asset, is volatile

The price of gold, like that of any asset price, is volatile. In nominal terms it has increased spectacularly over the more than 200-year period shown in **Figure 2**, and especially since the end of the gold peg of the US dollar in 1971. In real terms, the increase has been somewhat less spectacular, from $10.08 in 1971 (measured in 1913 dollars) to $59.89 in 2013. The real price of gold hit $73.60 in 1980 and $73.30 in 2012, underlining the volatility of the (real) gold price. Someone who invested in gold in 1971 and held onto it for 42 years, that is, till 2013, would have achieved an annual real rate of return of 4.3 percent (minus carry costs) - reasonable given the riskiness of the asset.

Figure 2. Nominal and Real Price of Gold, 1790-2013



Note: The real series is deflated by the US consumer price index, where the index begins at 1913=1.0
Source: Kitco Charts & Data, Bureau of Labor Statistics and Citi Research

If an asset can never be sold, it is worthless, unless you can consume it

Item (2) on the Gold Initiative ballot makes little sense to us. Holding all one's physical assets in one nation means ignoring the benefits of geographic diversification of 'custodial risk'. Item (3) is quite extraordinary because it would make the SNB's gold holdings worthless. Making it illegal to ever sell any of the gold the central bank has now or acquires in the future and enforcing this gold sale ban effectively would make the gold useless as an international reserve. The gold stock can never be used for foreign exchange market interventions and it likely cannot be used as collateral. The gold becomes useless as a store of value of any kind. The gold has no consumption value to the central bank. Its value is therefore zero.[2]

[2] If the ban on gold sales were credible, that is. In the real world, the value of the gold stock would remain positive only because the world (and the markets) knows that no commitment is credible forever, especially a commitment that we feel makes little or no sense. Whatever the present rules,

What about the first point, the requirement that the SNB hold at least 20% of its assets in gold? Is gold the kind of asset that should constitute at least 20% of a central bank's portfolio? We consider what, if anything, makes gold special in what follows. For those readers who cannot wait to hear our conclusion, the short answer to the question: "Would it make sense for the SNB to increase its gold holdings to at least 20% of its balance sheet on average (permitting it to sell the gold when it deems this necessary)", the short answer is: no. The slightly longer answer is: absolutely not. Further elaboration follows.

What's special about gold?

Gold is costly to produce and store

Gold is unlike any other commodity. The only things that come close to it are Bitcoin and similar digital peer-to-peer currencies.[3] Gold is costly to extract from the earth and to refine to a reasonable degree of purity. There is an (unknown) upper limit to the total amount that is recoverable at any cost. It is costly to store. It has no significant remaining uses as a producer good – equivalent or superior alternatives exist for all its industrial uses.

To a fair approximation, gold has no intrinsic value

About 70 tonnes of gold is used annually in dentistry[4] (out of a total annual production of close to 3000 tonnes). Gold use in dentistry is gradually giving way to advanced composites and porcelain veneers and crowns. Gold is also used in jewelry. The Gold Council reports (flow) consumer demand for gold in 2013 as reaching a record high of 3,863.5 tonnes. However, this consumer demand includes not just jewelry (2209 tonnes) but also small bars and coins (1654 tonnes). Small bars and coins represent demand by households for gold as an asset, investment demand, that is, not 'consumption' demand. In our view, a significant part of the demand for gold in the form of jewelry is likely to represents investment demand rather than true consumption demand as well.[5] True consumption demand for gold, for its intrinsic aesthetic qualities, is likely to be small indeed. Annual 'flow' true consumption demand, medical (including dentistry) demand and industrial demand (405 tonnes – mainly in electronics) is therefore likely to be dwarfed by annual new gold production. Central banks added 368.6 tonnes of gold net to their reserves in 2013 – a form of investment demand.[6] We can therefore safely ignore the intrinsic value of gold as an industrial, medical or dentistry input and as a consumption item and treat it as a 'fiat commodity' – one that has value as an asset if and to the extent that enough people believe that is has value as an asset.

Gold is effectively shiny Bitcoin

For the purposes of the rest of this note, gold can be viewed as shiny Bitcoin. Bitcoin too is costly to produce (to 'mine', using high-powered servers that could be doing other, more useful things instead, using energy both to keep the servers running and to cool them).[7] The algorithm governing Bitcoin is supposed to set an absolute upper limit of 21 million bitcoin units, although anything that can be programmed can be re-programmed.

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laws, constitutions or treaties say, there is always room for amendment or simple ignoring of these rules or laws in the future.

[3] See Wikipedia, Bitcoin, http://en.wikipedia.org/wiki/Bitcoin

[4] See Knosp, Holliday and Corti (2003)

[5] In India, where 11% of the world's stock of gold is held, gold is historically a form of investment and financial security for married women. See *Time*, July 14, 2013, "In India, Gold Glitters but Brings Economic Woes."

[6] See World Gold Council http://goldinvestingnews.com/40580/world-gold-council-2013-demand-supply-consumers-india-china.html and World Gold Council (2014).

[7] See Wikipedia, Mining, https://en.bitcoin.it/wiki/Mining

Like paper currency and Bitcoin, Gold is 'irredeemable'. It is an 'outside' asset – an asset of the holder that is not a liability of anyone else. Gold is anonymous, in the sense that it is accepted in payment without the receiving party having to know the identity of the paying party, and the identity of the previous owner(s) is not revealed on the gold ingots. This can only work if something can be identified reliably as being or not being gold. Counterfeiting (gold-painted lead ingots) are of course a risk (as it is with paper currency and, for all we know, with Bitcoin). Bitcoin is not anonymous, because every unit of Bitcoin is held in an electronic 'wallet', which has a clear and, in principle, identifiable owner. The legitimacy of a unit of Bitcoin is in fact established by tracing all is previous owners back to the original mining. It is possible to hide (through encryption) the identity of the current beneficial owner of a Bitcoin wallet, just as it is possible to hide the identity of the beneficial owner of a bank account behind an array of corporate, trust or personal fronts.

The total stock of 'above-ground' gold was about 177,200 metric tonnes as of the end of 2013[8] (a metric ton is 2,204 lbs. or 35,264 oz., for those of a non-decimal mind-set). About 50 percent of this existing stock of above-ground gold is kept as a pure store of value (for investment purposes), most likely somewhere below-ground, for security reasons. The other 50 percent exists as jewelry.[9] I would argue that most of this jewelry demand small-scale store of value (investment) demand by households, rather than demand driven by aesthetic considerations or other intrinsic values. The outstanding stock of physical gold, at 177,200 tonnes or thereabouts, is very large relative to the maximum amount of new gold that can be mined and refined during a year. The short-run supply curve of new gold is steep and becomes vertical at a volume of production that is small relative to the outstanding stock (annual gold production had been declining from a local peak of just over 2,500 tonnes in 2001 to 2,330 tonnes in 2008, but more recently has risen to more than 2,900 tonnes in 2013 – yet only 1.6% of the outstanding stock).[10]

John Maynard Keynes once described the Gold Standard as a "barbarous relic".[11] From a social perspective, gold held by central banks as part of their foreign exchange reserves merits the same label, in our view. The same holds for gold held idle in private vaults as a store of value. The cost and waste involved in getting the gold out of the ground only to put it back under ground in secure vaults is considerable. Mining the ore is environmentally damaging, especially if it involves open pit mining. Refining the gold causes further environmental risks. Historically, gold was extracted from its ores by using mercury, a toxic heavy metal, much of which was released into the atmosphere. Today, cyanide is used instead. While cyanide, another toxic substance, is broken down in the environment, cyanide spills (which occur regularly) can wipe out life in the affected bodies of water. Runoff from the mine or tailing piles can occur long after mining has ceased.

From a social perspective, gold and Bitcoin are dominated by central bank paper and electronic currency

Even though, from a social efficiency perspective, the mining of new gold and the costly storage of existing gold for investment purposes are wasteful activities, they may be individually rational. The same applies to Bitcoin. Its mining is socially wasteful and environmentally damaging. The benefits of Bitcoin are: (1) to libertarians, the existence of a privately provided and decentralized, peer-to-peer, alternative to a previously partly government-provided and centralized construct or arrangement, in this case central bank money or base money serving as a means of

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[8] See World Gold Council, http://www.gold.org/supply-and-demand/supply

[9] See Wikipedia, Gold Reserve, http://en.wikipedia.org/wiki/Gold_reserve

[10] See Wikipedia, Peak Gold, http://en.wikipedia.org/wiki/Peak_gold and http://business.financialpost.com/2014/01/23/gold-production-soars-to-record-in-2013-despite-price-drop-study/

[11] Keynes (1923), p. 172

payment and medium of exchange; and (2) the benefit of near-anonymity, or more exactly, the ability to hide the identity of the owner using strong encryption. This (near-) anonymity, shared by gold and paper currency, is valuable to all those interested in escaping the prying eyes of the state or of powerful private entities. This may be for good reasons (when the state is oppressive and unaccountable) or for bad reasons (when the anonymity of the store of value is used in criminal activity, tax evasion, money laundering or terrorism financing). There is no invisible hand here (or elsewhere) to ensure that the aggregation of individually rational behaviour adds up to anything desirable or sensible.

Because to a reasonable first approximation gold has no intrinsic value as a consumption good or a producer good, it is an example of what I call a *fiat (physical) commodity*. You will be familiar with fiat currency. Unlike what Wikipedia says on the subject, we argue that the essence of fiat money is not that it is money declared by a government to be legal tender. It need not derive its value from the government demanding it in payment of taxes or insisting it should be accepted within the national jurisdiction in settlement of debt. Instead the defining property of fiat money is that it has no intrinsic value; it derives any value it has only from the shared belief by a sufficient number of economic actors that it has that value.

The "let it be done" literal meaning of the Latin 'fiat' should be taken in the third sense given by the Online Dictionary: **1.** official sanction; authoritative permission; **2.** an arbitrary order or decree; **3.** *Chiefly literary* any command, decision, or act of will that brings something about.

The act of will in question is the collective attribution of value to something without intrinsic value. Being declared legal tender by a government may help achieving that status, but it is neither necessary nor sufficient.

Gold is very close therefore to the stone money of the Isle of Yap. This stone money, known as Rai, consists of large doughnut-shaped, carved disks, consisting usually of calcite, that can be up to 4 m (12 ft.) in diameter, although most are much smaller. Apparently, the total stock of Rai cannot be augmented any further. It also depreciates very slowly. This intrinsically useless form of money in the Isle of Yap is in all essential respects equivalent to gold today in the wider world. Another example would be pet rocks, as long as the rock in question is rare and costly to get into its final shape. Another is Bitcoin, a fiat virtual currency.

Gold has become a fiat *commodity* or a fiat *commodity currency*, just as the US dollar, the euro, the pound sterling and the yen (and a couple of hundred other currencies) are fiat *paper* currencies and as Bitcoin is a fiat virtual currency. The main differences between them are that gold, like Bitcoin, is very costly to produce, while the production of additional paper money has an extremely low marginal cost. If we count the deposits of commercial banks with the central banks, which together with currency in circulation make up the monetary base, as fiat money, then the incremental cost of fiat base money creation is zero.

The good news for gold bugs

Paper currency and electronic currency can be expanded at (near-)zero marginal cost. Over-issuance is a risk

Since gold is a fiat commodity currency, its value will be determined largely by its attractiveness relative to other fiat currencies – the fiat paper currencies issued by central banks. Gold should not be analyzed as one of a set of intrinsically valuable commodities (silver, iron, lead, zinc, platinum, aluminum, titanium etc. etc.) but as part of a set of intrinsically useless and valueless fiat currencies – the US dollar, the yen, the Yuan, the euro, sterling, the rupee, the rouble, Bitcoin etc. etc.. It is therefore in times that market participants are nervous about the future value of most other fiat currencies that gold will be most attractive.

Such a time is what we are going through now. Many systemically important central banks have expanded their base money stocks and balance sheets massively. The Fed has quadrupled the size of its balance sheet. The Bank of England has more than tripled the size of its balance sheet. Many central banks have bought vast amounts of public debt. In the UK, out of the initial £375 bn of quantitative easing, almost everything was spent on gilts. Over the past two years, the Fed added $1.7 trillion to its balance sheet (which is around $4.5 trillion as of end-October 2014) through large-scale asset purchases involving Treasuries and Agency MBS.

Although in most of the developed world low-flation or even deflation is the immediate threat, there is a medium and long-term threat of much higher inflation in all countries with enlarged central bank balance sheets and the prospect of large future fiscal deficits. The great advantage to investors of gold is that, although it is not intrinsically valuable, it is very costly to increase its stock. The tap can be opened at the drop of a hat for fiat paper and electronic currency. The tap produces never more than a trickle in the case of gold.

So when fiscal profligacy threatens price stability in some of the main industrial countries (especially the US and the UK) because the central banks in these countries may be forced to monetize both the stock and large new net flows of public debt, the one fiat money whose quantity cannot be varied at will by a monetary authority will do well. We see that with gold today. We also see that, to a lesser degree, in the strength of the euro. The ECB is by far the most independent of the leading central banks. It also has a heavily asymmetric de-facto interpretation of price stability: inflation is unacceptable, deflation is OK.

So until the risk of serious inflation is removed from the medium-term outlook for the US, the UK and other fiat currencies, gold could be a relatively attractive store of value *despite the cost of storing it*.

This argument, however, assumes that if paper or electronic fiat money loses its value, gold will keep its value. That is an assumption and, as I shall argue in what follows, most likely an unwarranted assumption.

The gold bug's nightmare

The fundamental equilibrium price of a fiat currency like gold or Bitcoin is zero; any positive price is a bubble

An economy with fiat money can have many different equilibria. To make the point as clearly and simply as possible, consider a stationary economy. Population, endowments, technology, government spending, taxes and preferences are all constant. The government budget is balanced. Prices are flexible. There is a constant stock of fiat money (which could be paper money, gold, Rai, pet rocks, or Bitcoin). This fiat money is perfectly durable and therefore can serve as a store of value. It pays no interest. Because this fiat money exists and is durable, it can, in principle, be a store of value – an asset. It is may help, but is not necessary for the argument that follows to assume that, should this fiat money have positive value, society has (informally/spontaneously/collectively) decided to use it as a medium of exchange or as means of payment. It could even be legal tender.

With a bit of further work, it can be shown that such an economy will have an equilibrium with a positive, constant price of money (a constant general price level). Economists call this the *fundamental* equilibrium. This stationary economy will, however, also have many other (in fact infinitely many other) non-stationary equilibria, called (speculative) bubbles. They always have equilibria in which the value of money starts at a positive value but falls steadily towards zero – the general price level rises without bound even though the quantity of money is constant. The holders of money anticipate the future inflation and thereby reduce the real stock of money balances they want to hold. This further increases the actual and expected rate of inflation, and the real stock of money balances goes to zero: the general price level goes to infinity or the price of money goes to zero. In other words, the economy becomes Zimbabwe.

What is often ignored is that this economy has an equilibrium that is even more ‘fundamental’ than the ‘fundamental’ equilibrium with a constant positive value of money. That is the equilibrium in which the price of money is zero in every period, not just in the long run (as with the speculative inflationary bubble equilibria). Remember, fiat money, including gold or Bitcoin, is intrinsically useless. It has value only because people believe it to have value. If everyone expects that money will have no value in the next period, it will have no value this period, because no-one will be willing to take receipt of money to carry it into the next period where it will be valueless. So fiat money with a zero value is always an (unfortunate) fundamental equilibrium.

I would actually call it the *only* fundamental equilibrium. All other equilibria with a positive price of money – an asset with no intrinsic value – are benign (relatively speaking) bubbles. The constant price of money (constant general price level) equilibrium is also a bubble, based entirely on belief and trust – a beneficial bootstrap equilibrium, lifting itself by its hair, like the Baron von Münchhausen.

In a world with multiple fiat moneys, the zero value of money equilibrium lurks for each of the fiat currencies, including gold and Bitcoin. In a classic paper, Kareken and Wallace (1984) have shown that even in the other (nice) fundamental equilibrium, in which each of these fiat currencies has a constant positive value, those constant positive values can be anything – there is exchange rate indeterminacy between the various fiat currencies. This holds for paper or electronic fiat money, gold and Bitcoin.

So if gold has positive, albeit wildly fluctuating value, it is because we are in a benign bubble for gold. Likewise, Bitcoin’s positive value represents a benign Bitcoin bubble. The gold bubble is, of course, pretty impressive. Intrinsically useless gold has positive value. It has had positive value for nigh-on 6,000 years. That must make it the longest-lasting bubble in human history.

Is there a possibility that, out of the blue, the market could produce a zero value for central bank-issued fiat paper and electronic money (base money)? Yes, if the prices of goods and services in terms of base money are freely flexible. Fortunately they are not. The world is Keynesian. Nobody understands the mysteries of the unit of account or numéraire, but for some reason in most societies today for most of the time, central-bank issued fiat money or base money has been the unit of account for most contracts, and prices of goods and services in terms of this numéraire, are sticky - empirically and for reasons we don’t understand, but they undoubtedly involve limited computational capacity and other manifestations of bounded rationality. Nominal wage and price rigidities therefore rule out the zero price of base money equilibrium (notwithstanding the fundamental equilibrium at the end of a hyperinflation).

But other asset prices are not sticky in terms of the numéraire. There exists therefore an equilibrium in which the price of all other fiat moneys (including Bitcoin and gold) in terms of base money is zero.

We are obviously not in an equilibrium in which the prices of gold and Bitcoin at zero. Does that mean that in the future also the value of gold and of Bitcoin will be (relatively stable) even if the central bank were to start running the printing presses at full speed, producing a hyperinflation in terms of base money prices? Not necessarily. Assume the initial prices of both gold and Bitcoin in terms of base money are positive and that the value of base money in terms of goods and services is positive. Once gold and Bitcoin have positive value in terms of base money today, their future value is determined by no-arbitrage relationships between these three fiat moneys – all of which don't have any intrinsic value as consumer goods, intermediate goods or capital goods. No arbitrage means the absence of risk-free pure profits from buying and selling these three stores of value against each other. Since neither currency nor gold nor Bitcoin is interest-bearing, the exchange rate between currency, gold and Bitcoin should be expected to be constant over time. Any change in the currency price of Bitcoin and gold is therefore unanticipated. There must have been a lot of major surprises! The fact that the stocks of Gold and Bitcoin are finite does therefore not suffice to keep them safe from hyperinflationary base money issuance by the central bank.[12]

Conclusion

Gold is the world's most persistent bubble: 6,000 years old and going strong

I don't want to argue with a 6,000-year old bubble. There have been hyperinflations with the value of central bank base money going to zero, but the price of gold has not followed that of paper money. Perhaps that was because, at the time, gold still had some intrinsic value as a productive input, and even today retains some intrinsic value as a consumer good. Even if we view gold as an intrinsically valued commodity, it would still be unsound to invest 20% of the central bank's balance sheet in a single commodity. If the central bank is to invest in commodities, better to have a balanced portfolio of commodities or, more conveniently, a balanced portfolio of commodity ETFs or other derivatives.

No central bank should hold any gold reserves, in our view

Requiring a central bank to put 20 percent of its balance sheet in any single commodity, even if that commodity had meaningful intrinsic value, represents a highly unorthodox and risky investment strategy, in our view, regardless of whether one judges it by its likely future profitability or by its wider social benefits. We conjecture that the SNB is most concerned that the Gold Initiative might pass.

Even though I view gold as a pure bubble, that bubble may well be good for another 6,000 years. Its value may go from $1,200 per fine ounce to $1,500 or $5,000 for all I know. Investing a vast amount of money in something whose value is based on nothing more than a set of self-confirming beliefs will make for an exciting ride.

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[12] The fact that the stock of Bitcoin is capped does not mean that its effective quantity cannot be expanded without bound, even if there were no paper or electronic central bank money around. New Bitcoin-like virtual currencies can be created, even if the stock (number of units) of the original Bitcoin, call it Bitcoin1, and the associated number of Bitcoin units Bitcoin1, is capped at 21 million units. Bitcoin2, Bitcoin3 etc. all have finite recoverable/mineable quantities, but the sum of all Bitcoin units,

$$\sum_{j=1}^{\infty} \#\text{Bitcoin}j$$

, that could be mined could have an open-ended number of units. If the markets were to decide that all Bitcoins are perfect substitutes for each other at an exchange rate of one unit for one unit, say, they *would* be perfect substitutes at that exchange rate. Of course, if the markets decided that gold is a perfect substitute for all these Bitcoins at an exchange rate of, say, 1 unit of Bitcoin for 1 troy ounce of gold, it would be. And, as noted in the body of this note, if there were central bank base money outstanding and the markets decided to treat Bitcoin as a perfect substitute for base money at a fixed exchange rate, it would be.

Whether that is enough to impose it as a requirement on one's central bank is another matter.

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Appendix A-1

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