Journal of Financial Stability 17 (2015) 92–99

Contents lists available at ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfstabil

Synthetic commodity money

George Selgin*

Director, Center for Monetary and Financial Alternatives, The Cato Institute, 1000 Massachusetts Avenue NW, Washington, DC 20005, United States

ARTICLE INFO

Article history:
Received 10 February 2014
Received in revised form 25 April 2014
Accepted 21 July 2014
Available online 13 August 2014

Keywords:
Commodity money
Fiat money
Bitcoin
Swiss dinar

ABSTRACT

The conventional dichotomy of "commodity" and "fiat" base monies overlooks a third possibility that shares some features of each. This third type, which I call "synthetic commodity money," resembles fiat money in having no nonmonetary value; but it resembles commodity money in being not just contingently but absolutely scarce. I discuss some actual examples of synthetic commodity monies, and then argue that special characteristics of synthetic commodity money are such as might allow such a money, if properly designed, to supply the foundation for a monetary regime that does not require oversight by any monetary authority, yet is able to provide for a high degree of macroeconomic stability.

1. Introduction

This paper considers monetary reform possibilities posed by a class of monies that has been overlooked in the literature on monetary economics. Because the monies I have in mind involve features of both commodity money and fiat money, as these are usually defined, without fitting the conventional definition of either type, I refer to them as "synthetic commodity" monies. The special features of such monies, I argue, give them the potential to supply the foundation for a monetary regime that does not require oversight by any monetary authority, yet is able to provide for all such changes in the money stock as are needed to achieve a high degree of macroeconomic stability.

2. Conventional base monies

Effective monetary control is fundamentally a matter of establishing a base-money regime that succeeds in regulating the growth of the monetary base in a manner consistent with the preservation of overall macroeconomic stability. The nature of the banking regime can have some bearing upon the extent to which the base must be capable of expanding to provide for an economy's overall monetary needs. But an ideal monetary base regime is one that's able to deliver reasonable stability despite banking innovations.

The search for an "ideal" base money has consequently long preoccupied monetary economists. Generally the search takes as its starting point the assumption that all base monies fall into one of two categories: "commodity" money and "fiat" money.[1] However, consideration of the attributes conventionally assigned to these types suggests that the conventional dichotomy is false, and, more importantly, that it excludes a class of potential base monies having characteristics that can make them especially capable of supplying the foundation for monetary regimes that are both macro-economically stable and constitutionally robust.

According to the standard definition, "commodity" money consists, as the term suggests, of some useful article of trade, that is, something that has a use other than that of being a medium of exchange,[2] and that is also *naturally* scarce, in that it commands a positive value in equilibrium, which (assuming competing suppliers) is equal to its marginal cost of production.

"Fiat" money, in contrast, is generally understood to consist of paper notes, or central bank deposit credits readily convertible into such notes, that are useful *only* as exchange media, and command a value in equilibrium far exceeding their zero or near-zero marginal cost of production. It follows that the scarcity of fiat money is not a "natural" scarcity but one that must be contrived. As such fiat money, unlike commodity money, does not lend itself to competitive provision, understood here to entail rivalrous production of

* Tel.: +1(202)789 5240.
E-mail address: gselgin@cato.org

http://dx.doi.org/10.1016/j.jfs.2014.07.002
1572-3089/

[1] Another dichotomy – that of privately versus publicly supplied base monies – though perhaps no less important, is only of tangential relevance to the main thrust of this paper. Some germane points are raised regarding public-versus-private "synthetic commodity money" in this article's concluding section.

[2] That is to say, something "intrinsically" useful, to use the common and terse (if inaccurate) expression.

Scarcity	Nonmonetary Use?	Yes	No
	Absolute	Commodity	Synthetic Commodity
	Contingent	Coase Durable	Fiat

Fig. 1. Base money types.

homogenous units, because, as Friedman (1960, p. 7) (among others) has observed, such production would tend to drive its value toward zero:

> So long as the fiduciary [fiat] currency has a market value greater than its cost of production. . .any individual issuer has an incentive to issue additional amounts. A fiduciary currency would thus probably tend through increased issue to degenerate into a commodity currency – into a literal paper standard – there being no stable equilibrium price level short of that at which the money value of currency is no greater than that of the paper it contains.

Indeed, because the nominal quantity of fiat money can be increased without resort to more paper and ink, simply by supplying larger-denomination notes than previously, "it is not clear that there is any finite price level" that will constitute an equilibrium (ibid.).

Monopolistic provision is thus a necessary condition for fiat money to command a positive value in equilibrium, and thereby potentially serve as the foundation for macroeconomic stability. But monopolistic provision is not sufficient, for a profit-maximizing monopoly supplier of fiat currency would also find it profitable to expand the nominal stock of such money at a rate far in excess of that required to preserve its purchasing power.[3] For this reason, the scarcity of fiat money must be contrived, not merely by monopolizing its production, but by somehow having the monopoly producer supply a less-than profit-maximizing quantity.

The disadvantage of fiat money, relative to commodity money, rests precisely in the fact that its scarcity, being thus contrived, is also *contingent*. A matter of deliberate policy only, it is subject to adjustment at the will of the monetary authorities or, if those authorities are bound by a monetary rule, at that of the legislature. Consequently, although a fiat money can be managed so as to not only preserve its purchasing power over time, but also so as to achieve the greatest possible degree of overall macroeconomic stability, there is no guarantee that it will be so managed, and market forces themselves (as distinct from political ones) offer no effective check against its arbitrary mismanagement.

The history of fiat money, furthermore, makes clear that the risk of severe mismanagement is far from being small, let alone trivial: while more recent experience offers some exceptions to Irving Fisher's (1920, p. 131) claim that "Irredeemable paper money has almost invariably proven a curse to the country employing it," that experience nevertheless supplies many further instances of the reckless, if not disastrous, mismanagement of fiat standards.

Commodity monies have drawbacks of their own, of course. They are vulnerable to supply shocks – that is, to shocks that shift the base-money supply schedule. In the case of metallic moneys such shocks might consist either in the discovery of new relatively high-yield ore or of lower-cost means for extracting minerals from known sources. In the absence of positive innovations to supply, on the other hand, the wearing-down of outstanding coins and rising marginal extraction costs will, in a growing economy, result in secular deflation. Changes in the nonmonetary demand for an ordinary commodity can also destabilize a monetary regime based upon that commodity. Had 18th century England been on a copper standard, for example, it might have been plunged into a deflationary crisis by the British Navy's discovery of copper's merits as material for ships' sheathing, which led to a sharp increase in the nonmonetary demand for that metal, and hence in its relative price.

Finally, commodity monies are costly. Friedman (1962, p. 221; also 1960, pp. 4–8) regarded the fact that a commodity standard "requires real resources to add to the stock of money" as the "fundamental defect" of such a standard. And although White (1999, pp. 42–48) has shown that Friedman dramatically overstated the likely resource costs of a gold standard,[4] the fact remains that a fiat standard is, in principle, capable of having lower resource costs than a genuine commodity standard entailing the actual employment of the money commodity as either a circulating or a bank reserve medium.[5]

3. Synthetic commodity money

The inadequacy of the standard fiat-money commodity-money dichotomy becomes evident upon considering how the conventional definitions of each sort of money actually refer to not one but *two* distinct characteristics: a commodity money has nonmonetary use value *and* is naturally or inevitably scarce; a fiat money has no nonmonetary use value *and* is scarce only by design.

These two-part definitions suggest that the usual dichotomy is but half of a complete classification of conceivable (though not necessarily practical) base-money types, as illustrated in the above two-by-two matrix (Fig. 1):

The matrix shows how the usual dichotomy sets aside the possibility that base money may consist of something that has a nonmonetary use or uses, but is only contingently rather than absolutely or "naturally" scarce. An example would be a durable good which, though capable of being reproduced at zero marginal cost, is rendered scarce by having rights to it, or to the technology needed to reproduce it, assigned to a monopolist charged with restricting

[3] For example, using a variable semi-elasticity model of the demand for money (as opposed to the more conventional Cagan approach), Easterly et al. (1995) arrive at an unrestricted seigniorage-maximizing inflation rate of 266 percent per annum.

[4] To be fair, Friedman starts from the premise that the only "genuine" commodity standards are ones in which money consists solely of the money commodity itself, or of claims fully backed by commodity money. He was led to do so by his belief that the admixture of any "fiduciary" element necessarily introduces an element of monetary discretion into what is ostensibly a commodity-based arrangement. Friedman was guilty then of conflating the consequences stemming from the presence of fractional-reserve commercial banks with those stemming from the presence of fractional-reserve central bank; eventually he revised his opinion (Friedman and Schwartz, 1986). Although Friedman's measure of commodity money resource costs does not apply to the historical gold standard, it does apply to proposals for 100-percent commodity money regimes, including those proposed by Rothbard (1962) and Buchanan (1962).

[5] In practice, as Friedman (1986) himself eventually conceded, while the direct resource costs of fiat standards may be relatively low, the indirect costs stemming from price-level uncertainty tend to be relatively high.

output sufficiently to allow the good to command a positive value in exchange. The classic instance, offered by Coase (1972) to illustrate his famous "conjecture," is a fine lithograph, the plates for which are possessed by a monopolist. In recognition of Coase's having drawn attention to them, I refer to such goods as "Coase Durables."

Coase's conjecture itself consisted of his observation that, because lithographs are durable goods, a monopolist charged with maintaining a Coase-Durable standard might find it difficult to do so, because the monopolist can profit by striking and selling more lithographs until their exchange value no longer exceeds their (trivial) marginal cost of production. Consumers, anticipating this, will be unwilling to pay more than that cost even for the first units supplied. For this reason a Coase-Durable standard, despite being based on something having nonmonetary use value and being overseen by a monopolist, is no less subject to collapse as the sort of "competitive" fiat standard considered by Friedman. That is, in so far as the monopolist is free to administer it with sole aim of maximizing profit, such a standard is just as likely to devolve into a "literal" paper standard – that is, a genuine commodity standard in which the relevant, scarce commodity is the paper upon which the lithographs are struck.[6]

According to the durable goods literature, two common means for avoiding this outcome are (1) resort to a money-back guarantee and (2) public destruction of the engraved plates used to strike the lithographs. In the first option, purchasers are promised the return of their purchase price in the event that the price of lithographs (to refer again to that example) falls below it. In the present example, in which lithographs serve as an economy's standard money, the guarantee would take the form of a "goods back" guarantee, in which the monopolist offers to redeem unwanted lithographs in some fixed real amount of one or several real goods. Such a guarantee effectively converts the lithographs from a base to a "credit" money, while making the good or goods for which they can be redeemed into the economy's actual base or standard.

The second option – destruction of the plates – converts the lithographs, according to our classification, into ordinary commodities, by making them irrevocably rather than just provisionally scarce.

Just as a Coase durable good standard money consisting of lithographs might be converted into a commodity standard in the conventionally understood sense by arranging for the public destruction of the lithograph plates, so might a standard based on "intrinsically useless" paper notes be converted into one that resembles a genuine commodity standard in depending on rising marginal production costs to limit the supply (and maintain the scarcity) of base money. This possibility brings us to the neglected, upper-right quadrant of our base-monies grid – the quadrant labeled "synthetic" commodity money. Such money consists of objects which, though lacking nonmonetary value, are absolutely rather than contingently scarce. More generally a synthetic commodity money is money that lacks nonmonetary value but is nevertheless reproducible only at a positive and rising marginal production cost, if indeed it can be reproduced at any cost at all.

4. Synthetic commodity money versus rule-bound fiat money

Although synthetic commodity money might be regarded as nothing more than a particular kind of a *rule-bound* fiat money, I think it proper to distinguish between these. The difference warranting the separate designations is that real resource costs alone limit monetary base growth in a synthetic commodity-money regime, whereas in rule-based fiat money regimes, as these are conventionally understood, base growth is limited by positive *transactions* costs, including any penalties to which rule-violating authorities are subject.[7]

In practice monetary rules, to the extent that they can be said to exist at all, have never been enforced by means of severe sanctions; indeed, it is not clear that they have ever been subject to any meaningful enforcement at all. Instead, monetary rules have tended to take the form of vague mandates, as often as not self-imposed by central bankers, who are consequently able to revise them with impunity.[8] In short, the distinction between discretionary and rule-based fiat-money regimes is itself largely hypothetical, and has been so precisely because the existence of fiat money presupposes that of a monetary authority which, being materially capable of actively managing its quantity, is bound to be tempted to make use of that capacity. As I put the matter elsewhere,

> Like a married bachelor, a rule-bound central banker is a contradiction in terms, for both the background of central bankers and the incentives they confront, combined with the inescapable imperfections of even the most carefully crafted of monetary rules, will inevitably tempt them to tinker with the money stock (Selgin 2010, p. 467).

Because it requires neither voluntary restraint on the part of a monetary authority nor the threat of sanctions, a synthetic commodity money, like an ordinary commodity money, supplies the basis for what Buchanan (1962, pp. 164–165) calls an "automatic," as opposed to a deliberately "managed," monetary system. According to Buchanan, a managed system "embodies the instrumental use" of the price level or some other macroeconomic variable "as a norm of policy either loosely by discretionary authorities possessing wide latitude for independent decision-making powers, *or closely in the form of specific rules constraining discretionary authority within narrow limits*" (emphasis added). In an automatic system, in contrast, "monetary policy as such consists solely of the designation of a single commodity or service as the basis for the monetary unit." Our understanding differs from Buchanan's only in allowing for the possibility of *synthetic* commodity-based as well as commodity-based "automatic" regimes.

The automaticity of a synthetic commodity base regime means that an economy relying upon such has no need for a monetary "authority" at all, meaning one charged with either discretionary management of the monetary base or the enforcement of a monetary rule.

Indeed, a lasting synthetic commodity regime may well be incompatible with the presence of any authority capable, not merely of establishing the regime, but also of supplanting it with a new one. That this is so may suggest that the distinction we have drawn between a synthetic commodity money and a rule-bound

[6] Bulow (1982, p. 325) notes the similarity between Coase's result and that reached in treatments by Kydland and Prescott (1977) and others of the time-inconsistency problem confronting a monopolistic supplier of fiat money.

[7] Even in theory the distinction is the clear-cut one provided here only under the assumption that counterfeit base money can always be readily identified as such. Otherwise government-imposed penalties, though not needed to limit growth in the stock of official quasi-commodity currency, must play a part in suppressing counterfeits.

[8] Proponents of monetary rules themselves, including some of the staunchest, have been inclined to treat such rules as being subject to revision. Thus Friedman (1962, p. 243) observes, regarding his then-favored k-percent rule, that he does not regard it "as a rule which is somehow to be written in tablets of gold and enshrined for all future time. . . .I would hope that as we operated with it, as we learned more about monetary matters, we might be able to devise still better rules which would achieve still better results."

fiat money is after all not so sharp: that "rules" in some sense – rules that make it costly if not impossible for a government to tamper with or replace an established synthetic commodity monetary regime, by introducing alternative forms of base money to supplement or supplant the former synthetic commodity money, must prop up such a standard. But although this is indeed so, it is no less so with respect to any conceivable monetary regime, including one based on a genuine commodity standard. The distinction between a synthetic commodity standard and a rule-based fiat standard therefore seems no less valid than that between a commodity standard and a rule-based fiat standard.

5. Advantages of synthetic commodity money

Friedman (1962, p. 219), paraphrasing Poincaré, observed that "Money is too important to be left to the central bankers." Critics of commodity standards, on the other hand, insist that money is too important to be "sacrificed. . .to the operation of blind forces" (Keynes, 1936, p. 339). The distinguishing characteristic of a synthetic commodity money, and the source of its potential advantages relative to other sorts of base money, is precisely that by resorting to it one can avoid leaving the management of money *either* to central bankers *or* to the blind forces of nature. Instead, supply is determined once and for all by artificially arranged resource constraints – constraints that transform what might otherwise be zero or close to zero marginal production costs into costs that are rising, if not infinite.

Because the real resource cost of a given real stock of synthetic commodity money need not be any greater than that of a comparable stock of fiat money, a synthetic commodity standard is free from the cost disadvantages of a genuine commodity standard. Because its scarcity, though immutable, is nevertheless contrived, that scarcity is not subject to changes stemming either from raw-material discoveries or from technological innovations. Because a synthetic commodity money has no alternative, nonmonetary uses, there is no such thing as a varying nonmonetary demand for it that can alter its purchasing power. Finally, like that of a genuine commodity money, but unlike that of a fiat money, the supply of a synthetic commodity money is not subject to politically motivated or capricious modification.

6. Inelastic synthetic commodity money

The most straightforward means for converting a fiat money into a synthetic commodity money is also the one that most resembles the standard means for preserving the rarity of an artist's lithograph, that is, public destruction of the original engraved plates, which fixes the supply of lithographs at the number struck when the plates are destroyed. Fiat money, or at least paper representatives of such money, itself consists of small lithographs, albeit ones that are not valued as such, that cannot be replicated (that is, perfectly copied) without access to original plates. Destruction of the plates used to make an established official currency, combined with other steps to prevent the imposition of a new official currency, would have the effect of raising the marginal resource cost of producing a unit of official base currency from (close to) zero to infinity.

The base money regime that such a reform would give rise to resembles a "frozen" fiat monetary base regime of the sort that Friedman (1984) eventually came to favor. The chief difference is that, insofar as Friedman viewed his proposal as one for adopting a monetary *rule* only, albeit a very strict one, the regime he envisioned remained, in Buchanan's terminology, a "managed" rather than an "automatic" regime, and therefore one in which the scarcity of base money continued to be contingent rather than immutable.

A second important difference is that the sort of synthetic commodity money regime considered here freezes, not the monetary base, which consists of the sum of outstanding paper currency and bank reserves, but the stock of paper currency.[9] The difference could be eliminated, initially, by either converting all bank reserve credits into cash prior to destroying the plates, or (more conveniently) by equipping the monetary authority with notes equal to 100 percent of banks' reserve credits prior to doing so. However, steps would have to be taken to preclude any future creation of reserve credits not fully backed with currency, which destruction of the plates alone would not achieve. On the other hand, if such steps are taken eventual deterioration of the currency stock would cause the monetary base to gradually decline.

More generally, "destroying the plates" must be understood metaphorically to refer, not merely to destroying the means for replicating outstanding units of paper currency, but dismantling the entire bureaucratic apparatus for creation of new units of official money, whether represented by paper or by computer digits, and dismantling it in such a way as to rule-out any possibility of its immanent revival. This is so because there is, after all, a crucial difference between a public authority capable of printing money, and an artist capable of making lithographs. The difference is that an artist cannot simply decree that lithographs struck from newly engraved plates must be accepted and valued as if they were identical to earlier ones that can no longer be produced. In contrast, a monetary authority is capable, not merely of printing paper money, but also of dictating the forms of paper money that banks and other private financial institutions may use to redeem depositor's accounts and to settle accounts with one another.

7. The Iraqi Swiss dinar

While no government has ever deliberately established a synthetic commodity money, and though it is not even clear what steps would be required to *officially* establish such a money – that is, what steps a government might take in order to truly deprive itself of the means for authorizing new forms of money – synthetic commodity money is not just a hypothetical possibility. A recent, unplanned instance of such money was the so-called Iraqi Swiss dinar.

Prior to the Gulf War Iraq's official currency consisted solely of paper dinars printed in 1990 or earlier by Thomas De La Rue in the U.S. using Swiss-engraved plates. In 1993, however, U.N. sanctions prevented Saddam Hussein's government from importing any more of that currency. In response the government resorted to new, locally printed notes bearing Hussein's likeness and consequently known as "Saddam" dinars. Although the Sunnis and Shiite's of southern Iraq were quick to take advantage of the government's initial offer to swap new (Saddam) dinars for old (Swiss) ones one-for-one, the Kurds of northern Iraq, now isolated from the rest of the country, had little choice but to continue employing old Swiss dinars, and did so even after Saddam Hussein officially and vindictively deprived Swiss 25 dinar notes, which made up most of the Kurdish currency stock (Coats, 2004, pp. 51–54), of both their legal tender status and their receivability in payments to public institutions.

Kurdish Iraq thus found itself employing, as its principal circulating medium of exchange, not a fiat money the supply of which could be altered by a central monetary authority, but a synthetic

[9] This statement assumes that there are no banks capable of issuing their own notes denominated and redeemable in the synthetic reserve medium. The added flexibility to be had by allowing such banks is discussed below.

commodity money consisting of paper notes that could no longer be replicated. In the south, in contrast, Saddam dinars were eventually issued on an enormous scale. Consequently, whereas by the mid-1990s the inflation rate in the south, with its fiat standard, had risen to 250 percent, with a corresponding rate of depreciation against the U.S. dollar, in the north Swiss dinars that were no longer the responsibility of any official monetary authority held their value relative to the US dollar. By 1998 the Saddam-Swiss dinar exchange rate had risen to 100:1, where it hovered before rising to 300:1 in the course of the 2003 invasion. After Hussein's government fell, In October 2003, the Coalition Provisional Authority issued its own new Iraq dinars,[10] at a rate of one-for-one against Saddam dinars and 150 to one (which was below the market rate but above purchasing power parity estimates) for those Swiss dinar notes that had not been demonetized and which were therefore, technically, still liabilities of the Central Bank of Iraq.[11]

The Swiss dinar episode and similar examples of what might be termed "abandoned" fiat money standards[12] demonstrates both the viability of a synthetic commodity currency and the impracticality of a synthetic commodity regime in which the marginal production cost of the synthetic commodity is in fact infinite, while outstanding units of it are subject to physical deterioration. With regard to viability, the episode shows that "intrinsically useless" notes can continue to function as money, even though their use as such is, not only officially unrecognized, but officially condemned. A synthetic commodity money need not be supported either by legal-tender status or by being receivable for public payments, though such attributes might of course contribute to its value and purchasing-power stability. With regard to practicality, the episode suggests that, if it is to be capable of providing for an economy's – and especially a growing economy's – long-run needs, a synthetic commodity monetary regime must at very least be capable of allowing for regular renewal of, if not for absolute growth in, the nominal stock of paper currency.

8. "Perverse elasticity" a consequence of banking restrictions

The extent to which a frozen-base base monetary regime is likely to fail to meet the requirements for macroeconomic stability depends on the nature of the banking regime with which it is associated. In Kurdish Iraq prior to the 2003 invasion there was, essentially, no banking system at all, so that the money stock consisted entirely of Swiss dinars, with no complement of transferable bank deposits. The money stock of a fixed-base regime that coexists with a fractional-reserve banking system, in which base money continues to be the only form of *circulating* currency, will tend to be, not merely *in*elastic, but *perversely* elastic: because changes in the public's desired ratio of currency to deposits will in such an arrangement translate into changes in the stock of bank reserves, which must in turn result in a multiplicative change in the equilibrium supply of bank deposits, the equilibrium supply of money in the broader sense – of currency plus transferable bank deposits – will vary with changes in the desired *composition* of money holdings. In particular, the public's attempts to swap deposits for currency must, in the absence of offsetting intervention by the monetary authorities, result in a decline in the total stock of money. It was in order to avoid the problem in question – a problem dramatically illustrated by the "Great Contraction" of the early 1930s – and thereby reduce the monetary system's dependence upon discretionary action to stabilize bank reserves, that a number of American economists mainly associated with the University of Chicago once argued for the elimination of fractional-reserve banking in favor of a system of "100 Percent Banking" (Tolley, 1962).[13]

But as Friedman (1960, p. 69), himself for a time a proponent of 100-percent reserve banking, recognized, undesired changes in the money stock arising from changes in the public's desired ratio of currency to deposits can also be avoided by "permitting banks to issue currency [while restricting] what is presently high-powered money to use of bank reserves." Although Friedman himself once rejected this alternative on the grounds that it would invite rampant counterfeiting – a position based on unwarranted generalization from antebellum US experience, he eventually became convinced that there was no sound economic argument against freedom of note issue (Selgin, 2008).

Besides being capable of making the equilibrium money stock depend only on the total stock of base money, and not on the public's preferred ratio of currency to bank deposits, an entirely free banking system,—here meaning one in which there are neither restrictions on banks' ability to issue their own (redeemable) notes nor minimum statutory reserve requirements, is also capable to a limited extent of preserving a stable level of nominal spending by accommodating changes in the velocity of money, and of doing so despite a fixed monetary base (Selgin, 1994), because in such a system reductions in the velocity of money lead, *ceteris paribus*, to corresponding reductions in the flow of payments and, hence, in banks' optimal prudential reserve ratios. The combination of free banking and an inelastic synthetic commodity standard is therefore capable in principle of automatically promoting macroeconomic stability.

But while this combination might be compatible with a high degree of monetary stability, it might still be far from ideal. For one thing, extensive growth in the demand for real money balances, including growth stemming from an expanded labor force, could only be accommodated by means of a decline in equilibrium nominal wage rates, with all the potential for short-run misallocation of resources that such a decline may entail; and even a very limited, residual public demand to hold base money would undermine

[10] These were once again printed using the old Swiss plates, though with new colors distinguishing them from the original Swiss dinars (King, 2004, pp. 7ff).

[11] A compromise was reached regarding the 25 dinar Swiss notes: Kurdish authorities had wisely taken the precaution of urging citizens to register their holdings of these with local authorities after Hussein repudiated them. Consequently the Coalition government agreed to exchange new dinars for Swiss 25 dinar notes at the 150-to-one rate only for persons who had registered their former holdings, and up to the amount so registered, for an extended period ending on April 17, 2004 (Coats, 2004, p. 54).

[12] Another recent episode – the continued use of shilling notes from the former Central Bank of Somalia following the collapse of the Barre regime and that bank's looting and closure in early 1991 – blurs instead of clarifying the distinction drawn here between quasi-commodity money and a commodity money proper: while the circumstances precluded further production of authentic (old) Somali shillings, counterfeit shillings were imported and successfully circulated to such an extent as to cause old shillings generally to command little value beyond their actual marginal resource cost. Allowing for this, the shillings resembled more an ordinary commodity (paper and ink) than a synthetic one. See Mubarak (2003) and Luther and White (2011). While Swiss dinars were serving as money in northern Iraq, old Zaires continued for a time to be the preferred currency in Zaire's diamond-mining province of East Kasai, were they traded in April 1997 for US dollars at a rate of 16M:1, despite having been officially replaced in 1993 with new Zaires rated at 1 new Zaire = 3 million old. The preference for the old notes reflected the belief, which was in fact born out, that being fixed in supply the old notes would not depreciate as rapidly as the new ones (Anonymous, 1997). In July 1998 the new Zaires were in turn replaced by (new) Congolese francs.

[13] The sort of 100-percent reserve system proposed by Rothbard (1962) and some other Austrian-School economists differs from the Chicago version in calling for a 100-percent *gold* standard.

the arrangements capacity to accommodate velocity changes.[14] Finally, while it is intriguing to contemplate the implications of a rigid synthetic commodity money arrangement accompanied by a free banking system, the possibility that banking regulations will never allow banks to issue circulating IOUs of any kind, let IOUs denominated in and intended as substitutes for a synthetic commodity money, makes it worthwhile to consider arrangements that might promote overall macroeconomic stability despite continued reliance upon base money itself as the economy's only form of cash.

9. Elastic synthetic commodity money

To envision a synthetic commodity money the stock of which is capable of growing, and of growing automatically, to accommodate growth in real money demand, it is useful to recall another monetary rule that Milton Friedman proposed – his well-known k-percent rule, providing for a constant growth rate of the (fiat) monetary base – while recalling as well Friedman's observation that such a monetary rule might just as well, or better, be implemented by a computer as by the FOMC.

To get from the computer-implemented k-percent rule envisioned by Friedman to an elastic synthetic commodity standard, one need only imagine a version of his imaginary computer program that, once set working, cannot be shut off or otherwise tampered with: for instance, one that could only be altered using a key or code that has been deliberately thrown away. The program would thus establish once and for all a predetermined path for the base money stock.

10. Bitcoin

Since Friedman first proposed his computer-controlled monetary system, advances in computer technology have not just made such an immutable, synthetic commodity version of his proposal possible. They have led to the creation of an actual semi-elastic synthetic commodity currency – albeit a private digital or "cyber" currency, rather than a government-authorized paper currency – the stock of which automatically grows, though at a rate that eventually declines to zero, transforming it into an inelastic synthetic commodity. The currency, Bitcoin, was introduced in 2009.

According to Grinberg (2012, p. 163), Bitcoin "blocks" are generated by "miners" by solving a mathematical problem, with the size of blocks and the difficulty of the problem adjusting so as to keep total Bitcoin output growing at a steadily diminishing rate:

> As the number of miners in the network changes, the problem difficulty adjusts to ensure that bitcoins are created at a predetermined rate and not faster or slower. Currently, about 50 bitcoins are issued every ten minutes, although the rate will halve to 25 bitcoins in about two years and will halve every four years after that. At those rates, 10.5 million bitcoins will be created in the first four years, half that amount in the next four years, and so on, approaching but never reaching a total supply of 21 million bitcoins.

Although by forming "pools" possessing large amounts of computer power, some enterprising Bitcoin miners have been able to achieve relatively high yields, by doing so they alter the collective's share of total Bitcoin output only, rather than the total itself (ibid, p. 167).

The increasing marginal mining cost of Bitcoin gives it a superficial resemblance to a precious metal standard. But whereas the discovery of a more efficient ways to mine a precious metal results in an increase in the overall rate of metal output, and not just the relative output of particular mines (White, 1999, pp. 28-36), with Bitcoin such innovations alter output shares only, and not total coin output, which is exogenously determined. Bitcoin production is, in other words, not vulnerable to supply shocks in the usually understood sense.

Some claim, however, that Bitcoin is not entirely free from exposure to supply shocks, in the shape of innovations undertaken by its own developers. According to Grinberg (ibid., p. 175) although it is frequently portrayed as lacking any "central institution with discretionary authority to increase the money supply more quickly than the inflation [sic] rate built into the software," Bitcoin's five-member "development team," which is responsible for maintaining, debugging and otherwise improving the Bitcoin software, constitutes a "de facto central bank" which, while being incapable (unlike government-backed central banks) of compelling anyone to accept new Bitcoins based on revised (open-access) software that produces them at a different rate than their predecessors. Grinberg supposes that "most users would probably use the new version. . .because of their trust in the development team" (ibid., n. 71). But he adds that, although such a regime change might occur because the team "honestly and correctly believes" that it is "in the best interest of the Bitcoin community," it might also result from that team's being "co-opted by a particular interest group." Any coalition, Grinberg observes, might "take control of the Bitcoin network by convincing a majority of Bitcoin users to use a different version of the software" (ibid., p. 176, n. 72) and thereby establish a new Bitcoin standard to compete with, and perhaps entirely destroy, the old one. For instance, Grinberg refers to a Bitcoin forum commentator's concern that a coalition of members of the Bitcoin community might "push for minting more the 21M BTC and stop the deflationary process built-in to the concept," using any number of "economical and political arguments. . .to support this idea in a very rational fashion" (ibid., p, 176).

Such misgivings appear misplaced: they treat as a fault of Bitcoin what is in fact a virtue of currency competition, to wit, the possibility that a new currency may shove aside an established one, despite network externalities favoring the latter, provided that the new alternative seems sufficiently advantageous in other respects. That in the particular scenarios considered the upstart currency happens to be offered by the same company responsible for the established one hardly alters the point, which is that the rival is only likely to make headway if it is in fact likely to be superior in at least some important respects.[15] Whatever advantages an established synthetic commodity standard may possess, these need not be regarded as being somehow undermined by the possibility that an even better standard might supplant it.

Indeed, a particular virtue of Bitcoin's open-source software is that, while it allows for innovations to the base-money supply process, it does so in a manner such that coins mined using modified software, instead of being outright replicas or counterfeits outstanding coins, are in fact distinct coin "brands": because software innovations are themselves visible, and coins can be identified according to the programs used to generate them, software and product differentiation go hand-in-hand. As Bitcoin's FAQ page explains,

[14] Selgin (1997) distinguishes between the macroeconomic consequences of changes in the general level of equilibrium factor prices and those of changes in the general level of final-goods prices.

[15] For a formal analysis of conditions under which a new fiat currency may succeed, despite network effects, in replacing an established standard, see Selgin (2003).

> BitCoin is a distributed network, so any changes implemented to the system must be accepted by all users. Someone trying to change the way BitCoins are generated would have to convince every user to download and use their software—so the only changes that would go through are those that would equally [sic] benefit all users. . . .If users don't like the changes, they won't take.

For this reason the implications of Bitcoin-type supply innovations may be better understood by reference to the monopolistic-competition frameworks of Benjamin Klein (1974) and Hayek (1978) than by appeal to Friedman's scenario in which rival producers supply indistinguishable fiat monies.

11. Almost ideal synthetic commodity money

For all the ingenuity it exhibits, Bitcoin is far from being an ideal monetary medium from a macroeconomic perspective. Although quantity of Bitcoins will continue to increase until 2040, in that year Bitcoin will become just another example, albeit a digital one, of a synthetic commodity money with a supply that is at best absolutely constant and, at worst, slowly declining owing to attrition.[16] According to Dowd (2013, p. 26), were a Bitcoin standard established at that or some later date, then, assuming a Bitcoin attrition rate of .5 percent, a real income growth rate of 2 percent, and a constant Bitcoin velocity of circulation, the economy would be subjected to a 1.5 percent rate of deflation, which could be problematic, and especially so when growth, instead of being driven solely by gains in total factor productivity, depended on increasing labor input.[17] Changes in Bitcoins' velocity could also destabilize both the price level and nominal spending, and especially so if Bitcoin appreciation, by encouraging hoarding, results in accelerating deflation (see Barber et al., n.d.) In short, as Dowd observes (ibid., p. 27), although the supply of Bitcoins is perfectly predictable, the demand for them is at present very unpredictable, "and there is nothing in the Bitcoin system to stabilize it." And although it is true that the demand for Bitcoin may become much less unstable as the Bitcoin payments network expands, there is no reason to assume that it will be any less subject to occasional, unpredictable changes such as those to which conventional forms of base money have always been subject. These shortcomings of a Bitcoin standard raise the intriguing possibility that one might create a synthetic commodity money based upon a more macro-economically friendly production protocol – one that might achieve outcomes similar to those that might also be achieved by a perfectly enforced monetary rule. Such a money might, for example, bear a perfectly elastic supply schedule, so as to preserve a stable purchasing power, like the common brick standard recommended by Buchanan (1962), but without that standard's potentially high resource costs. Alternatively, it might serve to achieve results similar to those that Scott Sumner (2012) and others would have the Fed achieve by deliberately targeting the growth rate of U.S. Nominal GDP, using a mining protocol in which the cost of base money production rises when expected NGDP growth rises above the targeted value, and declines when it falls below.

For example, instead of the present Bitcoin arrangement, in which a "difficulty parameter" controlling the overall rate of Bitcoin output is reset every 14 days so as to maintain the predetermined global rate of output despite improvements in mining technology, one can imagine a system in which the difficulty parameter responds, not only to changes in mining technology, but also to changes in the global synthetic-money transactions volume, so that mining becomes more profitable whenever that volume falls short of, and less profitable when it exceeds, some target path. Although providing for such state-dependent adjustments is technologically challenging, it appears that the challenge can be met without sacrificing the advantages of complete decentralization.[18]

12. Private versus government-sponsored synthetic commodity money

Although I have suggested that a synthetic commodity monetary regime might perform better than either existing fiat money regimes or than potential commodity money alternatives, I have deliberately avoided suggesting that any government is likely to take steps to help establish such a regime. Indeed, rather than make that suggestion, I am inclined to argue that, while it is possible to *conceive* of a government-sponsored synthetic commodity monetary regime, it is difficult to imagine a government actually embracing the idea, and more difficult still to imagine one that would not be tempted to interfere with, and ultimately to undermine, an established synthetic commodity standard by means of its ability to introduce and to confer legal tender status upon some new fiat currency.

King (2004) has argued that it is both undesirable and *impossible* for any government to commit its successors to an immutable monetary regime:

> The key question for a public currency is how do we prevent the government (ourselves) from abusing its issuing power in the future? Collective decisions today cannot bind future collective decisions. . . monetary arrangements can always be changed in the absence of an outside enforcer. . . .A really bad government will simply restore discretion to itself (ibid., pp. 3–4).

Although King here insists upon the impossibility of a permanently binding monetary *rule*, his arguments would seem to apply with at least equal force the alternative of a synthetic commodity money. It thus appears that, just as the temptation of private issuers to profit from hyperinflation "bedevils private fiat money production" (White, 1999, p. 239), that of public resort to legal tender laws and other coercive measures must "bedevil" attempts to establish a "public" synthetic commodity standard.

The unofficial status of both of the real-world instances of synthetic commodity money considered here is therefore more than just an incidental feature of those monies. Whether the future will give rise to more examples of unofficial synthetic commodity money, and whether conditions will ever arise such as could result in any of them displacing official money both on a large scale and permanently, remains to be seen. For the time being, however, the possibility of monetary stabilization achieved by means of a synthetic commodity standard remains as hypothetical as it is tantalizing.

References

Anonymous, 1997. Zaire: popular monetarism. Economist 342 (8011), 69–70.
Barber, S., Boyen, X., Shi, E., Uzan, E., n.d. Bitter to Better – How to Make a Bitcoin Better Currency.
Buchanan, J.M., 1962. Predictability: the criterion of monetary constitutions. In: Leland, B.Y. (Ed.), In Search of a Monetary Constitution. Harvard University Press, Cambridge, MA, pp. 155–183.

[16] Although bitcoins do not wear out, bitcoins can be "lost" when private storage devices ("wallets") or computer files containing "keys" their owners must have in order to use them are lost or destroyed.

[17] Greater difficulties arise in this case because the decline in equilibrium output prices would also entail some corresponding decline in nominal wage rates.

[18] For some possibilities, see https://en.bitcoin.it/wiki/Contracts#Example_4:_Using_external_state.

Bulow, J.I., 1982. Durable-goods monopolists. J. Polit. Econ. 90 (2), 314–332.
Coase, R.H., 1972. Durability and monopoly. J. Law Econ. 15 (April), 143–149.
Coats, W., 2004. My Travels to Baghdad. Warren Coats, Bethesda.
Kevin, D., 2013. Contemporary Private Monetary Systems (unpublished).
Easterly, W.R., Mauro, P., Schmidt-Hebbel, K., 1995. Money demand and seigniorage – maximizing inflation. J. Money Credit Bank. 27 (2), 583–603.
Fisher, I., 1920. The Purchasing Power of Money, 2nd ed. Macmillan, New York.
Friedman, M., 1960. A Program for Monetary Stability. Fordham University Press, New York.
Friedman, M., 1962. Should there be an independent monetary authority? In: Leland, B.Y. (Ed.), In Search of a Monetary Constitution. Harvard University Press, Cambridge, MA, pp. 219–243.
Friedman, M., 1984. Monetary policy for the 1980s. In: John, H.M. (Ed.), To Promote Prosperity: US Domestic Policy in the Mid-1980s. The Hoover Institution, Stanford, CA.
Friedman, M., 1986. The resource cost of irredeemable paper money. J. Polit. Econ. 94 (3), 642–647.
Friedman, M., Schwartz, A.J., 1986. Has government any role in money? J. Monet. Econ. 17 (January), 37–62.
Grinberg, R., 2012. Bitco: an innovative alternative digital currency. Hastings Sci. Technol. Law J. 4 (1 (Winter)), 159–207.
Hayek, F.A., 1978. Denationalisation of Money: The Argument Refined. Institute of Economic Affairs, London.
Keynes, J.M., 1936. The General Theory of Employment, Interest, and Money. Macmillan, London.
King, M., 2004. The institutions of monetary policy. Am. Econ. Rev. Pap. Proc. 94 (2), 1–13.
Klein, B., 1974. The competitive supply of money. J. Money Credit Bank. 6 (November), 423–453.
Kydland, F.E., Prescott, E.C., 1977. Rules rather than discretion: the inconsistency of optimal plans. J. Monet. Econ. 85 (3), 473–491.
Luther, W.J., White, L.H., 2011. Positively Valued Fiat Money After the Sovereign Disappears: The Case of Somalia. George Mason University Department of Economics Paper, pp. 11–14.
Mubarak, J.A., 2003. A case of private supply of money in stateless Somalia. J. Afr. Econ. 11 (3), 309–325.
Rothbard, M.N., 1962. The case for a 100% gold dollar. In: Leland, B.Y. (Ed.), In Search of a Monetary Constitution. Harvard University Press, Cambridge, MA, pp. 94–136.
Selgin, G., 1994. Free banking and monetary control. Econ. J. 104 (November), 1449–1459.
Selgin, G., 1997. Less Than Zero: The Case for a Falling Price Level in a Growing Economy. The Institute of Economic Affairs, London.
Selgin, G., 2003. Adaptive learning and the transition to fiat money. Econ. J. 113 (484), 147–165.
Selgin, G., 2008. Milton Friedman and the case against currency monopoly. Cato J. 28 (2 (Spring/Summer)), 287–301.
Selgin, G., 2010. The futility of central banking. Cato J. 30 (3), 465–473.
Sumner, S., 2012. The Case for Nominal GDP Targeting. The Mercatus Center, Arlington, VA.
Tolley, G.S., 1962. 100 percent reserve banking. In: Leland, B.Y. (Ed.), In Search of a Monetary Constitution. Harvard University Press, Cambridge, MA, pp. 275–304.
White, L.H., 1999. The Theory of Monetary Institutions. Blackwell, London.