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Aims and Scope

The Journal of Prices & Markets, published by the Ludwig von Mises Institute of Canada, is a journal that seeks to improve the understanding of the role of markets in the economy. Submissions should seek to shed light on contemporary issues while being grounded in a praxeological reasoning. Prices & Markets welcomes submissions from a variety of fields such as politics, sociology, and psychology, where ever they can bring relevance to economic and financial questions.

Mission

It is the mission of the Ludwig von Mises Institute of Canada to educate the public to the importance of placing human choice at the center of economic theory, to encourage a revival of critical historical research, and to advance the Misesian tradition of thought through the defense of the market economy, private property, sound money, and peaceful international relations.

“Economics is mainly concerned with the analysis of the determination of money prices of goods and services exchanged on the market. In order to accomplish this task it must start from a comprehensive theory of human action.... [I]t must not restrict its investigations to those modes of action which in mundane speech are called “economic” actions, but must deal also with actions which are in a loose manner of speech called “noneconomic.”

—Ludwig von Mises

Unintended Consequences

How “macro” should national income accounting be?

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It is trivial to say that any cardinal number can be added to another to answer the question of “how many” or “how much” of something there is. The trick lies in teasing some relevance out of the resultant sum. The relevant tradeoff in constructing any aggregate is between the advantage of reduced complexity of a unique figure summarizing data and the disadvantage of the information lost from any individual figure within the set.

This realization was what Friedrich Hayek had in mind as he reviewed John Maynard Keynes’s 1930 *Treatise on Money*. Disappointed with the turn that he saw economics taking,

Hayek lamented that “Mr. Keynes’ aggregates conceal the most fundamental mechanisms of change” (1931: 277).

There is an enduring appeal to macroeconomic theorizing. The urgency of the problem of 2.8 million unemployed Americans (5.8% of the workforce) seems to be a more important problem than, say, your neighbor losing his job. Likewise, the fact that Canadian per capita income was \$52,000 in 2013 seems a more useful statistic than the salary of, e.g., Mike, from Canmore. Aggregates are appealing. They’re also dangerous when misapplied.

Although the misapplication of macro-aggregates is well-known, there is a deep-rooted commitment amongst the economics profession to accepting them at face value, cognizant of their limitations. In this vein, I've (2013) written about how the velocity of money commonly discussed is one such misapplication. The benefit of the equation of exchange is the simple relation between money and expenditures. What the common reckoning of money's velocity loses sight of is that not all expenditures are paid for with money – purchases on current account and initial funding provided by fractional-reserve bank created money are two such examples. It's not incorrect to say that velocity is the ratio between nominal expenditure (PY) and some monetary aggregate (M), but what this velocity means (if anything) is the key to understanding its implications.

The rate of unemployment provides a similar example. It may be that 5.8% of Americans who want a job don't have one, but for any one individual there are only two relevant unemployment rates. You either have a job or don't creating own-unemployment rates of either 0 or 100%.¹ Instead of discussing an unemployment "rate", perhaps we should be discussing the unfortunate phenomenon in terms of the rate of job finding, as I've suggested in Howden (2014). This, too, is an aggregate, though one that hits a little closer to home for any one unemployed individual.

It's not that we need to rid ourselves of the baggage of macro-statistics completely. Rather, we need to 1) critically assess whether they are appropriate, if so, 2) for what role, and finally

3) whether they are consistent as a tool we can use to tell the story we want.

Consider the national income accounts. That gross domestic product is analogous with the aggregate income of an economy is something every first year economics student learns. GDP certainly appears to be important, even to those who think money doesn't matter. The author of the textbook I use in my *Principles* class, Greg Mankiw, reconciles this paradox by noting that

[a] a large GDP does in fact help us to lead a good life. GDP does not measure the health of our children, but nations with larger GDP can afford better health care for their children. GDP does not measure the quality of their education, but nations with larger GDP can afford better educational systems. GDP does not measure the beauty of our poetry, but nations with larger GDP can afford to teach more of their citizens to read and to enjoy poetry... In short, GDP does not directly measure those things that make life worthwhile, but it does measure our ability to obtain the inputs into a worthwhile life. (Mankiw and Taylor 2010: 485)

Incomes themselves and aggregate income in particular, are useful to the extent that they allow one to keep "score" of their monetary contribution to society. More to the point, they let you see how this contribution varies over time. Quite literally, they tell you when you are faced with a change of fortune.

Surely any objection to aggregates cannot be solely on the basis of losing sight of the trees for the forest. Businessmen score their success or failure over the previous year by aggregating sales and costs to determine net income. Even vulgar unit-based expressions, such as sales per customer, are useful. This usefulness is not in spite of, but because of the fact that no one

¹ Excluding marginally attached or over-qualified workers. Even the binary own-unemployment rates of 0 and 1 are suspect if considered relative to whether one wants a job or not. Somehow the own-unemployment rate of 1 in the case where I want a job cannot be much different than my similar un-ownership rate of a Ferrari of 1, though I doubt many economists place much importance on the second figure.

customer will be the average. In a former life I found myself as a clerk in a clothing store. Total sales and profit concerned me little, but I could depend on the average customer to spend \$ x and earn me \$ y in commissions. I motivated myself accordingly.²

Aggregates are much more useful than the seeming insignificance of my own pay. During the socialist calculation debate, Mises (1985: 71-72) made clear that it was “[o]nly because the prices of all goods and services in the market can be expressed in terms of money [that] it is possible for them, in spite of their heterogeneity, to enter into a calculation involving homogeneous units of measurement.” And, as Joe Salerno reminds us along a similar vein, it is only through the use of homogeneous units, themselves created and made possible through monetary aggregation, that economic calculation can be successful (2010: 469). Some form of aggregation is the building block of the rational allocations provided for on the market.

Austrian economists are reluctant to use aggregate income measures, such as GDP, not because they are necessarily incorrectly constructed, but because they are not useful for the task at hand. The scope of transactions taking place at any one time is much broader than those focused only on the payment of “final goods and services”, as GDP focuses on. While Hayek’s critique of the aggregate might be the most famous, Skousen (1990; 2010) has provided the most useable alternative (one which many Austrian economists strongly support) in his gross domestic expenditure (GDE) figures. (In fact, through his efforts the U.S. Bureau of Economic Analysis now publishes quarterly data on the figure dating back to 2005Q1 under the guise of “gross output”.) Skousen’s GDE includes all monetary transactions, and generally shows that intermediary goods (excluded

in standard GDP calculations) represent about double the value one obtains by focusing exclusively on final transactions. (In 2013, American GDE totaled \$29.7 tr. versus \$16.8 tr. for GDP.)

GDE might be a step in the right direction, but it is unclear what direction that is. David Colander (2014) views it as merely another statistic to confuse students, though that is no reason to exclude it as a tool of useful analysis. (Many things confuse students, as well as economists.)

Two criticisms of GDE spring to mind, both with Austrian-type origins. In the early days of the development of an aggregate income statistic there was vibrant debate as to whether government services should be included. On the one hand, it is questionable how much value the government portion of expenditures actually represents. After all, “the government’s tax revenue and deficit revenue are both burdens imposed on production, and the nature of this burden should be recognized. Since government activities are more likely to be depredations up, rather than contributions to, production, it is more accurate to make the opposite assumption: namely, that government contributes nothing to the national product and its activities sap the national product into unproductive services” (Rothbard 1962: 1293). Such a criticism may be valid in some instances, but just because an expenditure is inefficient or at the expense of other productive enterprise cannot be a reason to exclude it. (Otherwise we could count an innumerable amount of private expenditures that would satisfy both criteria.) In a similar vein, one could exclude government services since they are not transacted at market prices whether because they are paid through taxes, or because they are sold through monopolized services (Coyle 2014: 29-30). On the other hand, government services usually represent intermediary goods that would otherwise be excluded. In any case, Austrian economists should be wary of rejecting one measure because it includes government services (GDP)

2 The classical statistician in me would relish a poor sales week for the implications it had for the next week’s commissions.

while embracing another with a similar inclusion (GDE).³

From a technical point of view, the number of monetary transactions in an economy (the monetary sum of which GDE measures) is itself a product of the structure of businesses. Larger businesses, conglomerations, and the result of mergers and acquisitions all bring an increased emphasis on intra-firm transactions at the expense of those taking place between firms. Hayek alluded to this in his discussion of the difficulties of varying the money supply to meet the needs of the economy, because it is not entirely clear what such needs would be. At one extreme, one large firm (or a completely socialized economy) will, per definition, have no need for any extra-firm transactions (or money to conduct such transactions in). For the same amount of output, one firm per production process would lead to the maximum amount of extra-firm transactions. Business size, and the total number of businesses, matter for the construction of GDE.

In a sense, income matters in a way that the sum of expenditures does not. I am not sure whether any individual considers the total amount of purchases or sales he makes over the course of a year, though he certainly will often consider the amount of income he earns.

What needs to be done is a reconstruction of aggregate income statistics in a more meaningful way. I will suggest three such figures.

The first disaggregates income between that which is privately procured and that which is through government activities. Rothbard's (1963: 296) use of "gross private product" (GPP) is useful. Effectively GPP subtracts government expenditures from the calculation of GDP. Normalizing GPP by allocating it among the private workers who create it gives an idea

of what is the average income created by a privately employed worker. (Alternatively, since the national income accounts are determined by expenditure classes this figure will amount to the average cost of each private worker.)

Just as Rothbard's GPP/private worker is helpful in teasing out the rise and fall of the private sector's fortunes, taking the total of government expenditures and normalizing it for the number of public employees (G/public worker) gives one a reckoning of how well the government's fortunes are faring. Again, since the national income accounts are able to treat income and expenditures more or less as interchangeable variables, this figure will tell us how expensive each public worker is, or how lucrative it is to be employed as one.

Finally, it is instructive to compare these two figures to the average income earned per worker, both public and private. In distinction to the more common GDP/capita figure, this statistic uses only those employed as the denominator (instead of the whole population). The result is a figure that shows the average income generating contribution per worker, or the average expense incurred by the employment of each employee.⁴ Figure 1 gives a snapshot of these figures since 1960.

I will conclude with a brief interpretation of these aggregate income figures. Since 1960 the average income generated by a private worker has grown at an annual rate of 4.57%. This is slightly lower than the average per total workers (public and private) at 4.77% and far lower

3 One could imagine what the Austrian response would be to a surging GDE figure attributed to a surge in government expenditures in the face of a drop in private transactions.

4 In all three figures cited, GPP/private worker, G/public worker, and GDP/worker it is not strictly accurate to equate the resultant figure with the average cost or income generated by the relevant worker. There are many sources of income (e.g., interest, dividends, etc.) not related to wages, and likewise many expenses (e.g., capital costs, interest payments, etc.) not related to wages. In all cases the figure given should not be taken as synonymous with what the average worker incurs, but rather what the relevant total cost /income associated with that worker is.

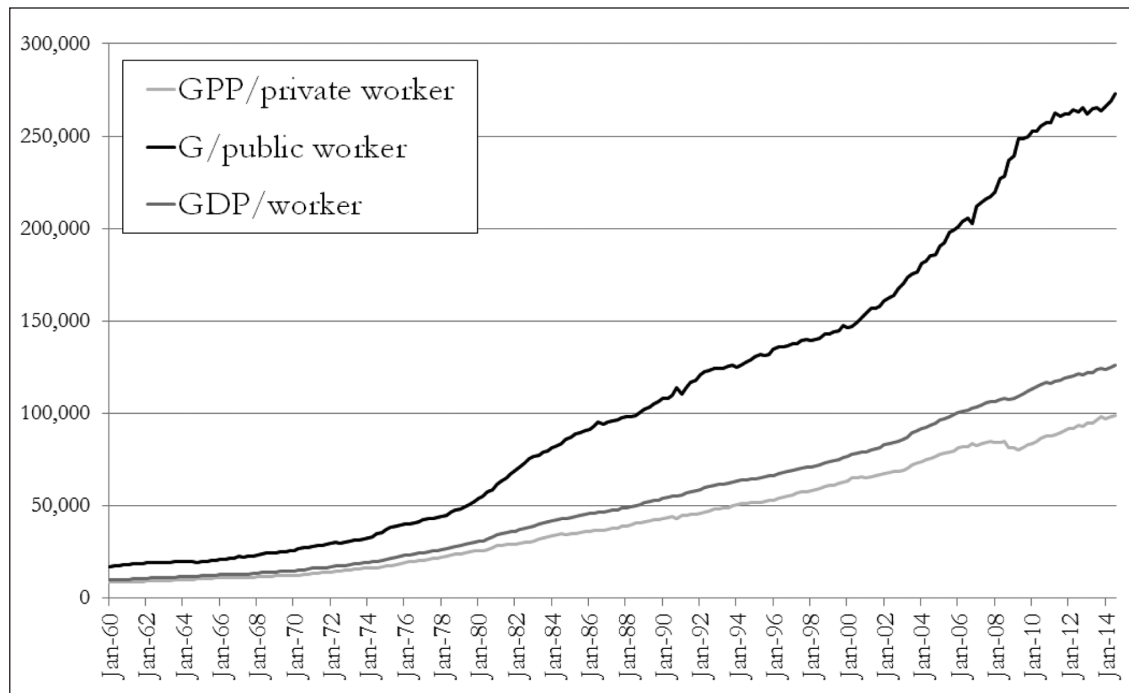


Figure 1: Aggregate income figures for the United States, 1960-2014

Source: Federal Reserve Bank of St. Louis

than the average for public employees at 5.20%. In some sense the growth in private income has lagged that of the greater average, and has performed far worse than its public counterpart. Not only that, but the volatility in the growth of private income has also been far more pronounced than in the public sector. Recessions are far more damaging to private workers. Between 2008Q3 and 2009Q2 the average private worker saw his income reduced by more than 5%. (The average public worker, in contrast, saw his income contribution increase by nearly 9% over the same period.)

There is one alternative way to look at the above figures. Instead of treating them as the income generated by each worker, one can

think of them as the expense created by each worker. Under this interpretation one can point to one of two facts. The first is that the average public employee is nearly three times as expensive as the average private worker. This way of interpreting the data is not so telling, as it could be that the government specializes in services that are inherently more expensive to produce (e.g., national defense, law and justice enforcement, healthcare, etc.). Alternatively, and of more relevance, one could point to the fact that the average growth rate in expenditures per public employee has risen much more rapidly than that of private workers. More pointedly, this divergence has grown especially wide since the year 2000.

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Bounded Rationality

All Rich and Equal: The Long-Run Effect of Expansion in Wealth

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Economists and political philosophers are often concerned with measuring the level of inequality of wealth or income in an economy, and in particular, with the question of whether certain kinds of political systems lead to greater or lesser levels of inequality. Indeed, the issue of inequality is regarded as being sufficiently important that there are textbooks devoted to the subject (e.g., Cowell 2011) and even entire scholarly journals devoted to analysis of the subject (e.g., *Journal of Economic Inequality*, *Journal of Income Distribution*).

Notwithstanding this fact, there is widespread confusion about the nature of wealth

inequality and the effects of wealth expansion and income mobility over time. One of the most common manifestations of this confusion is regular assertions that equality is increasing and that this is the result of free-market capitalism. It is now common to hear critics of the free market concede that it is conducive to the generation of large amounts of wealth, but claim that this wealth comes with rising inequality.

There is enough of an empirical basis for this to make the story plausible to many people. Comparing static measures of inequality across time there has been rising inequality of incomes in Western countries since approximately after

WWII when economies were liberalised to some extent from wartime controls and “progressive” taxation was ameliorated. However, such comparison of static measures is invalid for a number of reasons; it gives a very misleading picture of changes in inequality.

The pseudo-dynamic empirical investigations obtained by comparing static measures of inequality across time fail to account for mobility of incomes over a human lifetime and also fail to account for diminishing marginal returns of wealth. Broadly speaking, as a society becomes wealthier there are two major effects that are both conducive to greater equality (other smaller methodological issues can also affect this; see, e.g., Fields 1987). One is the effect of diminishing marginal returns, which tends to reduce inequality in the attainment of human needs. The other is the effect of greater health and longevity, which affects income mobility in ways which also tend to reduce inequality over time. Analysis of changes in inequality over time can only be done properly by adjusting static measures of inequality to account for these effects.

Measures of inequality of wealth—the Lorenz curve and Gini coefficient

Analysis of inequality in wealth usually uses money as the numéraire for calculation of the level of inequality. This is quite a natural measure, insofar as money serves as a proxy for all exchangeable goods in the economy. The inequality in the distribution of wealth or income is often quantified via a transform of the static distribution of that quantity at some point in time. The most common transform is the Lorenz function (Lorenz 1905). In contexts where we are dealing with the distribution of wealth¹ this function tells us the proportion

of total wealth held by some specified proportion of the lowest wealth-holders. To obtain a scalar measure of inequality it is common to use the Lorenz curve to determine the Gini coefficient of the distribution (Gastwirth 1972; Dagum 1980). This is a value between zero and one, with zero representing perfect equality of wealth (i.e., everyone has the same amount of wealth) and one representing perfect inequality of wealth (i.e., one person has all the wealth).

The Lorenz curve and Gini coefficient are both invariant to changes in scale, so that the units of measurement of wealth (e.g., dollars, cents, francs, etc.) do not affect the measurement of inequality. This is a desirable property, insofar as these units are arbitrary in a static scenario.² However, the measurement of inequality of wealth, measured in money, also means that changes in the average level of wealth over time do not show up in comparisons of wealth inequality across time. When comparisons in the distribution of wealth are made over time it is often the case that the average level of wealth is changing over time (usually increasing) and this does not manifest in any change in the Lorenz curve or Gini coefficient. Even if the average level of wealth doubles or triples over time the distribution of wealth maintains its shape, and this means that there is no change in the measures of inequality over time.

In a static analysis this is entirely desirable—if the distribution of wealth maintains a particular shape (but is subject to changes in scale) then the change in scale should not result in any change in the measured level of inequality.

insinuate that wealth or income is actually “distributed” in the sense of being collectively owned and then apportioned out to individuals.

2 Alternative measures of inequality have been proposed which do not satisfy this scale-invariance property (e.g., Kolm 1976a, 1976b). Nevertheless, scale-invariance is generally regarded to be useful in ensuring that the units of measurement do not affect the inequality measure.

1 To be clear, when we talk about the “distribution” of wealth or income in this article, we are using the term only in the statistical sense. We do not intend to imply or

However, as any economist knows, wealth itself is only a means to the end of the satisfaction of human wants. Wealth stands as an adequate proxy for the entire class of exchangeable goods, but as a person's wealth rises there is diminishing marginal returns to this class of goods, and a consequent substitution to non-exchangeable goods. What is really of interest in the analysis of inequality of wealth is inequality in the satisfactions that are obtained from these varying levels of wealth.

The Lorenz curve and Gini coefficient of raw wealth or income values is pervasive in economic analysis and related political discussion. While somewhat useful in giving a static picture, these measures are often used for more than this. In particular, the Lorenz function and Gini coefficient for raw wealth or income values are often shown changing over time and this is intended to give a picture of the changing level of inequality. The World Bank and other international agencies keep data on the change in these measures over time (World Bank 2014; UNU 2014) and this data is used in analysis of inequality over time (e.g., Biancotti 2006).

Unfortunately, this kind of time comparison can be highly misleading. If the average level of wealth is rising over time then there will be diminishing marginal returns to wealth; the rising level of wealth makes further acquisition of exchangeable goods relatively less valuable than the acquisition of non-exchangeable goods. Use of raw wealth or income values in the Lorenz curve of Gini coefficient ignores this change.

Measuring inequalities over different times or places

In cases where we are concerned with a comparison of inequality across two different distributions of wealth (varying by time and/or place) the comparison in raw measures of inequality is not really telling us what we need to know. What is needed is an accounting for

the fact that higher levels of wealth come with diminishing marginal returns. This might be accomplished by applying some kind of transformation to the individual wealth or income values to adjust for diminishing returns prior to putting them into inequality measures. Some form of increasing concave transformation with a fixed point at zero could be applied to inflation-adjusted wealth or income values. The concavity of the transformation would ensure that the marginal returns are diminishing, perhaps down to zero.³ This would yield a measure accounting for diminishing returns to wealth.⁴

There is some recognition of the need to adjust for changing levels of wealth or income. For example, Stanton (2006) advocates adjusting individual income values by taking logarithms prior to calculating inequality measures. (This is one example of an increasing concave transformation that could be applied. It would need to be adjusted slightly to have a fixed point at zero.⁵) This idea is based on a variation

3 Given a wealth variable w it would be sensible to use a second-order differentiable function R with $R(0) = 0$, $R'(w) > 0$, $R''(w) < 0$ and $\lim_{w \rightarrow \infty} R'(w) = 0$. This captures the requirement of increasing value (i.e., wealth is a good) and diminishing marginal returns with the marginal returns approaching zero in the limit.

4 Diminishing marginal returns is a core concept in microeconomic theory. When preference relations are strictly convex this yields a utility function which is subject to diminishing marginal returns; Jehle and Reny 2000, p. 19. Nevertheless, "utility" in this context is merely a representation of an underlying ordinal preference. Diminishing marginal returns with respect to wealth and income have also been found empirically in various investigations in "happiness research"; see e.g., Veenhoven 1991, p. 10; Diener et al. 1993, p. 204; Diener and Biswas-Diener 2002, p. 204; c.f., Easterlin 2005. The latter should be taken with appropriate scepticism since they are based on self-reported happiness levels. We do not wish to venture into the complications of utility theory and interpretation here.

5 The reason a fixed point at zero is necessary is that the inequality measures we have discussed here apply only to non-negative quantities. Any transformation which gave negative values would make the inequality

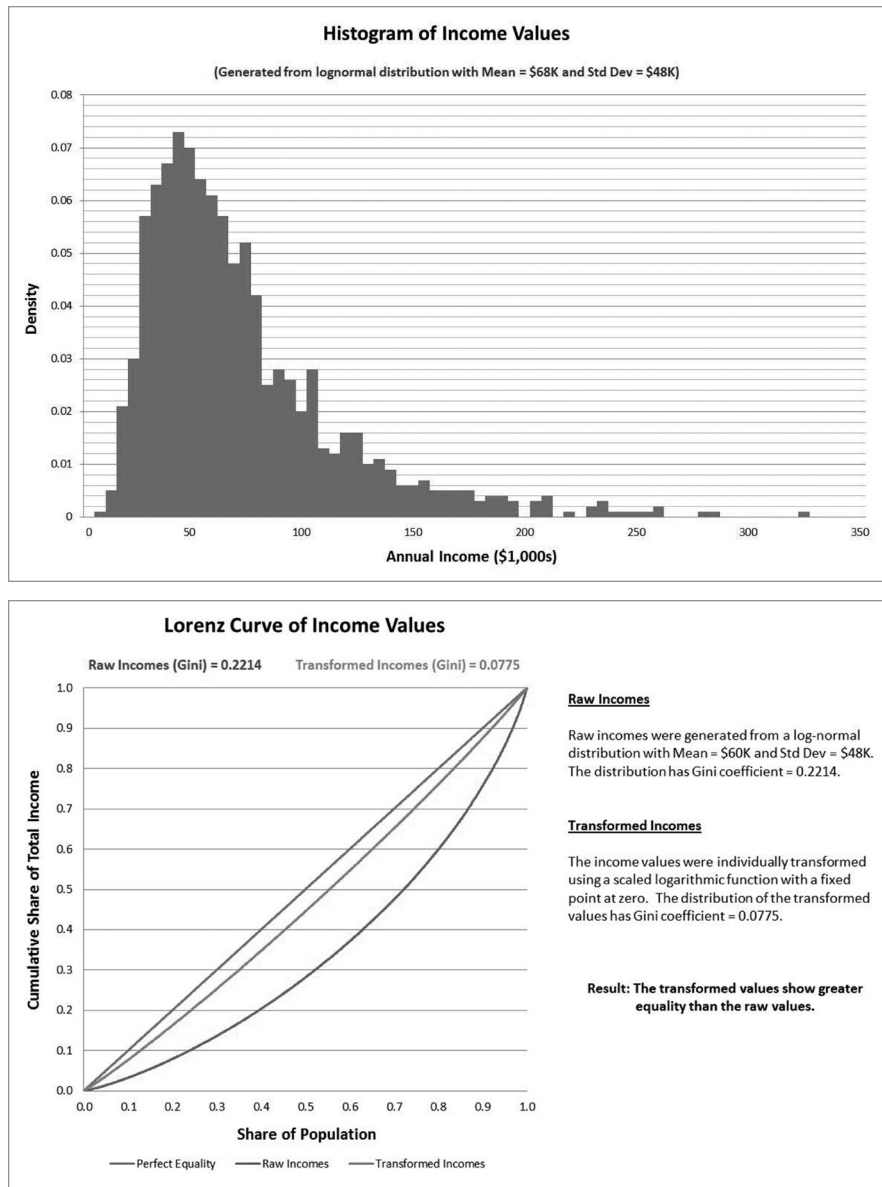


Figure 1: Analysis of inequality for randomly generated income data

of existing methods used in the calculation of the Human Development Index by the United Nations Development Programme. This index uses income data and adjusts per-capita income by taking logarithms. This is explained as an

measures inapplicable. Hence, the “logarithmic” transformation would have to be shifted to give a fixed point at zero, and thereby yield only non-negative values. For example, if the level of wealth is $w \geq 0$ then the transformed value would be $\ln(1 + w) \geq 0$. This would give an increasing concave function with a fixed point at zero.

attempt to account for diminishing marginal returns of income (UNDP 1990, p. 13; UNDP 2005, p. 341) but as Stanton rightly points out, it is not sufficient to account for this, owing to the fact that the transformation should be applied to individual values rather than the aggregate (Ibid Stanton, p. 9).

It is easy to illustrate the effects of this kind of adjustment. In Figure 1(a) below we plot the income histogram for a set of randomly generated income values from a log-normal

distribution. We consider these raw income values and also consider what happens when we transform them using an appropriate concave function to attempt to account for diminishing marginal returns.⁶ The Lorenz curve and associated Gini coefficients for the raw income values and their transformed values are shown in Figure 1(b). It can easily be seen that the transformation yields much greater equality.

The mathematical effect of transforming the individual wealth or income values via a concave function is to make the Lorenz curve closer to the line of perfect equality and reduce the associated Gini coefficient. Intuitively this reflects the fact that when the diminishing marginal returns of wealth are considered, people

are more equal than a consideration of their raw wealth or income values would suggest.

The effect of rising income and wealth

As wealth rises over time this effect of diminishing marginal returns will yield greater equality even when the shape of the distribution of wealth or income is preserved (i.e., when the inequality in the raw income or wealth values is constant). This is shown in Figure 2 for the same income values. As the income level is scaled upward, with the shape of the distribution remaining the same, the Gini coefficient decreases. So, for example, if the shape of the income distribution shown in Figure 1(a) is

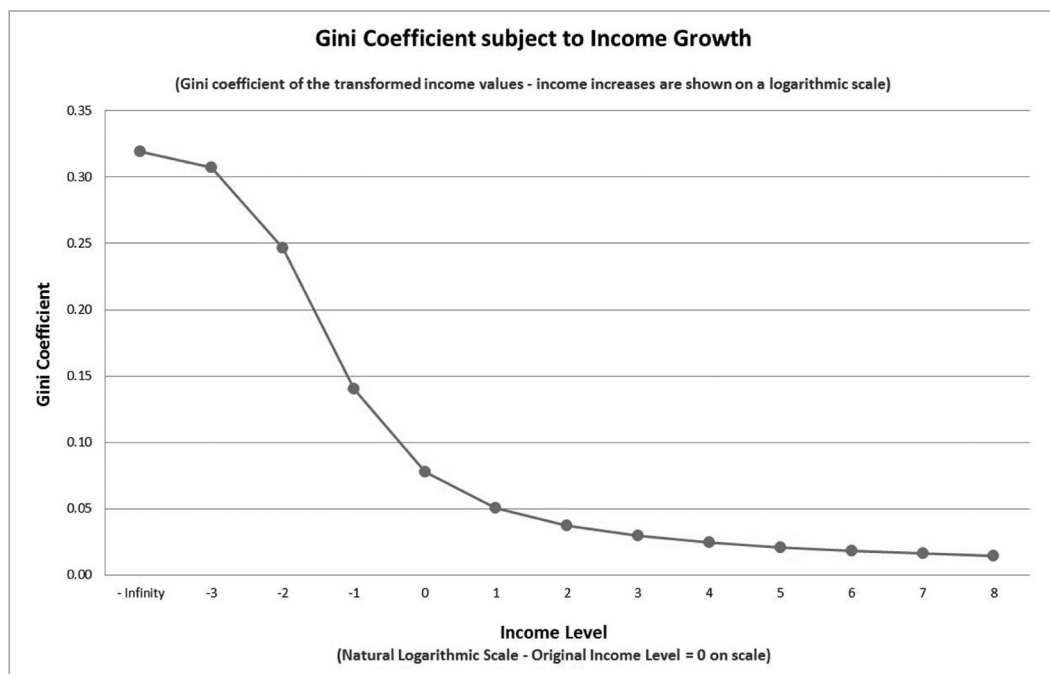


Figure 2: An example of changes in inequality subject to income growth⁷

⁶ We let $w_1, \dots, w_n$ be the set of raw income values measured in \$1,000s (for our analysis we generated one-thousand of these values). We define the transformed values $q_1, \dots, q_n$ by $q_i = \ln(1 + w_i)$ which is the same transformation we have previously discussed. This satisfies the suggested properties for such a function.

⁷ In this figure the Gini coefficient for the value zero on the horizontal axis is the coefficient for the transformed values from the original raw income data. The different values along the horizontal axis represent scale changes in income on a logarithmic scale. The value of negative infinity at the left of the figure reduces the income values

preserved but the scale is increased by a factor of $\exp(2) \approx 7.389$ (i.e., a multiplicative increase in the income of each individual) the Gini coefficient decreases to the value $G = 0.0373$. Note that this comparison is done *ceteris paribus* since the shape of the income distribution is assumed to be constant over time.

If the average wealth and income increases without limit the Gini coefficient of the transformed values approaches zero, meaning that the distribution of the transformed values approaches a state of perfect equality.⁸ It is important to understand that this occurs solely due to the scaling—it occurs when the shape of the distribution of the raw values remains the same, so that inequality of the raw values is constant. Intuitively this reflects the fact that every individual in society is becoming extremely wealthy, so that inequalities in wealth manifest in smaller and smaller inequalities in the satisfaction of human needs, with those inequalities eventually being pushed down to zero. In the limit the inequalities in satisfaction become so small that the situation approaches perfect equality, notwithstanding that inequalities in raw wealth and income values are preserved. (One very nice aspect of this kind of analysis is that it is then extremely easy to measure the extent to which the rising level of wealth is responsible for diminishing levels of inequality. This is done by comparing the Gini coefficient of the raw values with the Gini coefficient of the transformed values.)

It is worth stressing that this example is merely illustrative, since there is nothing

sacrosanct in the chosen transformation for income or the randomly generated income distribution. The important thing illustrated by the example is the fact that the real level of inequality diminishes as wealth grows, owing to the effect of diminishing marginal returns. The exact rate at which this occurs (shown in Figure 2) depends on the distributional shape of wealth or income, the rate of growth, and the form of the transformation.

Although not dealt with here, other effects of rising wealth should also be considered in dealing with inequality comparisons over time. As wealth rises there is a corresponding increase in health and longevity and this means that the income trajectory for people will tend to be longer. Measurement of inequality should also account for the fact that people in the economy are different ages and are therefore at different points in their income trajectory. These various effects mean that inequality measures which are taken over raw wealth or income values should be regarded as nominal measures. Real measures would require accounting for diminishing marginal returns and age difference in the income trajectory. Most importantly, comparisons of inequality across time should be based on *real* measures which have been adjusted to allow for these issues.

Conclusion: all rich and equal

The title of this article alludes to the ultimate consequences of this effect as the average level of wealth and income in an economy grows. If the distribution of wealth remains constant in shape as the average level of wealth grows then each individual in the economy grows rich on an absolute standard. As this occurs there is also a corresponding increase in longevity and therefore a corresponding lengthening of the income trajectory over the age of each person. Even if the shape of the distribution does not remain constant, there will be convergence to

arbitrarily low, which means that they are essentially a linear transformation of the raw values. (At this limiting value the Gini coefficient is the same as for the raw income values.)

⁸ This follows from the fact that the marginal returns are approaching zero in the limit – i.e., $\lim_{w \rightarrow \infty} R'(w) = 0$. This applies more broadly than just in the present example, but we limit ourselves to a single example here.

inequality due to diminishing marginal returns so long as the changes in the shape of the wealth distribution do not outweigh this effect.

Comparisons of inequality based on nominal measures will give the illusion that inequality is constant in this situation but in reality the level of real inequality is diminishing down to zero. (In more realistic situations where the distributional shape is changing over time the nominal measures may show changes in the level of inequality but these will tend to overestimate the level of inequality more and more over time, and there will still be convergence to perfect equality for all but pathological cases.) Present comparisons of inequality mislead people by

failing to account for these effects. They thereby exaggerate present levels of inequality and romanticise past levels of equality.

This has implications in judging institutional frameworks and political philosophies. If it is true that free-market capitalism is conducive to the generation of wealth (as even its critics seem to concede) then it must also be true that *ceteris paribus* this rising wealth will yield real reductions in inequality over time, even when inequalities in the distribution of raw wealth values persists. Indeed, in the limit this will lead to a situation approaching perfect equality. In this sense, the people in such an economy will become *all rich and equal*.

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The More Things Change...

The Fed: Bully with No Stick

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Central bankers believe they can push people around are like pieces on a chessboard. Armed with theories, graphs, and equations, the monetary mandarins believe the world revolves in the palm of their hands. It hasn't worked out that way.

On Milton Friedman's 90th birthday, when he was simply Governor Ben S. Bernanke, the man who would become Fed chair and create more (supposedly) high-powered money than any head of the Fed in history famously told the audience and Friedman himself in closing,

Let me end my talk by abusing slightly my status as an official representative of the Federal Reserve. I would like to say to Milton and Anna: Regarding the Great Depression. You're right, we did it. We're very sorry. But thanks to you, we won't do it again.

(Bernanke, 2002)

Bernanke did indeed do *it* again and then some.

In their famous book *A Monetary History of the United States* Anna Schwartz and

Friedman (1963) criticized the Fed for being too tight, putting the “Great” in Great Depression. However, Murray Rothbard explained in his book, *America’s Great Depression*, which ironically first appeared the very same year as *A Monetary History*, “The Federal Reserve tried its best to continue its favorite nostrum of inflation—pumping \$268 million of new controlled reserves into the banking system (the main item: an increase of \$305 million in bills discounted).” (2000: 262)

But as much as the Fed tried to inflate, people had other ideas, pulling cash out of the banking system to stymie central bankers. “Hence, the will of the public caused bank reserves to decline by \$400 million in the latter half of 1931,” wrote Rothbard (2000: 262), “and the money supply, as a consequence, fell by over four billion dollars in the same period.”

After the crash in ‘29 the Fed lowered its rediscount rates from 4.5% at the beginning of 1930 to 1.5% in mid-1931. The rate was then raised to 3.5%. Economists criticized the central bank for being too tight. However, Rothbard points out (2000: 262) the Fed’s “policy was still inflationary on balance, since it still increased controlled reserves.” At the time the Fed was still constricted by the gold standard. More inflation “would have endangered the gold standard itself.”

Since the financial crash of 2008, the central bank with Ben Bernanke and now Janet Yellen has quadrupled its balance sheet but price inflation is stuck below their 2% benchmark. The PhDs are nonplussed, getting no bang, for 4.5 trillion bucks.

A couple of Fed employees toiling a long ways from the home office (St. Louis) believe they have the answer for the Fed balance sheet not providing the assumed stimulus. Economist Yi Wen and associate Maria A. Arias pop this question in their *St. Louis Fed paper*, “So why did the monetary base increase not cause a proportionate increase in either the general

price level or (gross domestic product)?” (Wen and Arias, under “Declining Velocity”)

Could it be that people and especially businesses have cut back after the crash of 2008 and are doing the wise thing—saving money—no matter what perverse incentives the central bank puts in front of them? Yes, according to Wen and Arias: “The answer lies in the private sector’s dramatic increase in their willingness to hoard money instead of spend it. Such an unprecedented increase in money demand has slowed down the velocity of money.” (Wen and Arias, under “Declining Velocity”)

Keynesians at the central bank think people are just so many particles to be plugged into their models to determine what to set the fed funds rate to, or how much Q to stir into its QE. But when the researchers plugged numbers into $MV=PQ$, they admitted, “(I)nflation in the U.S. should have been about 31% per year between 2008 and 2013, when the money supply grew at an average pace of 33% per year and output grew at an average pace just below 2%.” (Wen and Arias, opening section)

While Bernanke was trying to keep his promise to Friedman, prices have been rising at less than two percent. And it’s deflation that central bankers continue to worry about. The reason is money velocity has plunged from over 17 times before the recession to 4.4 during the first half of 2014.

Consumers and firms have been gloomy since the financial crisis, according to Arias and Wen, who offer as one explanation: “the dramatic decrease in interest rates that has forced investors to readjust their portfolios toward liquid money and away from interest-bearing assets such as government bonds.” (Wen and Arias, under “Declining Velocity”)

This all makes sense praxeologically. Human action is purposeful to attain goals, making a person better off. This doesn’t mean people are always right. “All that praxeology asserts is that the individual actor adopts goals

and believes, whether erroneously or correctly, that he can arrive at them by the employment of certain means,” explains Rothbard (1997: 59).

But after a devastating financial crash, leaving millions upside down on their primary asset—their home—and with much smaller retirement accounts, it makes perfect sense that post 2008, $MV=PQ$ might not add up. Rothbard (1997: 73) writes:

Econometrics not only attempts to ape the natural sciences by using complex heterogeneous historical facts as if they were repeatable homogeneous laboratory facts; it also squeezes the qualitative complexity of each event into a quantitative number and then compounds the fallacy by acting as if these quantitative relations remain constant in human history. In striking contrast to the physical sciences, which rest on the empirical discovery of quantitative constants, econometrics, as Mises repeatedly emphasized, has failed to discover a single constant in human history. And given the ever-changing conditions of human will, knowledge, and values and the differences among men, it is inconceivable that econometrics can ever do so.

The Fed leadership’s continued expansive monetary policy leads the two researchers in St. Louis Fed office to conclude,

In this regard, the unconventional monetary policy has reinforced the recession by stimulating the private sector’s money demand through pursuing an excessively low interest rate policy (i.e., the zero-interest rate policy). (Wen and Arias, under “Declining Velocity”)

Individuals act with a purpose, and they figured out that government bonds yielding zero are no better than money and are, in fact, riskier.

Wen and Arias write, “the best form of risk-free liquid asset is no longer the short-term government bonds, but money.” (Wen and Arias, under “Declining Velocity”) So households are sitting on \$2.15 trillion in savings—close to a 50% increase over the past five years—and banks have \$2.8 trillion in reserves parked at the Fed.

While cash piles up, bankers are still saying no to loans. Professor Steve Hanke often makes a point Lord Keynes made in 1930, that central banks create “state money,” the high-powered variety, but the primary creator of money is the commercial banking system. Since the financial crisis, banks have been collectively timid.

At the end of 2007 commercial bank assets totaled just over \$13 trillion. At the end of the first quarter of 2014, commercial bank assets were \$14.9 trillion an annual increase of just 2.3%, a fraction of the growth in assets for the six year period previous. Assets were \$6.5 trillion at year-end 2001 and doubled by year-end 2007, an annual increase of 16.7%.

In a piece entitled “Bernanke’s Monetary Mess” in Hanke (2014) wrote,

Since August 2008, the month before Lehman Brothers collapsed, the supply of state money has more than quadrupled, while bank money has shrunk by 12.1%—resulting in an anemic increase of only 4.5% in the total money supply (M4). The public is confused—as it should be. After all, the Fed has embraced contradictory monetary policies. On the one hand, when it comes to state money, the Fed has been ultra-loose. But, on the other hand, when it comes to the largest component of the money supply, bank money, a tight monetary stance has been embraced.

So the Fed, fixer of all it disrupts, is not so all powerful after all, prompting University of Chicago finance professor John H. Cochrane (2010) to mock,

The Fed is reduced to hoping that announcements will work; that merely saying “exceptionally low levels for the federal funds rate for an extended period” will prod people to push prices higher. Others such as the IMF’s chief economist Olivier Blanchard and several Fed governors have advocated that the Fed announce a higher inflation target. This is the WIN (“Whip Inflation Now”) strategy from the 1970s – tell them you

want different rate of inflation and hope it happens. Speak loudly and hope they don’t notice you have no stick. But what do you do if it doesn’t happen? Make a bigger announcement?

Central bankers shouldn’t make promises they can’t keep. And followers of the Austrian school should remember what Austrian theory is built upon (individual action) and not overestimate the Fed’s power.

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Bitcoin is Memory^{*}

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Abstract: We maintain that the crypto-currency bitcoin is a practical application of what is termed “memory” in the monetary economics literature. After reviewing the theoretical literature on money and memory, we offer a brief overview of the bitcoin protocol and argue that, like memory, bitcoin functions as a public record-keeping device. Finally, we provide evidence that—in line with the standard theoretical account of memory—bitcoin use has soared as the expected cost of storing traditional monies increased.

Keywords: bitcoin; crypto-currency; currency competition; medium of exchange; memory; monetary standard; money; payment system

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In four frequently cited articles, Kocherlakota and Wallace (1998) and Kocherlakota (1998a; 1998b; 2002b) consider the similarities and substitutability of money and memory.¹ The authors conclude that, in many cases, money and memory are analytically equivalent. Their results are typically offered as a justification for the widespread acceptance of intrinsically useless monies: if humans lack a perfect record-keeping device (i.e., memory), using money might be socially beneficial.² However, one might just as well conclude that technological developments in record keeping or increasing costs associated with money might reduce the beneficial scope of those monies commonly employed in the past.³

A new and relatively successful cryptocurrency called bitcoin is an example of such a technology. In what follows, we review the theoretical literature on money and memory, provide a brief overview of the bitcoin protocol, and argue that bitcoin might serve as a practical application of the theory. Specifically, we explain that bitcoin functions as a public record-keeping device. As such, it serves as an alternative to historically accepted monies while enabling transactions in much the same way. Consistent with the standard theoretical account of memory, we provide evidence that bitcoin use has soared as the expected cost of storing traditional monies increased.

Money and Memory

The principle finding of the money and memory literature is that both devices are capable of facilitating exchange. Using OLG,

turnpike, and random matching models, Kocherlakota (1998a) considers whether money is inessential when agents have access to memory.⁴ He defines money as hand-to-hand currency buyers and sellers can use to transact. Memory, on the other hand, is a publicly observable (and instantaneously updated) record of past transactions that buyers and sellers can consult prior to transacting. Kocherlakota confirms that the set of incentive-feasible allocations with money is contained in the set of those with memory. Indeed, if money is divisible, Kocherlakota (2002b) shows it effectively functions by providing an observable record of past transactions—that is, agents can tell whether a potential trader is running a current deficit or surplus with society by looking at the money balances that trader is carrying. Hence, money is memory.

Kocherlakota and Wallace (1998) extend the earlier model by allowing for imperfect memory and non-zero cost money. Imperfect memory is modeled as a record-keeping device that is not updated instantaneously. As a result, agents must take into account the probability that the public record accurately reflects the status of their trading partner. The authors also recognize individuals might incur costs storing or verifying the legitimacy of a hand-to-hand currency. In this modified environment, Kocherlakota and Wallace demonstrate the existence of equilibria where both money and memory are used. Moreover, they show that, when the probability of observing an up-to-date record is sufficiently high, agents will choose not to employ costly money.

The money and memory literature is often cited to explain why money circulates. If money is a primitive form of memory, record-keeping must be sufficiently imperfect to warrant the use of media of exchange (Shi 2006, p. 662). The prevalence of hand-to-hand currencies

1 See also: Araujo and Camargo (2008, 2010).

2 See, for example, Kocherlakota (2002a).

3 Indeed, the former is the motivation offered by Kocherlakota and Wallace (1998, p. 272), who note that “Technological developments, especially during the past two or three decades, have greatly enhanced our ability to keep up-to-date records.”

4 Corbae et al. (2002) consider money and memory in an endogenous, or directed, matching model.

throughout the world would seem to imply that human subjects lack a perfect record-keeping device. At the same time, however, we observe areas of life where human subjects rely exclusively on record-keeping devices (e.g., banking and payment systems based on credit). As Kahn and Roberds (2009, p. 19) note, “Informational limitations are not set in stone. At a cost, they can be and are overcome. [...] If the benefit is high enough the institutions for gathering or recording the information develop.” Hence, one cannot rule out the use of record-keeping devices entirely; and, following Kocherlakota and Wallace (1998), it is useful to consider how the tradeoffs between money and memory might change over time and place.

Bitcoin as a Medium of Exchange

Bitcoin is an open source, peer-to-peer crypto-currency developed by Nakamoto (2008) and launched in 2009. The system relies on public-private key technology and the decentralized clearing of payments to enable quasi-anonymous transactions. To understand how the bitcoin protocol functions, consider a typical payment. Both parties in a transaction have a public and a private key. The *payer* uses its private key to verify that it is the rightful owner of a balance of bitcoin. The payer identifies the *payee* by the latter’s public key. Submitting this information via the bitcoin software effectively amounts to requesting that all other peers on the network acknowledge the transaction is valid. Once the transaction is authenticated (discussed below), all other peers are notified that the payee now holds the balance transferred from the payer. To spend these coins, the new owner repeats the process—becoming the payer to a payee identified only by its public key.

The bitcoin system allows transactions to be authenticated without need for a central clearing authority. Transactions are grouped together for processing. Authenticating the

block of transactions requires the solution to a complicated cryptography problem. Peers on the network effectively guess until a solution is found. The first peer to complete this “proof-of-work” shares the solution with all of the others by adding the bundle of transactions to the blockchain—a public record of all past transactions.⁵ Since all peers can observe the record, ownership is easy to substantiate and an agent cannot spend the same balance more than once.

Completing the “proof-of-work” requires costly computing power. Members of the network are willing to incur this cost to solve the problem (and authenticate the transactions of others) because the system rewards the successful number cruncher with ownership of newly created bitcoin. This decentralized clearing process is often referred to as mining—a reference to commodity monies of the past. An algorithm, which runs every 2,016 blocks, regulates the rate of block creation (and, hence, the rate of new money creation) by altering the digit length of a string of zeros in the proof-of-work.⁶ Under the current protocol, a new block is created every ten minutes.

Bitcoin has several clear strengths. As mentioned above, bitcoin allows quasi-anonymous transactions. A user’s key does not contain any personally traceable information in and of itself. If a user takes precautions to never associate their personal identity with their public key, the bitcoin system provides anonymity through obscurity. We say that transactions are “quasi-anonymous” since bitcoins can be transferred without either party revealing their real-world identity in transactions that are neither face-to-face nor require the physical delivery of

5 The block-chain currently includes all past transactions, but the software retains the ability to shorten the chain if necessary (Nakamoto 2008). The record of all current bitcoin owner’s public keys, however, will never be dropped from the chain (Babaioff et al. 2012).

6 Adding a zero exponentially increases the difficulty of finding a solution (Nakamoto 2008).

goods or services. However, users purchasing bitcoin on an exchange must link some piece of self-identifying information such as a credit card or bank account number; cash purchases of bitcoin require physical delivery of the hand-to-hand money; and, in order to take possession of a good or service purchased with bitcoin, one may need to reveal identifying information such as a shipping address or point of pickup.

Another strength of bitcoin is the predictability of its production. Since there is no central authority, and the speed of hashing is regulated, bitcoin is not subject to monetary supply shocks.⁷ Indeed, as Selgin (2013) explains, it performs better in this respect than commodity monies: “whereas the discovery of a more efficient way to mine a precious metal results in an increase in the overall rate of metal output, [...] with Bitcoin such innovations alter output shares only, and not total coin output, which is exogenously determined.” As such, the supply of bitcoin grows at a steady, predictable pace.

Although the system offers several advantages over traditional fiat currencies, bitcoin is not without weaknesses. Perhaps most notably, it was not designed to accommodate shocks to money demand. Since the supply of bitcoin follows a predetermined trajectory, changes in demand cause its purchasing power to fluctuate.⁸ In March 2013, the dollar/bitcoin exchange rate crashed when an update to the system was not simultaneously adopted by all users on the network.⁹ On the other hand, those acquiring bitcoin on speculation that they will be able

to sell it at a higher price in the future and/or positive developments in the broader bitcoin network (e.g., ATMs, third-party payment processors, etc.) have tended to push its purchasing power up. The price has risen from roughly \$13 on January 1, 2013 to a high of \$1132 on November 28, 2013¹⁰. And, perhaps because speculators became less confident in the future of bitcoin, its price fell. At the end of May 2014, bitcoin was trading at \$631. The existence of demand shocks like these makes the purchasing power of bitcoin relatively unstable.¹¹

Bitcoin might also suffer from relatively high transaction costs. Recall that, at present, a block of transactions is processed roughly every ten minutes. Such a long processing time might hinder some spot market transactions. Moreover, the problem is exacerbated if multiple bundles are vying to be added to the blockchain simultaneously since, once one block is verified, all others must restart the cryptography problem. Some transactors try to overcome this problem by including a small bounty of bitcoin for the first peer to successfully hash the block containing their transaction. Although these bounties are relatively small and uncommon at present, many believe they will increase in size and frequency as the number of bitcoins created through mining declines. Hence, in the future, the transaction costs of using bitcoin could be substantial.

Bitcoin also suffers from a network effects problem. Few retailers accept bitcoin as a form of payment due to the small user base; and many consumers will not consider using bitcoin until a significant number of retailers accept bitcoin payments. Simply put: network effects favor the status quo.¹² This makes it

7 Grinberg (2012) offers an alternative view, describing bitcoin's five-member development team as a “de facto central bank.” See also: Selgin (2013).

8 Luther and Young (2014) consider the significance and magnitude of various demand shocks to the value of bitcoin.

9 The March 12, 2013 software update was particularly problematic in that, during the mix up, some funds were double spent. An initial response saw bitcoin's value fall by 22% in an hour. It rebounded promptly.

10 On December 3, 2013, it would hit \$1132 again.

11 Luther and White (2014) consider whether bitcoin's unstable purchasing power precludes it from becoming a major currency.

12 Nair and Cachanosky (2014) discuss entrepreneurial efforts to break the network effect.

difficult for bitcoin to get off the ground.¹³ As Luther (2013b) shows, bitcoin may fail to gain widespread acceptance *even if* it were superior to existing monies—that is, even if everyone prefers a situation in which everyone uses bitcoin (and no one prefers one where anyone uses anything else). Although it is difficult to isolate and gauge the magnitude of the network effects problem, there is reason to believe it is non-trivial.¹⁴

Despite the network effects problem, bitcoin has managed to gain some acceptance. The market for bitcoin is continually evolving and, today, users have an increasing number of ways to acquire and spend bitcoin. Mining, as mentioned above, is one way to obtain bitcoin. Many of the early holders of bitcoin obtained their balances exclusively through mining. However, advances in computer technology have made it nearly impossible for the average user to obtain bitcoin by mining.¹⁵ Completing proof-of-work is so computationally intensive at present that only users with a network of custom-built computers can obtain bitcoin at a point where the market value of the bitcoin mined exceeds the costs of mining. Today, it is far more common for users to acquire bitcoin

via an online exchange.¹⁶ Exchanges like Bit-Stamp and OKCoin convert bitcoin to/from many currencies, including USD, EUR, JPY, CAD, GBP, CHF, RUB, AUD, SEK, DKK, HKD, PLN, CNY, SGD, THB, NZD, and NOK. In December 2012, Bitcoin-Central became the first exchange officially licensed (by France) as a payment services provider.¹⁷

Ongoing efforts aim at making it easier to acquire and use bitcoin. BitcoinATM, Lamassu Bitcoin Ventures, and Robocoin have all developed automatic teller machines where users can exchange cash for bitcoins. Lamassu and Robocoin are in the process of launching their hardware. Lamassu boasts that its machines accept notes from over 200 countries. BitcoinATM, in contrast, is trying to market its software to existing ATMs. Others, including Bitinstant, are preparing to launch debit cards that can be connected to one's Bitcoin account. Casascius has even developed physical bitcoin, which are linked to digital bitcoin. These metal coins, which are presumably intended to circulate as a hand-to-hand currency, contain a private key needed to access its electronic counterpart.¹⁸ By making bitcoin easier to acquire and spend, these developers hope to tip the balance in favor of the crypto-currency.

An increasing number of Internet middlemen have also made it easier to transact with bitcoin. PizzaForCoins, for example, allows users to place an online pizza delivery order at existing pizza chains using bitcoin as payment.

13 Of course, it also gives bitcoin a first-mover advantage over alternative cryptocurrencies. If some cryptocurrency is to succeed, bitcoin would seem to be the most likely in that it has the largest network. On the likelihood that bitcoin will succeed, see Luther and Gochenour (2014).

14 The difficulty stems from the usual entanglement of network effects and legal restrictions (Luther 2013a). However, Luther and White (2011) present a case where agents continue using a relatively poor money in the absence of legal restrictions, suggesting that the network effects problem is significant.

15 The average user, operating on a much smaller scale than specialized miners, will be able to earn similar expected returns (though, at a much higher variance) as mining hardware becomes commoditized. Profit-sharing arrangements could be employed to lower the effective variance.

16 A majority of the bitcoin exchanges work on a bid-ask model.

17 As an anonymous referee points out, Bitcoin-Central accomplished this by partnering with an existing provider already in possession of the appropriate license; the partner deals with the regulatory and banking aspects of operations.

18 The private key is protected by a tamper-evident hologram to prevent one from spending the digital coin before passing off the physical coin.

Since the existing pizza chains do not accept bitcoin, PizzaForCoins accepts the cryptocurrency on their behalf. It then pays the pizza chain in its preferred currency. Another company, Bitpay, provides similar services for over 4,000 businesses, including Black Lotus and Wordpress. These services take on the exchange rate risk and allow retailers to accept bitcoin without having to manage multiple accounts.

Because of the privacy it provides, bitcoin has become especially popular in black market transactions. The Silk Road, a popular online marketplace for drugs and other illicit goods had roughly \$22 million in annual sales in 2011.¹⁹ Additionally, many online gambling sites, such as Satoshi dice, use bitcoin as the currency of choice. Bitcoin's quasi-anonymous nature makes the platform ideal for tax evasion, money laundering, and other currency transfer scenarios where the parties wish to remain anonymous.

Perhaps as a result of the currency's unique features, the bitcoin network has expanded markedly. Ron and Shamir (2012) estimate there were as many as 2.46 million unique bitcoin users trading in the system in 2012. The market capitalization at that time was just over \$100 million. Demand has since increased significantly. In May 2014, the market capitalization exceeded \$6,200 million. The extent to which bitcoin will gain widespread acceptance in the future is, of course, unknown; but it is already being employed as a medium of exchange in some markets.

Bitcoin as an Application of Memory

The bitcoin system serves as a functioning application of memory. Peers on the bitcoin network store a complete copy of all

past transactions, similar to the public ledger Kocherlakota (1998a) terms memory. Moreover, the bitcoin protocol effectively checks new transactions against this ledger prior to authorization. Unlike the theoretical construct, where past transactions are attributed to a particular agent, the bitcoin system records transactions by account. Given that an agent might possess several accounts and cryptography is used to obscure one's identity, it is difficult to get a full picture of the past transactions of a particular agent. In other words, the unit of analysis in the bitcoin system differs from that of the theoretical construct. Nonetheless, it is reasonable to describe the bitcoin system as memory.

As in Kocherlakota and Wallace (1998), there is some probability that, at a particular moment, the public ledger will be complete and up-to-date. The bitcoin protocol works to keep that probability high. Since proof-of-work is difficult to repeat, distorting the public record is costly. A malicious user intent on double spending bitcoin would need computational power sufficient to redo all the proof-of-work between the two transactions. The user would then need to hash a new fraudulent block before any other user hashes a legitimate block.²⁰ While technically possible, such a feat would be very costly to pull off.²¹ Adding to this possibility the time it takes to process a transaction and the potential for updating errors discussed above, it seems

19 The Silk Road operates on TOR. TOR is an online virtual private network (VPN) service that relays messages through its encrypted network to better protect users' identity and location data.

20 The fraudulent block serves to verify the second transaction as legitimate, even though the malicious user had already spent the balance in an earlier transaction. If another user hashes a legitimate block before the malicious user can redo the proof-of-work and pass the fraudulent block, the malicious user will have to start over in order to include the new legitimate block in the proof-of-work. The more legitimate blocks hashed between the two transactions, the more difficult altering the block chain to double spend the balance becomes.

21 Indeed, the malicious user would almost certainly earn a higher rate of return employing this computational power as an honest user.

reasonable to conclude that there is a non-zero (but perhaps small) probability of accessing an incomplete record of transactions.

Having contended that bitcoin resembles an imperfect form of memory, we next consider whether recent experience with bitcoin is consistent with the theoretical literature on memory. In particular, we consider the following three implications:

1. Both money and memory might facilitate exchange.
2. If memory is imperfect and money is costly to store and/or verify, equilibria exist where both money and memory are employed.
3. As the expected cost of storing and/or verifying money increases, memory is more likely to be used.

We discuss each in turn.²²

It is rather straightforward to show that the bitcoin experience is consistent with the first two implications of the theory. As described above, bitcoin is used to facilitate exchange in a variety of contexts. Cyber security, web domains, and leisure activities—just to name a few items—can be (and have been) acquired with bitcoin. In these contexts, bitcoin works in much the same way as traditional monies. At the same time, it is certainly not the case that bitcoin has replaced traditional monies entirely. Rather, bitcoin is often one of many payment options. In other words, since bitcoin

is an imperfect form of memory and traditional monies are costly to store and/or verify, both are employed to facilitate exchange.

Recent experience in Europe provides some evidence that, as the expected cost of storing and/or verifying traditional monies increases, bitcoin is more likely to be used. On March 16, 2013, the European Commission, European Central Bank, and International Monetary Fund offered Cyprus a €10 billion bailout package on condition that Cyprus would issue a one-time levy on all domestic bank accounts. Deposits up to €100,000 would be subject to a 6.7% levy; deposit balances in excess of this threshold would be subject to a 9.9% levy. Although the Cypriot parliament rejected the deal three days later, and the final agreement reached on March 25 required no such levies, the damage had already been done. The terms of the initial offer suggested that, in the event of a severe banking crisis in the eurozone, insured depositors might suffer losses—a state of affairs most had previously thought to be off the table. The result was a shock to expectations: deposit holders across Europe believed their deposits were somewhat less secure. As such, the expected cost of storing traditional monies had increased.

Less than two days after the announcement, Kuittinen (2013) noticed a surge in downloads of bitcoin-related applications to iPhones in Spain. In just one day, he noted, the ranking for “Bitcoin Gold shot up in the Spanish iPhone Finance category from 498 to 72, and another app called Bitcoin Ticker zoomed from 526 to 52.” Both apps monitor exchange rates between bitcoin and other currencies on Mt. Gox.²³ According to Kuittinen, it was no mere coincidence that bitcoin-related apps became more popular while “Spaniards brooded over the Cyprus crisis.” As we demonstrate below, the increase in enthusiasm for bitcoin apps was not limited to the Spanish market.

22 As an anonymous referee points out, evidence supporting these three implications does not constitute proof that bitcoin is memory since such evidence would also be consistent with alternative hypotheses. To be clear: we do not interpret any evidence that follows as proof of the hypothesis that bitcoin is memory. Rather, we have argued that the characteristics of bitcoin warrant its classification as an imperfect form of memory and, in what follows, merely consider whether the experience of bitcoin is consistent with the implications from the theoretical literature on memory.

23 Bitcoin Ticker also monitors BtcE, Bitstamp, Btc24, Bitcurex, VirtEx, and BTC China exchanges.

	Seven-Day Average Rank March 9-15	Seven-Day Average Rank March 16-22	Average Rank Increase
Cyprus	1166	577	589
Portugal	407	342	66
Ireland	630	417	213
Italy	610	370	240
Greece	248	243	5
Spain	367	131	236
France	646	638	8
Germany	501	466	35
UK	366	394	+27
US	926	878	48

Table 1: BitCoin Gold download rankings, by country, iPhone finance category, March 9-22, 2013

In table 1, we present iPhone finance category download rankings collected by AppAnnie, an app store analytics company, for the BitCoin Gold app from March 9 to 22, 2013. We include data for Cyprus, Portugal, Ireland, Italy, Greece, and Spain—all believed to have troubled banking systems at the time—as well as France and Germany, which were widely seen as safe. Two non-eurozone countries—the United Kingdom (UK) and United States (US)—are also included for comparison. We calculate average rankings for the seven-day periods before and after the bailout announcement for all ten countries. Then, we subtract the average ranking for the March 16-22 period from the average ranking for the March 9-15 ranking to gauge the seven-day average rank increases for each country.

The AppAnnie download ranking data is consistent with the view that, in response to the shock to expectations, bitcoin use increased. In particular, we find that iPhone users in countries suspected of having troubled banking systems were more likely to download BitCoin Gold relative to other apps in the seven-day period immediately following the bailout

announcement than in the prior seven-day period.²⁴ We also find that the increase in download rankings over these periods were typically larger in countries suspected of having troubled banking systems than those occurring in non-troubled eurozone and non-euro countries. Cyprus (+589), Italy (+240), Spain (+236), Ireland (+213), and Portugal (+66) experienced the biggest average increases in Bitcoin Gold download rankings. German (+35) and French (+8) rankings increased only slightly. The US (+48) experienced a small increase on average in its rankings. The average ranking fell in the UK (−26). On average, rankings increased by 224.90 in the six countries suspected of having troubled banking systems over the period, as compared with increases of 21.43 in the non-troubled eurozone countries and 10.50 in the non-eurozone countries. BitCoin Gold download rankings before and after the initial bailout announcement are depicted for each country in figure 1.

²⁴ Note that an increased ranking implies that the rank number is lower (i.e., a rank of 1 is greater than a rank of 100).

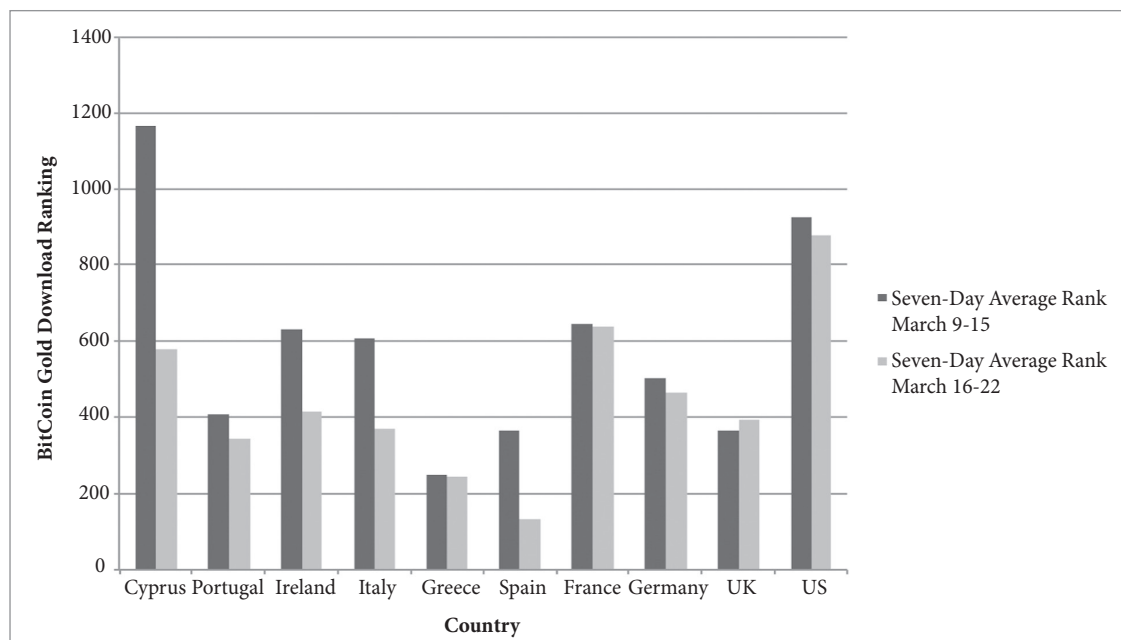


Figure 1: BitCoin Gold download rankings by country, before and after bailout announcement, March 9-22, 2013

The available exchange rate data is also consistent with the view that demand for bitcoin increased significantly following the initial bailout announcement. From January 1 to March 15, 2013, the dollar price of bitcoin increased at an average annualized rate of 630.50%. From March 16 to April 8, 2013, the dollar price of bitcoin increased at an astounding rate of 2,195.76%. Its price has since fallen back down a bit. Even still, from March 16 to June 5, 2013, the dollar price of bitcoin increased at an average annualized rate of 996.62%—much higher than that observed before the initial bailout announcement. The daily bitcoin closing price on the Mt. Gox exchange, in US dollars, from January 1 to June 5, 2013 is presented in figure 2.

Finally, that the US government has devoted considerable attention to bitcoin in recent months serves as supporting evidence that its use is on the rise. On March 18, 2013, the Financial Crimes Enforcement Network (FinCEN), a bureau of the Treasury tasked with enforcing the Bank Secrecy Act, issued guidance on regulations pertaining to those

administering, exchanging, or using virtual currencies. “A user of virtual currency is not [a money services business (MSB)] under FinCEN’s regulations and therefore is not subject to MSB registration, reporting, and record-keeping regulations,” FinCEN (2013) affirmed. “However, an administrator or exchanger is an MSB under FinCEN’s regulations, specifically, a money transmitter, unless a limitation to or exemption from the definition applies to the person.” In other words, bitcoin exchanges like Mt. Gox were required to register and comply with FinCEN’s regulations.

Mt. Gox did not register as a money services business with FinCEN. On May 14, 2013, the Department of Homeland Security and U.S. District Court for the District of Maryland served Dwolla, a mobile payment service used to transfer funds to/from Mt. Gox, with a seizure warrant for funds associated with Mt. Gox’s Dwolla account.²⁵ Complying with

²⁵ The seizure warrant did not name Mt. Gox, but rather Mutum Sigillum LLC, a Delaware-based Mt. Gox

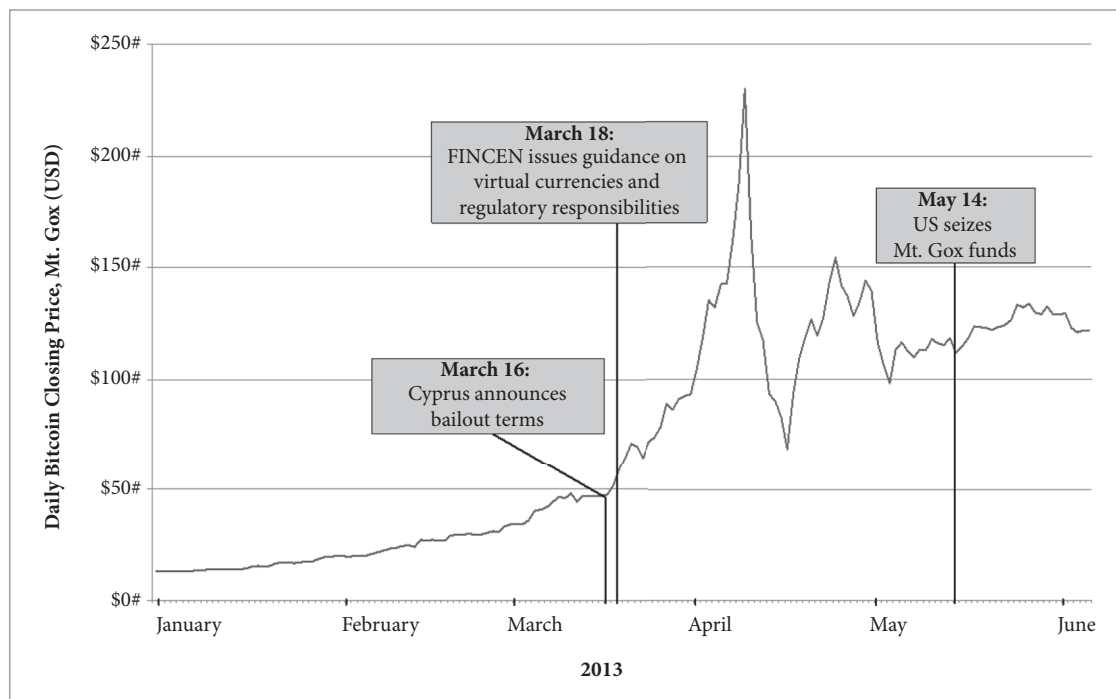


Figure 2: Daily bitcoin closing price, Mt. Gox (USD), January 1–June 5, 2013

the court order, Dwolla immediately ceased processing payments to/from the account and transferred Mt. Gox's balance to the government. According to the affidavit submitted in support of the seizure warrant, the accounts were seized because Mt. Gox was not registered as an MSB with FinCEN.

Bitcoin resembles an imperfect form of memory. It functions by providing transactors with a public record of past transactions. Moreover, recent experience with bitcoin is consistent with the theoretical literature on memory. Bitcoin facilitates exchange alongside traditional monies; and, as the expected cost of storing money increased in the eurozone, some transactors seem to have turned to bitcoin. This claim has been supported by the greater download rankings of bitcoin-related apps in the

affected countries, an increase in the growth trajectory of the dollar-bitcoin exchange rate, and increased attention from US regulators following the shock. As such, we conclude that bitcoin is memory.

Conclusion

Previous studies have tended to treat memory as a theoretically useful concept necessary to justify the use of traditional monies. In contrast, we show that theories of memory have practical applications. Specifically, we explain that the crypto-currency bitcoin is an example of such a technology. The bitcoin protocol functions by providing a public record of past transactions. As such, it is capable of facilitating exchange in much the same way as traditional hand-to-hand currencies. Moreover, since bitcoin is an imperfect form of memory and traditional monies are costly to store and/or verify, it is possible for the two types of exchange medias to coexist.

subsidiary. The connection to Mt. Gox was referenced explicitly in the affidavit submitted by Homeland Security Investigations Special Agent Michael McFarland in support of the seizure warrant.

Perhaps most importantly, we have provided evidence that—in line with the standard theoretical account of memory—bitcoin use soared as the expected cost of storing and/or verifying traditional monies increased. Following the initial announcement of the Cyprus bailout—and the realization that

insured deposit accounts in the Eurozone were not as secure as previously thought—there was a surge in downloads for popular bitcoin apps and a significant increase in the growth trajectory of the dollar price of bitcoin. US government oversight of bitcoin also seems to have intensified over this period.

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*Entrepreneurial Action Providing for Society's Future*¹

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Abstract: In maintaining capital, private entrepreneurs play a crucial role in societal provision for the future. Two societal concerns that are assumed to fall within the province of governmental responsibility: the threat of resource exhaustion and infrastructure neglect. But governmental ownership and existing legal institutions stifle entrepreneurial capital maintenance vital to extractive-resource conservation. Moreover, the institutions of government fail in terms of infrastructure maintenance. Governments cannot replicate the actions of entrepreneurs in maintaining infrastructure. Also, the self-seeking, career-oriented actions of legislators and bureaucrats can be impediments to infrastructure maintenance. This study concludes that earnest efforts at privatization would allow entrepreneurial capital maintenance to provide for the future.

Keywords: Entrepreneur; capital; extractive resources; infrastructure; government; legislators; bureaucrats; future

¹ A reviewer reminds the author that society cannot be treated an actor. Of course, only individual human beings act. The term 'society' is used here only for rhetorical convenience. Mises notes that "society does not exist apart from the thoughts and actions of individuals" (Mises [1962] 2006, 71).

Introduction

Resource conservation and infrastructure maintenance are actions that provide for society's future but are seen as being the inherent responsibility of the public sector. Extractive resources are seen as being fixed but depleting aggregate stocks in danger of ultimate exhaustion. This erroneous presumption seems to call for tighter governmental control over the exploitation of these resources. Also, evident degradation of public infrastructure seems to demand major public 'investment' to maintain and replace public facilities. But persistent public anxiety over resource exhaustion and infrastructure decay call into question the efficacy of government's presumed role in these matters. In both contexts, greater reliance on government intervention has been shown itself to be a failure.

At the same time, market forces of the private sector would seem to offer a viable and preferable avenue for entrepreneurial solutions to these public concerns. Privately controlled extractive resources are being renewed through entrepreneurial investments in exploration and development. Also of note is the fact that privately held infrastructure, as opposed to public infrastructure, is routinely maintained, improved and replaced through entrepreneurial prospects of profitable return. Why the contrast? Can an expanded scope of entrepreneurial action be seen as a desirable and effective solution to the above described concerns?

In free-market settings, the actions of private individuals have always played a critical role in providing for society's future. But what types of private actions provide for the future? How is the success of these actions determined? As expression of their time preference, individual members of society provide for the future in their acts of saving. Private entrepreneurs employ the financial resources provided by savers to invest in 'capital' to be committed to particular plans involving the production of

goods and services. But success or failure in these acts of provision for the future require monetary exchange that allows each acting individual human beings, including business entrepreneurs, to judge and rank the net future advantage of alternative courses of action. This provision for the future is made possible by the fact that capital itself is denominated in money. From the entrepreneur's perspective, capital represents the entrepreneur's *ex ante* calculational judgments of prospective net capitalized monetary worth of a planned employment of the enterprise's capital goods. But capital accounting eschews entrepreneurial expectations and plans; it must focus on the contemporary *net market monetary value* of enterprise's capital goods *at a specified date*. Between two successive time periods, the net change in the accounting calculation of enterprise's net market value yields a monetary calculation of the success or failure of the entrepreneur's plan. In capital accounting, income is the net contemporary increase in the market value of the enterprise's capital goods. But it is also a reckoning of the extent to which entrepreneurial action has provided for the future.

Private entrepreneurs are motivated to maintain capital by the urgency of sustaining future enterprise income (Mises. 1998 [1949], 512; Hayek [1941] 2007, 277-282). To the extent that these actions are undertaken in competitive markets characterized by monetary exchange, private entrepreneurial actions can play a critical and decisive role in (1) staving off what some see as global resource exhaustion, and (2) maintaining what is currently viewed as public infrastructure. But existing institutions impede the processes by which entrepreneurial actions could replenish exhausting resources and the maintain infrastructure. For example, attenuated, constrained or governmentally circumscribed property rights represent impediments to entrepreneurial resource renewal. Also, career oriented entrepreneurial activity of legislators and government bureaucrats play in

diverting resources from infrastructure maintenance. This paper explores the broader potential social benefits of private entrepreneurial capital maintenance activities and the institutional impediments that currently thwart the capacity of market activity to perform these beneficent roles. The paper highlights the reality that provision for the future is contingent on the degree to which the relevant resources can become privatized and brought into the compass of entrepreneurial planning.

Resource exhaustion verses capital maintenance

The role of extractive resources in the economy has been obscured by a mythology of exhaustion. By looking at resources from a global perspective, the assumed certainty of exhaustion would seem to be self-evident. Extractive resources are assumed to exist in fixed ultimate aggregates just as the crust of the earth itself is finite. However, when viewed in the context of human action, different insights begin to emerge. There is a replacement process that occurs as individual deposits are depleted. But there has been little attention paid to the entrepreneurial nature of this process and the way in which it is a matter of capital maintenance for the enterprise. A fuller understanding of this capital maintenance process highlights one of the ways in which the entrepreneurial action is critical to societal provision for the future. But it also highlights the extent to which man-made institutions are impediments to this particular aspect of capital maintenance.

The neglected role of the entrepreneurial action in resource renewal

The economics of exhaustible resource availability is fundamentally entrepreneurial which means that the notion of an aggregate fixed stock of a resource has no coherent relevance to human action required for renewal. Extractive

enterprises are by definition entrepreneurial and the known extractive deposits under the enterprise's management are among the capital goods employed by the firm to maintain or increase the firm's income (Brätland 2008, 386-393). Hence, feared aggregate exhaustion has no validity in a market environment in which entrepreneurs are able to maintain enterprise capital by replacing depleting deposits through investments in exploration and development. The efficacy of this process is demonstrated by the fact that proven reserves of virtually all extractive resources are higher today than they were 50 years ago. In instances in which reserves have not increased, the reason is found in the fact that the demand for the resource has declined.²

In a free market, replacement of exhausting resources occurs routinely because gradual depletion of deposits reduces the operating revenue margins (Adelman 1993, 222). Since capital maintenance is always about maintaining enterprise income, the firm is constantly replacing its depleting resource deposits through acquisition of exploration rights, discovery and development of new deposits. Hence, in such a market, replacement of resource deposits is only contingent on the prospective profitability of doing so. In this sense, the process of resource replacement is not dissimilar from the conventional replacement of depreciated capital goods. But this reality means that anticipated shortages of extractive resources reflected in prices would be a principal inducement of deposit replacement. The means by which resources are replaced emerges out of the entrepreneur's judgment of how enterprise income is affected

2 The statement is simply a praxeological deduction. Relevant examples are hypothetical; demand for petroleum could be destroyed by interventionist mandates imposed globally. In such a case, reserve replacement would cease even though in a free market exploration and development would otherwise continue to be profitable. Obviously, some policy makers are attempting to bring coal to such a fate.

by alternative prospective replacement strategies. But this resource-replacement process is fundamentally dependent upon access to land and managerial flexibility in maintaining capital and entrepreneurial income.

Entrepreneurial strategies of capital maintenance

Social concern over so called exhaustible resources has been conditioned by the notion that there is a global stock that must eventually be gone forever. However, the idea of an existing global stock is meaningless. The actual relevance of depleting stocks is found in the actions and strategies to maintain enterprise capital. Alternative strategies to maintain capital would include a comparison of the expected present worth of income that may accrue over differing time horizons. These comparisons are essentially subjective judgments of the respective risks and uncertainties associated with each strategy. At any moment in time, the extractive firm has numerous investment opportunities that include deliberate speculative delay or immediate efforts to explore, develop and extract resources. The following strategies are examples:

Engage in entrepreneurial delay with respect to (a) acquisition of additional exploration rights (leases), (b) additional exploratory efforts on owned leases,³ (c) investment in development on owned leases, and (d) production of the resource from developed leases already owned by the extractive enterprise;

Extract deposits but maintain capital by reinvesting proceeds in competing capital goods offering a greater rate of return but which *may not* be directly related to the extraction of resources.

As noted, these strategies must face an uncertain time profile of prospective revenues and financial outlays which means that choices made will involve due allowance for time preference and uncertainty. Moreover, opportunity costs of these alternatives will be subjective and unique to the individual extractive firm. In fact, for the extractive firm making a choice of one of these strategies, the opportunity costs will necessarily include a subjective reckoning of income thought by choosers to be obtainable from the next most profitable relinquished strategy (Buchanan 1969, 49-50).

A few additional words of clarification may be important. Firms engaged in extraction are always in search of new and more profitable deposits to replace depleting extractive-resource deposits. In choosing a strategy, the extractive firm compares the marginal expected opportunity cost of finding, developing and exploiting new deposits with the marginal expected opportunity cost of more intensive development and extraction of an existing known deposit. If the former costs are less than the latter, a decision to find new deposits promises a greater yield. The extractive firm would be inclined to pursue this strategy if the lower cost of new deposits were superior to those already under the firm's immediate control. One important aspect of this strategy is that it would reflect a decision to deliberately delay exploration or development of the property and resources to which it already has access on existing leases. In other words, the firm would be exercising latitude in the timing of exploration or development on its existing leases. Also, the extractive firm could purchase from other firms discovered but undeveloped deposits and then immediately embark upon development and extraction of these deposits. But again, such a strategy may reflect a decision to exercise delay with respect to prospects already under the firm's control.

The delay strategy would commonly be premised on an expectation that the capital

3 An exploratory effort can be viewed as successful if the firm making the discovery considers it to be a profitable candidate for eventual development and production.

value of a project would be greater if it were delayed until sometime in the future. While such deliberate delay could be based on expectations of longer-term rising trends in the price of the resources itself, it may also reflect the extractive enterprise's efforts to lower the financial outlays associated with the respective stages of investment in a planned project. In particular, such delay may be helpful in avoiding cost increases from bottlenecks that are likely to be encountered in regulatory efforts to expedite exploration and development.⁴ In the context of capital maintenance, any reduction in cost may significantly enhance prospective entrepreneurial income and in the process make provision for the future by conserving resources. But again, such delaying actions would be undertaken strictly on the basis of entrepreneurial judgments.

But an enterprise may choose to delay, for reasons bearing on volatility in the price of the resource. The different stages of the production process afford ownership of successive series of capital goods each of which represents a type of investment 'option.' Ownership of any investment option represents a right but not an obligation to proceed further with the next in a sequence of investment opportunities. In this case, this sequence of capital goods includes (a) exploration rights for particular lands, (b) discovered resources (c) developed resources, and (d) extracted resources ready to be sold. Each of these distinct capital goods are traded in the market and, hence, has a market price. The statistically measured volatility in the price of the resource itself would be reflected in statistical volatility in the market value of each of these capital goods. The volatility in the market price of the resource would enhance

the market value of each of these four capital goods but this increase in value is contingent on the enterprise's ability to delay action on each successive but distinct phase of investment.⁵ For example, in undertaking investment in exploration, the underlying asset or capital good sought would be *discovered resources*. These discovered but undeveloped resources are marketable and have a price and represent a type of *real* option to acquire developed resources. And, in turn, by committing to subsequent investment in development, the entrepreneurial enterprise would be seeking *developed resources*. But as with any option, real or financial, the length of the period during which the option can be exercised enhances the value of the option. At each successive stage, the extractive firm will value the ability to delay any further commitment to the project until evolving market conditions reveal more information about the future and the potential profitability of the next investment option.⁶ This advantage is reflected in an enhanced market value of each of the capital goods and the extraction project as a whole (Dixit and Pindyck 1994, 4). Hence, decisions to delay are critical in maintaining capital value and in conserving affected resources for the future. But as the discussion below will emphasize, institutions of leasing and land law tend to foreclose planned delay.

The second strategy highlights the reality that capital maintenance requires investment in those capital goods that offer the greatest

4 As this reality applies to production in general, see Alchian (1959, 23-40). Alchian's insight is evident in the research on leasing of Federal offshore lands on the Outer Continental Shelf (Mead et al. 1985, 110-112).

5 The investment valuation described here treats these distinct phases of resource exploitation as distinct 'real options' as opposed to stock call options and in which a higher statistical volatility in the price of the underlying asset enhances the value of both the stock option and the respective real options. See Dixit-Pindyck (1994).

6 Interestingly enough, each successive stage of investment in the project imparts a successively higher investment value to the project itself since these properties are traded between firms.

likelihood of attaining or maintaining profitability. The strategy highlights the reason that cost minimization in the replacement of physical capital goods is not necessarily equivalent to capital maintenance. The real motivation for investment to maintain capital is not to minimize cost of replacing particular capital goods but to increase income (Hayek 2007 [1941], 277-278). The two may be quite different since 'cost' minimization (or expense minimization) does not take into account returns that could be achievable by investment that may not be directly related to the firm's historical specialization.

Shift in the physical composition of capital goods sought could be prompted by newly revealed changes or previously unrecognized entrepreneurial opportunities in other markets. F.A. Hayek captures the motivations for such shifts: "... when we proceed to consider in detail the reaction of capitalists to unforeseen changes, ... we go back to the *rationale* of maintaining capital intact, the quantity of capital drops right out of the picture as a directly relevant magnitude. Its place is taken by a direct consideration of the size of the income streams that may be expected at different dates" (Hayek. 2007 [1941], 280): *italics in the original text*). It is in this sense that a focus on the physical replacement of resource deposits conveys a misleading interpretation of the investments necessary to maintain capital. But the converse is that investment within or outside of the extractive industries, will be sensitive to any anticipated higher returns that may be achievable as a consequence of anticipated scarcities of particular extractive resources.

The extractive firm may be constrained in its choice of replacement investments by realities of 'capital-good complementarity'. A grouping of capital goods would normally be in the form of resource deposits or assets related to the extractive activity such as processing or transportation. If the enterprise were to invest in capital goods not necessarily related to

extraction, it would be mindful of the degree to which such capital goods were complementary to assets comprising its existing operations. The most important issue would not be an issue of physical complementarity of capital goods. Expected profitability would always establish *economic* complementarity and would supersede issues that may bear on physical complementarity of capital goods. The central concern for the enterprise is the extent to which the particular investment alternative promises the largest addition to entrepreneurial income (Taylor 1970, 194). But while the individual enterprise is focused on future income, the societal consequence is that resources are conserved for the future.

Impediments to entrepreneurial capital maintenance by extractive firms

Although capital maintenance refutes the exhaustion myth, this refutation is hinges on access to lands, entrepreneurial latitude in managing resources, and secure rights of private property. But institutions of governmental control and jurisprudence definitely obstruct entrepreneurial actions of extractive firms striving to maintain capital. These hindrances include: a) foreclosure of land access because of government control of mineral lands; b) curtailment of entrepreneurial latitude arising from claims of surface owners; and c) in the case of petroleum, the firm's inability to acquire full control and ownership of reservoirs that it has discovered.⁷ The first of these impediments bears on access to land and the latter two impede extractive firms' ability to manage resources as capital assets.

7 Currently, petroleum law stipulates that the resource is not owned until it is captured at the wellhead (Williams and Meyers 1993, 203.1-203.3). See also: Lowe (1995, 29). Discovery does not establish any ownership claim. Because of the fact that petroleum 'migrates' within reservoirs and, hence, across property boundaries, a 'rule of capture' at the wellhead has been adopted.

a) Land access by entrepreneurs foreclosed by government ownership

Maintenance of entrepreneurial income requires a replacement of the capital goods critical to continued operation within the same industry. This entrepreneurial process requires access to new resources that may be extractable at lower cost. Resource replacement is usually dependent upon leasing arrangements between surface owners and enterprises seeking to find and develop new deposits. The one obstacle facing the extractive enterprise is that surface owners can exercise claims that totally foreclose access rights to extractive firms. These owners are invariably governments that have nationalized lands through acts of political power without actions that establish legitimate, ethical ownership (Bradley 1996, 76). Once these lands are under the political control of governments, access is governed by political processes. In modern democracies, this conflict is manifested in political struggles of self-appointed, politically active stakeholders to induce legislatures to assure politically popular uses of lands.

This political choice of popular uses of nationalized lands is one of the more pernicious features of democratic processes. Once lands are nationalized, alternative uses of these lands are chosen with the intent of appeasing 'stakeholders.' For the purposes of this inquiry, the important question is: who is a stakeholder with respect to the use of public lands? Unfortunately, political self-selection establishes who has a 'legitimate stake' in decisions concerning alternative uses of government lands. Stakeholders are constituents with diverse and subjective views on what for them constitutes an environmental amenity and the way in which they are affected by its presence or absence. Hence, this political process motivates allocative decisions on the basis of the political placation of certain self-selected political constituencies (Lopéz 2002, 211-213). This participatory process has little to do with 'efficient'

environmental policy or the commitment of resources to their highest valued use.

Political advocates of policies that foreclose access are unencumbered by the opportunity costs of such sanctions. In this sense, choosing and hence forsaking the value of the next most highly valued opportunity never impinges upon the actions of non-owning bureaucrats, politicians or environmentalists seeking to foreclose certain uses of government lands. Failure of firms to replace resources deposits can arise from the fact that political constituencies bear no opportunity costs in foreclosing lands to exploration and development. In bearing little of the opportunity costs of political foreclosure of access, self-selected stakeholders have incentives to become extremists in exaggerating preferences and overstating claims. Whatever the benefits of foreclosing exploration and development may be, these benefits are provided as a 'free good' through the process of political control.

b) Conflicting property claims solved by discoverer's ownership of discoveries

The preceding discussion also highlights the fact that the enterprise must have ample timing latitude if resource replacement is to be successful. But an early juridical declaration of surface owner rights has tended to preclude this entrepreneurial latitude in maintaining capital. An interpretation of the land surface owner's rights to subsurface minerals was first enunciated by the British jurist, William Blackstone: "land hath also, in its legal specification, an indefinite extent, upwards as well as downwards....downwards, whatever is in direct line between the surface of any land and the center of the earth....if a man grants all his lands, he thereby grants all mines of metal and other fossils" (Blackstone. 1983, 18; also quoted in Bradley 1996, 70).

Uncertainty and economic change mean that entrepreneurial latitude is always critical in managing capital goods including mineral

leases. The management of mineral leases as capital goods requires timing of lease activities so that capital value of entrepreneurial income is maximized (Brätland 2001, 694-695).⁸ But surface owners' financial interests demand expedited recovery which is inherently detrimental to the maintenance of capital. But the surface owner's financial rights are protected by court-imposed implied covenants that foreclose any action or lack of action that delays or diminishes the surface owner's receipt of royalties.⁹ Hence, by foreclosing latitude in the timing of these activities, the covenants reduce the net present value of mineral resources and impede the ability of the extractive enterprise to maintain capital.

c) Inability of the enterprise to acquire full ownership of discoveries

In the case of petroleum lands, the application of Blackstonian Principles has not meant that the owner of the surface also owns subsurface petroleum (Bradley 1996, 60-62). However, it does mean that the surface owner has the power to impose claims on a percentage

share of gross production. The consequence is that the surface owner's interests preclude the management of petroleum resources as capital assets and retard the entrepreneurial replacement of the resource. As a consequence, the claims of the surface owner dissipate the capitalized value of the resource. Moreover, mandates to undertake these activities at an earlier moment in time means that the opportunity cost associated with these activities will, in almost all cases, be increased (Mead, et al. 1985, 110-112).

These conflicts would not exist if the discovered petroleum deposit were to become the sole, exclusive property of the discovering enterprise. A Lockean principle of 'original appropriation' would supplant the Blackstonian perspective on the scope of the surface owner's property rights.¹⁰ Of course, in this situation, some consent to surface access would still be required from some surface owner to make exploration possible.¹¹ Court-imposed covenants would no longer impinge on the discovering firm's ability to engage in entrepreneurial timing in the scheduling of investments in the project. In this case, the surface owner would have no contingent claim on production. This situation would represent the

8 The surface owner's economic interests are defined by the attainment of a rate of revenue recovery that maximizes the present value of the royalty-receivables revenue stream. Delay only diminishes this present value of royalties receivable (Brätland 2001, 694-695).

9 Historically, these implied court-imposed covenants were thought to be necessary because lease agreements did not usually set explicit requirements for operation of the lease or marketing of the product. But, in fact, these covenants are enforced by the courts for the financial benefit of surface owners as the owner of the fixed percentage royalty. The one covenant in question is referred to as the 'diligence requirement.' Its purpose is to stymie any speculative discretion in timing of operations. But as Mises emphasized, speculative discretion is critical in dealing with market change (Mises 1998, 253; see also: Brätland 2012, 61-62; and McDonald 1971, 83-84). In fact expedited production works to the financial detriment of the extracting firm and blocks what would ordinarily be considered 'economic conservation of the resource' and entrepreneurial provision for the future.

10 This proposal was first put forward by Murray Rothbard (1998 [1982], 71-72). A version of the Rothbard proposal has been provided by Robert Bradley (1996, 69-74). Rothbard's focus is on the acquisition subsurface ownership rights as would be achieved through an act of being the first discoverer of petroleum deposit. He describes a form of Lockean original appropriation or 'homesteading' (i.e. first use of an unowned resource secures ownership). Ostensibly, current jurisprudence around the world prohibits this form of original appropriation. Robert Bradley has developed these ideas brilliantly in the work cited.

11 Directional (slant) drilling would be permitted such that a particular subsurface structure could be accessed from a multiplicity of surface locations. Competition between surface owners would weaken the bargaining power of any single surface owner (Bradley 1996, 72).

normative ideal from both an allocative and ethical perspective.¹²

Secure access to exploratory prospects is impeded that by governmental regulation and control of lands. While governmental constraints on land use are rationalized as actions required to address the environmental interests of the public, their imposition is a key stumbling block to this entrepreneurial role of resource replacement. With full rights of legitimately acquired private property, those parties motivated by environmental concerns could pay a price for committing lands to alternative uses. Such parties may purchase lands in question or may pay owners of resource properties to refrain from exploration and development. In either case, the party pursuing environmental objectives would be paying an amount at least equal to the opportunity cost of forsaking development.¹³

Government v. private entrepreneur in infrastructure maintenance

One of the fallacies of infrastructure maintenance is the implicit presumption that a major part of this infrastructure must be publicly controlled and maintained by government.¹⁴

12 It would be absurd to conclude that a party owning and using the surface, for whatever purpose also comes to own something about which he/she is ignorant or which the party has undertaken no action to establish a legitimate Lockean property claim. Ownership in this case must be premised on some form of action and expenditure of resources to establish a legitimate ownership claim (Epstein 1985, 61). The Blackstone concept defining the scope of property ownership is simply obsolete and dysfunctional.

13 This argument is congruent with Mises' discussion in *Human Action* (1998, 650-651). A failure 'to buy' property for its use or a failure to pay for its use is the source of externality. The act of buying or paying are the actions by which the actor takes responsibility for his actions. Hence, externalities are avoided.

14 The assumption of government's maintenance responsibility no doubt arises from the notion that the services these facilities yield are 'public goods' that cannot

Having made the financial outlay for the facilities that comprise public infrastructure, government takes on the responsibility of maintaining public infrastructure. Unfortunately, there is a pattern of historical inevitability to the neglect of public infrastructure that is endemic to its governmental provision and management. But, save for the occasional business failure or the deliberate scrapping of obsolete capital goods, there is clearly no such pattern of neglect with respect to *private infrastructure*. What accounts for the contrast in patterns of maintenance? One answer may lie in the unexamined presumption that the facilities comprising public infrastructure can be viewed as *public capital* and that a government can act in a sufficiently unified, coordinated way to somehow mimic the action of private entrepreneurs in maintaining this 'capital.' If not, a compelling case can be made that this public capital should be privatized and maintained by private entrepreneurs. But a *second* but related answer is that legislators and bureaucrats who are instrumental in providing and expending funds for infrastructure maintenance may employ their own entrepreneurial strategies in assuring the attainment of their own career ambitions (Loasby 1976, 190). These entrepreneurial actions may well divert attention and resources away from infrastructure maintenance. These officials include legislators and bureaucrats who view their own capital maintenance as those entrepreneurial actions that strengthen and promote their own careers.

Viability of government action to mimic entrepreneurial maintenance

Assume that the government is able to act as a *unitary entity* making decisions with the

be provided privately. However, evidence suggests that public infrastructure's services can be provided through private entrepreneurial undertakings; see: Niskanen 1971; Wollstein 1974; Foldvary 1993, 1-15; Rothbard 2004, 1029-41; Hoppe [1993] 2006, 7; Block 2009, 232).

intent of ‘maintaining total public benefits.’ The adjective ‘unitary’ is used here simply to mean that the government’s plans are formulated and undertaken as though prompted by ‘one mind.’ In other words, the government is *not* comprised of individual bureaucrats and legislators with self-seeking but frequently conflicting aspirations. Rather, the government is assumed to act in a unified way to maintain public infrastructure on the basis of *some attempted imputation of the net benefits that accrue to the public*. The emphasis on maintaining net public benefits is critically important because it represents *the only* legitimate analogue of the entrepreneur’s income.

Given the above assumption, can public infrastructure be legitimately viewed as ‘public capital?’ Is this label apt? In an economic sense, the legitimate concept of capital is premised on the ability of an acting entity to manage a *combination of resources* with the intent of earning an income for an *enterprise as whole*. Private property and monetary exchange afford the entrepreneur this ability. Hence, the aptness of the label, ‘public capital,’ hinges directly on the extent to which public infrastructure can be managed in a way that is functionally analogous to the maintaining of private capital. For the private entrepreneur, capital maintenance is ultimately about actions undertaken to maintain or enhance expected enterprise’s income. But what would be the counterpart of enterprise income for a government in attempting to requisite maintenance of public infrastructure?

Metaphorically, the income counterpart would be the total benefits yielded by all components of infrastructure *as a totality*. The maintenance problem arises from the fact that the benefits of infrastructure yield no appropriable sales revenue that would serve as guide to maintenance. Hence, the absence of a comprehensive and appropriable future monetary income means that the government is left without a unified guide in planning maintenance expenditures for the disparate facilities under its

purview.¹⁵ The government is left with no means of reckoning a rational tradeoff between maintenance projects. Another aspect of this problem is that there is a ‘disconnect’ between marginal intended use of infrastructure by the public and any planned maintenance that may be considered by government. Users of individual facilities and the governmental entity responsible for maintenance are necessarily different acting entities. To summarize, the following inferences highlight the inability of governments to mimic entrepreneurial maintenance and, hence, underscore the misleading nature of the ‘public capital’ label for public infrastructure:

- a) No non-political means are available for a government to weigh the relative tradeoffs of investment in *new* total infrastructure and maintenance of *existing* infrastructure as a whole.
- b) Also, the benefits of total infrastructure maintenance are not appropriable by those bearing the economic burden of total outlay.
- c) Scientifically legitimate means are unavailable to reckon the changing tradeoffs between current investment in infrastructure, as a whole, and the prospective future benefits (Buchanan 1969, 60).
- d) In general, means do not exist for government decision makers to reckon the *relative* tradeoffs between maintenance of some existing facilities of public infrastructure as opposed to maintenance of other facilities.
- e) Maintenance decisions for public infrastructure are based largely on physical deterioration with little rational reckoning of benefits or opportunity costs involved; the result is that some

15 While in some narrow instances, tolls can be collected for marginal use of some facilities, the problem of imputing maintenance tradeoffs for all components of public infrastructure still remains.

complementary facilities are inadvertently neglected that should be maintained while other facilities that should be abandoned are maintained.

An implicit concern is the maintenance of the functional complementarities that exist between different components of the infrastructure. If tolls are not collected for each such facility, the government is left with an imputation problem that would tend to preclude a balanced maintenance that preserves these complementarities. No calculational means of charging tolls that would account for the complementarities existing between the services yielded by groupings of such facilities. The critical issue is the fact that even with the collection of user fees or tolls on *some* facilities, physical wear and tear would be the only inducement for the maintaining complementarities (Brätland 2010, 41-42). Hence, there is no reason to believe that government could ever replicate the actions of private entrepreneurs in the maintaining of infrastructure.

Neglect arising from bureaucratic and political entrepreneurship

If governments, considered as institutions, are unable act as unified decision making entities in maintaining infrastructure, how effective are the actions of individual legislators and bureaucrats in achieving this objective? Evidence suggests that legislators and bureaucrats act in an entrepreneurial manner in fostering their own careers (López 2002, 211-228; Niskanen (1971, 38; Anthony Downs (1967, 2). In other words, for legislators and bureaucrats, careers become the capital they maintain or enhance by the personal maintenance strategies they pursue. But what are the consequences of such behavior for the maintenance of infrastructure? Since bureaucratic and political entrepreneurs are endemic to the workings of government institutions, the maintenance of

bureaucratic and political capital can become a source of infrastructure neglect.

For the legislator, entrepreneurship refers to the time-structured strategies employed in pursuit of political careers. "Capital maintenance," in this context, refers to the actions that legislators take to maintain their power, influence, and job satisfaction. In maintaining this metaphorical capital, legislators may direct their actions toward objectives largely or totally divorced from public-infrastructure maintenance. In their pursuit of personally chosen ends, they must husband tools or metaphorical capital goods to implement their plans. The metaphorical capital goods that legislators and bureaucrats must employ depend directly on the respective constituencies they must serve and on their own career aspirations. These capital goods may be intangibles that involve subjective judgments about the future actions required to achieve career ends.

Neglect of public infrastructure may arise from the legislator's failure to consider the complementarities between the two political capital goods—power and re-electability (Brätland 2010, 45). This neglect may be reflected in the legislator's failure to assure budget funding for the maintenance of existing public infrastructure in his district. For example, such neglect may be prompted by a legislator's focus on the well-publicized construction of *new* infrastructure. Although the legislator may neglect budget funding for *existing* infrastructure maintenance, he may have established sufficient power and re-electability to remain in office and pursue legislative objectives unrelated to maintenance of existing infrastructure. But such neglect may also arise from the legislator's shortage of political power, reflecting his failure or inability to generate support in the legislature for budgets that will finance infrastructure maintenance in his home district. This absence of power may be manifested in a failed logrolling negotiation or a lack of sufficiently strong alliances

in the legislature. The consequence may be the neglect of highways, streets, sewerage systems, and bridges in the legislator's home district. Moreover, if the legislator lacks seniority in the legislature, this neglect may occur even though he is a well-intentioned champion of efforts to maintain these infrastructure facilities.

A legislator's time preference is also critical in the timing and allocation of his two political capital goods—power and re-electability. One consequence is that any time-structured resource allocation for maintenance that derives from his actions may be totally divorced from any time cycle of deterioration or loss in usability that the public infrastructure facilities may sustain (Brätland 2010, 46). Hence, in the absence of an overt threat to his reelection, the legislator's actions over time may well result in chronic neglect of such facilities.

Like political capital, bureaucratic capital is a metaphor that can shed light on public officials' entrepreneurial actions or inaction over the course of time. The entrepreneurial bureaucrat of concern here is the senior executive with some direct or indirect responsibility for public infrastructure and with the power to affect how a bureau allocates its resources. As in the case of the legislator whose capital takes the form of a career, in this case the metaphorical capital in question is the bureaucrat's career. The bureaucrat's view of his career may take into account several subjectively defined sources of appeal.¹⁶ In any case, the career is the overarching metaphorical capital that governs the bureaucrat's entrepreneurial actions and the use of the resources at his disposal. This metaphorical capital suggests a time structure of maintenance that may be at odds with concerns over the maintenance of public infrastructure.

Although the bureaucrat is not an elected official, he must realistically face his own benefactors, constituencies, and power blocs in

managing the capital defined by his own career ambitions. These parties include: appointing officials to whom the bureaucrat reports; sponsoring legislators; subordinates in the bureau;¹⁷ that segment of the public most sensitive to the bureau's activities (that is, self-selected "stakeholders"); and prospective future nongovernmental employers. The latter group in this list would especially concern appointed executive bureaucrats whose long-term career objectives may lie outside of government. The bureaucrat's ability to deal with and satisfy these constituencies' determines the nature of the metaphorical capital goods he must employ in managing the capital represented by his own career.

What are these metaphorical capital goods? The question pertains to the resources he must employ to succeed. The capital goods required to give the bureaucrat at least the appearance of success include: budgets, reputation, and control. Although these aspects of employment do not necessarily include everything that the bureaucrat might want in a particular governmental position, they comprise the resources required to establish the appearance of success. These metaphorical capital goods present the bureaucrat with both complementarities and trade-offs in defining and constraining the actions that best enhance his longer-term career aspirations (Brätland 2010, 46-47). In considering these actions, how will infrastructure maintenance weigh into the bureaucrat's employment of these metaphorical capital goods? The bureaucrat will employ these capital goods to foster the maintenance of public infrastructure if such action maintains or enhances the prospects of attaining the goals that define his career ambitions. Otherwise, passive neglect of infrastructure may well be 'rational' for the bureaucrat.

16 William Niskanen (1971, 38) and Anthony Downs (1967, 2) offer similar lists.

17 Although the bureaucrat has managerial authority over subordinates, he is unlikely to experience sustained success in his position if he ignores the career aspirations of those under his organizational control.

But there would be mitigating concerns for the bureaucratic entrepreneur. The senior bureaucrat must be sensitive to the general public in considering programs of infrastructure maintenance that the bureau might undertake. Infrastructure neglect might conceivably draw unfavorable press, affecting the bureaucrat's reputation among the general public. However, unless the affected infrastructure involves roads or bridges, public reaction to neglect may well be tepid or nonexistent. In short, given the bureaucrat's possible motivations, larger government and expanding public budgets do not necessarily imply the availability of more resources for maintenance of depreciating infrastructure. If the relative neglect of *existing* infrastructure occurs without significant negative feedback from the public, the bureaucrat may perceive greater career advantage in pursuing ventures that are more likely to draw favorable reaction from appointing officials and sponsoring legislators. For example, *new* infrastructure may offer the bureaucrat more reputation-enhancing ways of dealing with his constituencies.

Although *new* infrastructure projects find favor with the constituencies that the bureaucrat must please, they tend to crowd out funding for maintenance of *existing* infrastructure. The bureaucrat may not be particularly concerned with the net social benefits of one infrastructure project as opposed to another competing project (Brätland 2010, 48). As Randall Holcombe has noted “[i]n undertaking actions with respect to infrastructure maintenance, ‘efficiency in resource allocation.’ is not likely to be a prominent consideration” (Holcombe 2002, 148-149). The bureaucrat will not reckon opportunity costs in terms of forgone or relinquished social benefits associated with another competing project. Moreover, as he chooses his action, he is unlikely to employ a planning horizon congruent with the realization of any benefits afforded by publicly supported maintenance projects.

Private entrepreneurs in maintaining hitherto public infrastructure

Entrepreneurial privatization of infrastructure would have several *implicitly inter-related but critically distinct features*. For example, entrepreneurial enterprises would not be dependent on the vagaries of governmental appropriations in attempting to allocate investment funds for maintenance of facilities. Also, private enterprises would not have maintenance plans stifled by officials beholding to political pressures and aspirations of public officials. Choices between competing investments in infrastructure would not be prompted by the influences of certain politically powerful constituencies. Moreover, schedules of infrastructure maintenance would not be disrupted by the legislative and bureaucratic delays common in political decision-making.

We can glean an important insight into public-infrastructure maintenance from the process by which a business firm maintains its own infrastructure. Private property and monetary exchange would enable the entrepreneurial enterprise to use market prices to subjectively evaluate the prospective opportunity costs and benefits associated with alternative schedules of maintenance for its privatized infrastructure facilities.¹⁸ Implicit in this reckoning would be the entrepreneur's ability to distinguish capital and income. Income is a way of looking at capital in terms of its expected return over the entrepreneur's planning time horizon. At the same time, capital, as the enterprise's judgment of net present worth, is a way of looking at the totality of future income from the point of view of

18 The task of economic calculation for the individual, according to Mises, “is to adjust his actions as well as possible to his present opinion concerning want satisfaction in the future” [1949] 1998, 215) Mises also notes: “The question . . . is whether a certain course of conduct increases or decreases the productivity of our future exertions” ([1949] 1998, 511).

the entrepreneur's reaction to market uncertainty and of his time preference, or rate of discount. For the enterprise, income would be the amount that could be consumed within a definite period without lowering the expected or desired investment worth of capital as reckoned by the entrepreneurial enterprise (Mises [1949] 1998, 261; Hayek [1941] 2007, 277-78).

For the entrepreneurial enterprise, investment in maintenance would not necessarily be focused on particular resources, but rather on how the entire complementary combination of owned facilities would affect the enterprise's profitability (Mathews 1996, 88-90). The resources at the business entrepreneur's disposal would be capital goods that could take the form of buildings, equipment, tools, goods of any kind and order, claims, receivables, cash reserves (Mises [1949] 1998, 262). The critical distinction is that specific infrastructure facilities (its capital goods) would not in themselves constitute capital, and their existence would not necessarily assure income or imply anything with respect to their maintenance of affected facilities. These things would become an aspect of capital only when they were owned, deployed, and maintained in the coherent pursuit of a single, unified plan undertaken by a specific enterprise. Hence, within the context of the enterprise's planning function, capital would emerge as an entrepreneurial reckoning of the net present monetary worth of the enterprise's own plan to employ its own facilities or capital goods (Lachmann [1956] 1978, 13).

Within this calculational context, the entrepreneurial enterprise would be able to make rational choices to maintain its capital as reflected in changes in the enterprise's prospective worth. Hence, for the entrepreneurial enterprise, depreciation would be always a matter of entrepreneurial judgment with respect to its effect on future capitalized income (Lachmann 1986, 66-67). Maintenance of capital would always be focused on a desired stream of future income. Therefore, depreciation would

always be judged within the context of the complementarities between various facilities. Maintenance decisions would focus on a facility's effectiveness in serving the complementary function of attaining the desired level of current and future profitability. Each maintenance decision ultimately would relate to the most profitable complementarity within a chosen combination of facilities employed in pursuing an entrepreneurial business plan (Hayek [1941] 2007; Lachmann 1986, 63; Mises [1949] 1998, 512). Hence, with respect to maintenance, the privatization of infrastructure would have the following implicitly interrelated but critically distinct features:

- a) Prospective monetary benefits of maintenance would be appropriable by the entrepreneurial enterprises (that is, costs and monetary benefits would be borne by the same entity).
- b) Business entrepreneurs would be able to evaluate the anticipated, yet uncertain, monetary trade-offs between current investments in maintenance and the desired future income return earned by providing infrastructure services.
- c) The entrepreneurial enterprises would be able to integrate plans for the maintenance of their infrastructure facilities into a comprehensive business plan focused on the maintenance of a desired time profile of future net revenue earned from the provision of services (Hayek [1941] 2007, 277).
- d) Physical deterioration of a particular infrastructure facility would be of concern only to the extent that it is judged to reduce the future monetary income yielded by the complementary combination of facilities that it owns.
- e) Business entrepreneurs would be able to rank maintenance priorities and assess the extent to which total revenue productivity of its infrastructure facilities

as a complementary combination is affected.

- f) Maintenance plans for particular facilities would be unique to individual entrepreneurial enterprises, reflecting the enterprise's market expectations and the particular complementarities that would be sought in its chosen combinations of infrastructure facilities.
- g) Because maintenance would be tied to a monetary income, the enterprise would be able to link its maintenance investments to the demand for its infrastructure services as expressed by its transactions with customers.

Privately held infrastructure would be maintained by profitable entrepreneurial business enterprises that own them. With the elements of public infrastructure in private hands, entrepreneurial owners would be able to derive an income stream from the provision of their services. Maintenance of this privatized income stream would constitute capital maintenance for the firms owning infrastructure facilities. Individual entrepreneurial enterprises owning infrastructure would be acting on their own behalf but in the process would be serving the interest of society as a whole in undertaking the maintenance of its own capital. These judgments of entrepreneurial success would be made with a degree of rationality that would be impossible in the absence of private property and monetary exchange. While the maintenance of privatized infrastructure would be a form of action that would provide for the future, its success but would be reckoned only in the context of individual entrepreneurial efforts to profitably serve users of owned infrastructure facilities.

Conclusion

Resource exhaustion and infrastructure neglect are perennial social concerns that do not have economically rational governmental

solutions. But, the institutions most capable of dealing with these issues are to be found in the incentives that are faced by private entrepreneurs availed of privatized resources. Extractive resource renewal and infrastructure maintenance are activities that could become routine by according private entrepreneurs a much less restricted role in societal provision for the future. However, this process is stymied by the institutional constraints imposed by government. These constraints include foreclosure of land access, regulatory encumbrances to entrepreneurial management of resources, and, in the case of petroleum, an inability to acquire full property rights in resources discovered by the enterprise. While entrepreneurial action is crucial to warding off resource exhaustion, these impediments mean that the entrepreneur's role in resource replacement can be only partially fulfilled.

Neglect of what is labeled public infrastructure seems to be endemic to government's assumed responsibility with respect to maintenance. First the absence of secure ownership rights and the nonexistence of a privatized revenue stream from the sale of services mean that governments are unable to mimic the actions of private entrepreneurs in maintaining infrastructure. The reason is that although public infrastructure ostensibly yields benefits, the absence of secure ownership and an integrated income stream mean that governments cannot implement a calculational program of maintenance. Second, career oriented entrepreneurial behavior on the part of legislators and bureaucrats undermine the governmental function of maintaining infrastructure. While maintenance of public infrastructure may, in some instances, be congruent with the career aspirations of legislators and bureaucrats, their self-interested goals may intervene in the allocation of public funds.

Governmental failures with respect to infrastructure maintenance offer grounds for privatizing what has been public infrastructure. As private property, the services of infrastructure

would be marketed thus placing the process of maintenance under the discipline of entrepreneurial capital maintenance. The marketing of

infrastructure services would allow the owning enterprise to focus on the maintenance of an integrated income stream.

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Commodity, scarcity, and monetary value theory in light of bitcoin

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Abstract: The relationships between bitcoin and the core economic concepts of goods, scarcity, commodity, and monetary types are examined based on a strict division between abstract action theory and technically informed case interpretation. This analysis identifies bitcoin as a rival digital commodity with competitive monetary and novel non-monetary characteristics. The emergence of such an unlikely “immaterial commodity” calls for refining the historical thesis of the “dematerialization of money,” which narrates an advance from material commodity monies to immaterial fiat monies. In contrast to conventional financial services and common historical practices, users can control and use bitcoin units, including advanced transfer features, without having to rely on third-party services or counterparty-issued substitutes.

Keywords: Monetary value theory; bitcoin; scarcity; rivalry; commodity

Facts do not speak; they need to be
spoken *about* by a theory.
—Ludwig von Mises¹

Introduction

Economists, regulators, and opinion makers the world over have made cases for classifying bitcoin as money, not money, a commodity, a miscellaneous form of property, an intangible asset, a private unit of account, and so forth for local positive law and taxation purposes in various jurisdictions. Meanwhile, bitcoin critics of many persuasions cite as a fatal defect its lack of “backing,” whether material or political.

This partly reflects the pre-existing landscape of monetary value theories. The hard-money oriented tend to be most unsettled by bitcoin’s lack of material backing. A simple “metalist” view clearly sees none of the commodity foundations supposedly necessary for a money to be sound. Even a commodity theory view that holds that money must *originate* as a commodity, though it can then lose backing over time, cannot approve of bitcoin as even a potential money—bitcoin never had any commodity backing that could have subsequently been lost.

Credit money theorists, who argue that the nature of money as such originates in, and is now, a credit/debt relationship, might wonder at the lack of any such relationship visible in bitcoin. Those with related understandings in the direction of state and sovereign theories of money might be curious upon finding that bitcoin seems to function in a monetary role in the absence of any political or legal privilege whatsoever.

In broad strokes, that to which these schools respectively attempt to ascribe the universal essence of the value of money as such is in all cases absent in bitcoin, which to that extent might reasonably be considered defective in their respective sets of eyes. Bitcoin can at best be viewed as “not money” and therefore not to

be taken too seriously. If the reality of bitcoin does not appear to conform to their various theories, it must be bitcoin that is a substandard thing, not their theories.

A combined assessment of the respective contributions and weaknesses of credit, state, sovereign, and commodity theories of money in light of bitcoin is a much larger project underway. The current treatment emphasizes the conceptual foundations of commodity approaches. Some of these foundations should also serve as groundwork for additional analysis.

Goods, scarcity, and commodity are concepts each associated more or less strongly with materiality. It is argued below that wholly informational bitcoins nevertheless meet key characteristics of a good, exhibit a novel endogenous form of scarcity, and trade as commodities do in terms of relative pricing characteristics. While the physical concept of materiality played a practical role in the formation of the economic concepts of goods, scarcity, and commodity, it was never a necessary logical requirement of them.

If this is so, it could reveal weaknesses in the “commodity versus pure information” dichotomy that helps divide the various schools of monetary thought as reflected in the overarching historical thesis of the gradual “dematerialization of money” (Huber 2013, 48; Simmel 1900). If something other than dematerialization *per se* can also characterize the long-term development of monetary history, it could open the way for subsequent re-examinations of what does account for the value of money, and of bitcoin, in light of the balance of positive contributions from these various schools of thought.

Method: Differentiating economic and technical layers

In the action-based approach to economics formalized by Mises,² interpreters combine

1 Mises 1953, 510.

2 Mises (1998, 2006, 2007). See also Hoppe (2006) and Hülsmann (2003, 2003b).

abstract principles with specific understandings of the technical natures of the objects that take roles as ends or means in specific acts. The approach seeks to carefully differentiate respective roles for 1) abstract economic theory, understood as among the logical implications of the concepts of choice and action as such; 2) the study of things (and unintentional non-action behaviors), as in the experimental natural sciences, technology, and engineering; and 3) the interpretation of human events in terms of the meetings of these subjective and objective components in acts and emergent social patterns. This facilitates the interpretation of specific acts and patterns situated in time and place (“history”), acts that took certain (technically understood) objects as ends or means and employed them within particular settings and contextualized understandings.

In the current case, the clear grounding of economic-theory concepts in action better distinguishes the economic from the technical layers of observed monetary phenomena. This better delineates which aspects are within the proper domains of which fields. Action-derived economic theory also provides a universal base framework separable from the particulars of local positive law classifications and normative monetary policy concerns, especially useful for examining a border-agnostic system.

The formal logic of choice and action as distinct from “rational choice”

This formal logic of choice and action should not be confused with the better-known artificial construct of a fictitious “rational choice” that no really existing human has ever made. While it has become fashionable to cite “modern research in experimental psychology” to refute the naive assumption of an alleged “economic rationality,” the Misesian approach to economics, apparently unbeknownst to such critics, does not make any such assumption, and has from the outset also sharply criticized rival

approaches that do. According to this critique, appending “rational” to “choice” was needed to create a representational proxy of real people that could be examined using mathematics. In contrast to this study of proxy humans has already long stood the logical-deductive lineage of Menger, Böhm-Bawerk, Mises, and beyond, which rejects this path as fundamentally misguided from the ground up.

Unrealistic assumptions such as “economic rationality” do undermine much of conventional economics, and Kahneman (2011) and Taleb (2010, 2012), for example, have squarely taken aim at the resulting target. However, such critiques, while largely on the mark regarding the approaches to economics these authors are addressing, do not apply to all schools. Specifically, there is no contradiction between experimental insights into decision psychology and the abstract concept of choice and action as advanced as the ultimate foundation of the causal-realist approach. In this view, the proper role of choice in economics is as an abstract universal, without “assuming” any limiting qualitative descriptors such as “biased,” “social,” “economic,” or “rational.” Examining the entire fabric of such qualifiers is then within what this approach considers the proper respective domains of many fields other than economic theory, including but not limited to psychology, management, anthropology, and history.

The importance of a minimum technical understanding

The application of action theory to specific cases and events entails considering both the balance of empirical/historical evidence and the theoretical concepts applied to its interpretation. Cases must be sufficiently identified as belonging to relevant classes if a theoretical interpretation is to apply suitably. If the observed phenomenon itself has been poorly understood, an economic theory interpretation of it will be compromised.

Thus, even when approaching bitcoin mainly from an economic-theory viewpoint, it is still essential to overall understanding to become at least minimally familiar with its major technical components, architecture, and functionality, as well as its surrounding business, volunteer, development, and other associational infrastructures. A tendency of observers to feel that bitcoin must be a scam or Ponzi scheme appears correlated with low knowledge of such technical underpinnings and contexts. More positive impressions appear to correlate with knowledge and expertise in relevant fields such as cryptography, peer-to-peer networking, and open-source development.³

A scarce, digital, monetary good

Disentangling the association between commodity and materiality entails examining the related concepts of scarcity and goods framed against the emergence of the digital economy over the past several decades. Since a commodity is a type of scarce good, in considering whether bitcoin can be a commodity, it should logically be possible to establish first that bitcoin is a *good* and second that it is a *scarce* good.

Bitcoin meets key characteristics of a good as defined in relation to action and choice. A good serves as a means within a structure of action. Böhm-Bawerk advanced a subjectivist explanation of goods in an 1881 paper, concluding that:

It is the renditions of service rather than the goods themselves which, as a matter of principle, constitute the primary basic units of our economic transactions. And it is only from the renditions of service that the goods, secondarily, derive their own significance. (1962)

The scarcity of economic goods derives from their limited availability, not in general, but “with respect to the actual ends that they are capable of satisfying,” explains Campan (1999, 21-33), elaborating on Böhm-Bawerk’s reasoning. Objects become goods only in relation to persons and their actions. A good has properties that render it useful within structures of action, and this must be understood primarily in terms of the structure of action, and only secondarily in terms of objective properties of the good.

Users obtain and use bitcoins, conceiving of them as digital objects from which they anticipate some such “rendition of services.” Among such services are filling the role of a type of liquid financial balance that can be put to use to better address the uncertainties of the future, whether near or distant. That is, users derive that type of value that has been described under the concept of the yield from money held (Hoppe 2009).

Bitcoin also meets another quality of a good that Böhm-Bawerk identified—it can be exclusively and effectively controlled and put to use by specific users (Campan 1999, 24). Bitcoin employs cryptographic keypairs and digital signatures to provide exclusivity of control. Bitcoin wallets contain keys and addresses to which units of bitcoin are cryptographically assigned as recorded on the blockchain. Once a user transfers bitcoin from one wallet to another, it is no longer controllable with the keys in the originating wallet, but controllable exclusively with the keys in the destination wallet instead. A given unit’s state of address assignment is mutually exclusive to its being in some other such state.

More than one party could potentially gain access to a copy of *the key* simultaneously, but only one such party can ultimately succeed in *using the key* to spend any associated bitcoin. User-level security is thus dependent on maintaining suitable control of signing keys. In bitcoin’s security design, there is “no reliance on recourse. It’s all prevention (Nakamoto 2008b).”

3 See Graf (Sep 2014) for a technical-structural overview of Bitcoin for a general audience.

Natural and artificial scarcity in the digital age

Precious metals and other commodity-money goods linked—more or less—scarcity and materiality in a monetary context over centuries. Yet bitcoin is squarely within the realm of non-material digital goods. Modern digital goods, such as media or document files, lack materiality and can, in principle, be copied *ad infinitum*, a fatal flaw for any good to function in a monetary role.

Paradoxically, the essence of the digital-information revolution, without which bitcoin could not exist, was that unlimited numbers of people could make and use unlimited copies of a good simultaneously without direct mutual interference. *Copies* of digital goods could be made at effectively zero variable cost without “the original” disappearing or even degrading.

Such mass digital replication dealt a crushing blow in certain areas to an age-old adversary—natural scarcity. In response, however, a legal and technical scramble to create and expand *artificial* scarcity ensued. The chief methods have been expanding copyright and patent legislation, treaties, and enforcement; ever more draconian, elaborate, one-sided, and unread software license terms; and the application of digital rights management (DRM) methods.

In monetary affairs, a similar blend of legalistic and technical artificial-scarcity measures are employed to combat the unauthorized replication of official paper slips (counterfeiting) and restrict to authorized members of national and supranational banking cartels the special legal privilege of issuing bank money, the private “fountain pen money” that flows from the pens of loan officers into upwardly revised digital account balances (Huber 2013, McLeay 2014).

How can bitcoin be interpreted in terms of such natural and artificial scarcity? The intuitive answer, that bitcoin is likewise “artificially” scarce, may not end up being entirely correct,

but to argue this requires turning to a different concept—rivalry.

Distinguishing rival and nonrival goods

A rival good is one that different parties *could not use* simultaneously for different incompatible purposes without coming into physical conflict. These are mainly physical goods as we most ordinarily think of them; they cannot be literally “copied,” each one must be *produced*. A nonrival good, in contrast, is one—such as an idea, method, or digital file—that *can* be copied or emulated freely. Moreover, each copy or instance can be put to simultaneous parallel uses without direct mutual interference. The concept rival thus specifies a descriptive relationship between the nature of certain types of goods and their objective employability when used in a social context.⁴

Defined, a **nonrival good** is a good that is copiable with perfect remainder of the original and useable by multiple actors simultaneously without mutual interference. A **rival good** is a good that is *not* copiable with perfect remainder of the original and is *not* useable by multiple actors simultaneously without mutual interference between physically incompatible uses.

The broad economic sense of the word scarcity can encompass both rival and non-rival goods; the concept of a “good” itself already implies this broad sense of scarcity (Mises 1998, 92-92). Yet the word scarcity can also be used to specify the narrower sense of a rival good. This rival sense is more useful in interpreting bitcoin and the word rival should also be clearer in this use.⁵

4 This narrower sense is used in property theory, such as in Hoppe 2010 Chap 2 and Kinsella 2001. Tucker and Kinsella 2010 used the terms “scarce and nonscarce goods.”

5 Scarce has yet a third meaning of “in short supply” or “not enough” relative to an assumed ideal baseline norm of comparison. This colloquial normative sense differs

On a descriptive basis, to prevent conflict between multiple incompatible uses in the case of a rival good, either exclusive control of the given single instance of such a good must be transferred (through abandonment, sale, gift, or theft), or an entirely new instance of the good must be produced.⁶

Are bitcoins rival goods?

Even though bitcoins are part of the normally copiable and therefore nonrival digital realm, they *cannot* be copied. Instead, as noted above, their current state of address assignment can be altered only with the required digital signatures on a transaction that becomes included in the blockchain. Such “spending” of bitcoin is a transfer of control assignment.

Although bitcoin is informational, the protocol and network nevertheless operate to deliver rival scarcity of units. This enables bitcoin to function in the social role of facilitating indirect exchange. It could not do so if it were a nonrival digital good, and almost all digital goods prior to bitcoin were nonrival.

Note also that this rival scarcity does not result from appending special legal status or technical protections to otherwise pre-existing nonrival digital objects. It is instead among the *inseparable defining characteristics* of bitcoins as they exist, and they exist in no sense other than as integral attributes of the cryptographic data structures of the Bitcoin blockchain, protocol, and network.

Also, unlike past cases, such as the immaterial recorded data content of credit ledgers and other debt recording substrates, no creditor/debtor relationship is recorded. No one is designated as owing or being owed anything. The

Bitcoin blockchain is not a record of outstanding debt obligations, but a ledger of exclusive control assignments to specified rival goods.

Newcomers to cryptocurrency are often concerned as to the issue of copiability when observing that forked and altered new blockchains, known as altchains, can be created *ad infinitum*. Indeed, altchains and their respective altcoin units have already proliferated. Bitcoin typically constitutes from 90%-95% of cryptocurrency market cap, with the next 500+ listed altcoins *combined* accounting for the remainder.⁷ Some of these, such as Namecoin, purport to fill quite different roles from Bitcoin, but others are relatively minor variations on the Bitcoin theme. Such variants each offer somewhat different issuance models that can be viewed as partly analogous to central bank monetary policies (Rochard 2013). Arguably, a version of “Bitcoin” with different unit production characteristics would no longer *be* “Bitcoin” in substance, but another new altcoin instead.

Even though *whole blockchains* can thus be copied and varied in this way and are therefore nonrival goods, cryptocurrency *units themselves* nevertheless still function as rival goods. In no case do units of altcoins factually constitute new units of *bitcoin*. Moreover, no such individual units are actually valued on the market as interchangeable direct substitutes from one chain to another. Instead, each is valued and priced as a distinct good, and each can in fact be observed to carry dramatically divergent valuations.

A bitcoin is thus a rival good. It is *not* copiable with perfect remainder of the original and is *not* useable by multiple actors simultaneously without mutual interference between physically incompatible uses. “Physically,” in this case, refers to the actions, devices, and network resources required to sign and send a specific transaction to the network. Only one such attempt to spend a given unit at a time *can succeed* in reaching the end sought. The protocol

yet again from the two distinct and more formal descriptive senses distinguished.

6 Coordinate ranges in three-dimensional space (the economic-theory concept of “land”), have both rival and nonrival characteristics; some uses of defined spaces can overlap, others not. Space thus has both rival and nonrival aspects relative to possible uses.

7 See Coinmarketcap.com for current figures.

renders any such “double spending” acts mutually incompatible.

Bitcoin and the competitive characteristics of monetary goods

Several characteristics objectively differentiate some rival goods as relatively competitive candidates for potential roles in facilitating indirect exchange in society. As a practical matter, units of silver have appeared most widely in monetary roles historically, with shell beads most widespread over both time and place among so-called social currencies.⁸ Typical lists of commodity-money characteristics include durability, divisibility, homogeneity and fungibility, value per weight unit (portability), and scarcity (as the opposite of abundance or cheap reproducibility).⁹

Bitcoin evaluates well on each characteristic. As a configuration of digital information, it is perfectly durable through time. This contrasts with any particular blockchain or private key recording *substrate*, each of which is at risk of loss, destruction, or “bit rot.” Bitcoin is infinitely divisible for any practical purpose—under the current settings, to 2.1 quadrillion satoshis¹⁰—but this too could be extended. “Signed outputs” of virtually any size can be generated and combined. Each unit is perfectly interchangeable and mathematically uniform, though this is

an ongoing area of tension and technical arms races between advocates of financial privacy and proposals and practices such as identity tracking and black- or white-listing of coins.¹¹ Bitcoin lacks the characteristic of weight altogether and therefore competes against material monetary commodities on value per weight with a score of “infinite.” On portability, it features always-on, costless global direct access and near-instant transfers.

Finally, its objective limitations on new production are defined directly within the protocol. They form part of the nature of what kind of units bitcoins *are*, which is unprecedented. By contrast, even declaring a “limited edition” of some coin or printed paper is ultimately a mere promise. Such promises are subject to later revocation, or simply the successful counterfeiting of additional units by other parties.

Examining such technical characteristics is not a direct task for economic theory. It is primarily a matter for specialized technical investigation and evaluation based on the standards and criteria of the relevant fields. Such facts, as they are understood, can then be subjected to economic interpretations.

Viewing “commodity money” with theory rather than history

In *The Theory of Money and Credit*, the first German edition of which appeared in 1912,¹² Mises used Chapter 3 to define and assign terms to the classes of monetary objects that he set out to analyze. He selected these terms to facilitate analysis better than the conventional, positive-law, and financial press terms of his time, which he found too superficial for this purpose (59-60). This emphasis on economic function as contrasted with outer appearances in elucidating “the processes by which the different

8 See Graeber’s description of social currency, its uses, and its differentiation from money used in straight trade (2011, esp. Chap 6). Social currency correlates with what Szabo (2002, 2006) called proto-money or collectibles. Ridley (2010, Chap 2) interprets early forms of trade facilitation as enabling the extension of specialization and thus knowledge and technology.

9 One concise discussion of these characteristics in terms of silver is in Hülsmann 2009.

10 A satoshi is the current name for the actual base unit in the protocol. A “bitcoin” was arbitrarily labeled early on as a 100-million-satoshi unit for initial human purposes. Currently, bits (100 satoshis) and millibits (100,000 satoshis) are among contenders for use in human communication, pricing, and client interfaces.

11 See Dawkins (1986) on the characteristics, features, and outcomes of evolutionary arms races.

12 English version cited: Mises 1953 (TMC).

types of money are valued” (61-62) remains a useful reminder of the importance of differentiating technical and economic factors.

Still, the typology does not immediately present an intuitive place for bitcoin.¹³ Bitcoin is not fiat money. It lacks any legal-tender status or other official privilege, stamp, or certification. Nor is it a token, note, or other type of issued money substitute. It is not “redeemable” at fixed rates in exchange for any more fundamental unit.

It is not credit money either. It entails no creditor/debtor or other promissory relationship. As Rothbard wrote of the nature of claims: “when the claim finally falls due, the creditor redeems the claim and acquires *the good itself*, thus ending the existence of the claim (2004, 167).” Bitcoin is, in precisely this sense, “the good itself.” The holder of a bitcoin balance owes nothing and is owed nothing on that basis.

This leaves one final candidate: commodity money. Yet for many observers, this initially seems as though it could not be correct either. First, they argue, bitcoin is not a “commodity,” and second, it is not “money.” If one’s conception of commodity necessarily entails materiality, it is impossible to consider purely informational bitcoin as one.

Some critics likewise attempt to dismiss bitcoin for allegedly having the fatal defect of not being “money.” Šurda labels this the “money or nothing fallacy (if bitcoin is not money, it’s nothing).” The distinction between money and other media of exchange *can* be useful, but use of terms should be grounded in analytical purposes. The adjective “monetary,” derived from money, encompasses a range of objects and phenomena of interest to “monetary theory,” which includes media of exchange that may not be technically classifiable as money according to specific definitions. Mises also noted that

this “money” distinction, at least when based on an imprecise descriptor such as “commonly used,” is not necessarily that important in principle. Of primary importance is that the theory of indirect exchange refers “to all instances of indirect exchange and to all things which are employed as media of exchange...The theory of money was and is always the theory of indirect exchange and of the media of exchange (1998, 395).”

Beyond this generality, however, there is still some additional value to be gained from distinguishing which among several media of exchange is used as the dominant unit of pricing and accounting in a given area, and this could then be designated as the exclusive “money,” to the extent this linguistic distinction proved analytically useful.¹⁴ It is worth noting in this context that in common usage, most people would make no such distinction: a Singapore dollar left in someone’s pocket upon returning to euro-denominated France would still be a specimen of “money,” even though it would be unusable in a shop (let alone being the local unit of economic calculation). All of this is therefore of concern only in the technical use of terms as defined and justified for specific analytical purposes.

Some hard-money oriented critics of bitcoin cite sources such as Menger’s *On the origins of money* (2009 [1892]) and other works as support for claims that bitcoin’s lack of materiality is a serious defect, as, according to such venerable classics, money “must originate as a commodity,” by which such writers appear to have some *material* commodity firmly in mind. Meanwhile, some credit money theory commentators reject Menger’s discussion as merely another reflection of the historically naive “myth of barter.”

13 Šurda (2012, 23-28) also similarly examined bitcoin in terms of the TMC typology.

14 See Graf Sep 2013, referencing Koning 2013, for an initial treatment of the separability, under technical definitions, of “money” and media of exchange in a bitcoin context.

A note on debt recording and the “myth of barter” critique of economics

The critique of economics as such for its alleged reliance on a made-up primitive social phase of barter as its “founding myth” was recently elaborated in Graeber 2011, which carried forward the thesis from Mitchel-Innes (1913, 1914). The balance of issues raised warrant separate treatments. However, at least one preliminary response is that the “barter story” is *supposed to be* a theoretical reasoning tool that should not be misapplied as a quasi-historical claim as to the actual purported existence of a Barter Eden. If the statements of the theory of direct exchange have at times, especially understandable in their earliest developments, been mixed with conjectural historical speculations, it is only necessary to point out that it is a misapplication of pure theory to employ it as a weak proxy for historical research.

One role of economic theory, including insights derivable specifically from the theory of direct exchange, is to aid in and clarify the interpretation of history, including the balance of any and all historical, archeological, and anthropological material available. Mises 2007 [1957] addressed the relationship between theory and history in general, and Mises 1998 [1949] (202-203) in particular includes an unequivocal statement of the strictly theoretical role that “the barter fiction” should play in economic theory.

The case of credit money, in which debt instruments circulate in trade, does differ from commodity money in that the credit money instruments (the tablets, tallies, or circulating notes) do not themselves have a significant independent prior value as goods (Hülsmann 2008, 28). They are *records* of outstanding credit relationships, and as such *do* represent the “pure information” of credit-money school thought. Such items *do* carry information about outstanding credit/debt relationships. If the records themselves circulate as tradable

instruments, they can initially begin to become valued as substitutes for the goods to which the creditor was entitled under the claim recorded. The relative market valuations of substitutes and original goods can then also diverge in various ways under various conditions.

However, the credit money school approach seems to have taken this special case and extended it in an attempt to define the general nature of money as such as being a credit instrument. One historical challenge to this as a general, rather than a special, theory of money, is that it does not seem to explain the frequency with which such historical credit/debt records were *denominated in* units of precisely such goods as have been traditionally described as commodity money, such as amounts of silver or grain in ancient Mesopotamia or numbers of cattle in Ireland or camels in Somalia.¹⁵ Theoretical economists have focused on the natural competitive factors differentiating commodity money goods from all other goods, which has a bearing on *why* credits/debts in debt ledger systems would have strongly tended to be initially denominated in *those* units, as opposed to others.

The theoretical relevance of commodity in relative liquidity

Returning to Menger, his central theoretical use of commodity in his considerations on the origins of money was in the comparative analysis of the pricing of various classes of goods, a general theoretical issue. He contrasted markets for specialty goods such as technical instruments with those for general-purpose goods, especially those types of fungible goods that are literally traded on commodities markets. Relative to other types of goods, it is nearly as easy to either buy or sell commodity units at a given going market price. This contrasts with other items for which the relative positions of buyers and sellers differ more widely.

15 Patterson 1994; Van Notten 2006.

For most—non-commodity—goods, it is easy to go to a store and buy something, but much harder to turn around and sell it. One may not be able to resell the item at all, or if so, only at a steep discount from the price just paid. On a commodity market, however, the relative positions of buyers and sellers are much more similar. Regardless of whether one is currently in the role of buyer or of seller, one faces similar price spreads and a similar relative ability to have transactions executed in a timely way, not the case with non-commodity goods.

Money is that good which, for whatever specific sets of reasons in each time and place, is at the apex of this hierarchy of what Menger called “saleability” (liquidity). Other media of exchange, such as bitcoin today, are not at the very top—the dominant local money itself is, but are still ahead of most all other goods on the market (cars, shoes, tomatoes) in terms of the nearness of the relative bargaining positions of buyers and sellers.

The primary relevance of commodity to Menger’s discussion was to contrast the relative liquidity of goods rather than their materiality. His primary topic was not things or events, but the relative liquidity of different types of goods and what this might tell us about the economic nature of money.

Progress on understanding the various actual historical origins of monies in specific times and places should follow from combining the best of historical research with the application of the best of causal-realist economic theory. In this process, the proper respective roles and methods of the distinct disciplines involved should be identified and maintained.

The alleged absence of non-monetary uses of bitcoin

Bitcoin critics often cite current non-monetary uses as an allegedly necessary characteristic of a monetary commodity, one that bitcoin obviously lacks. One helpful

observation in considering this view is that the global payment system functionality of Bitcoin is inseparable from the use of bitcoin units. The bitcoin unit and the Bitcoin network are an integrated totality best understood in a unit/system duality framework. Attempting to value the one in the absence of the other is purely analytical in that their actual practical separation is impossible. There is a single unit/system phenomenon, aspects of which *can be viewed* either with system or unit perspectives. In contrast, more familiar types of monetary units are comparatively (though not entirely) payment-method agnostic. Units and transfer methods can be selected and used more independently of one another. Multiple currencies can transfer through the same interbank network or the same currency might be sent using two different remittance services.

It is fashionable to claim that the Bitcoin “blockchain technology” is the “real” innovation, independently of bitcoin “the currency,” which, it is usually added, does have its problems. However, an alternative way to look at this is that it may be the *inseparability* of system and unit that is itself the “real” innovation, at least from a mainly monetary point of view. A fully integral (inseparable) payment-system/payment-unit is novel, and theoretical treatments of bitcoin valuation must account for it.¹⁶

While it is often *assumed* that bitcoin has no former or current non-monetary applications, examination reveals candidates.¹⁷ Many of these are easier to grasp in the context of

16 See Graf Nov 2013, Section 10 on unit/system duality applied to monetary theory. See more recently also Tucker Aug 2014 on payment-system/unit inseparability and unit valuation.

17 For example, Šurda Dec 2013, quoting Molyneux, lists at least eight. The specific issue of non-monetary value components *prior* to the first emergence of a medium-of-exchange value component is taken up in Graf Nov 2013 in the context of the regression theorem in purchasing power theory.

the above integral unit/system perspective. Such functions include, but are not limited to: 1) integrated, permanent, and free secure storage independent of value amount stored, with units always accessible by holders from anywhere with network access; 2) multi-signature corporate fiduciary controls; 3) time-stamped proof of existence for any document or data; 4) multi-signature transaction escrow (itself a lynchpin in the construction of true peer-to-peer online marketplaces¹⁸); 5) ownership registry and secure low-cost title transfer technically independent of geography; 6) the secure, permanent, and low-cost recording of a signed hash of any sort of contract or document whatsoever;¹⁹ and 7) the infrastructure required for publically proving current control of bitcoin reserves. These are all functions supported on the Bitcoin network, but none of them are counted directly under traditional monetary functions.

For the “blockchain technology” to function and self-finance as it does, individual units must be able to gain and sustain some non-zero valuation as discrete units. What users can in turn do with these units is dependent on the characteristics of the network of which they are inseparable components.

A drawback of the “synthetic commodity” concept

Another proposed conception of monetary commodities suggests that they can be distinguished as naturally occurring goods as contrasted with artificially produced or synthesized goods.²⁰ This distinction may have some valuable uses, but it also has a conceptual drawback. Part of the general meaning of an economic good already includes an aspect of being

distinguished from mere objects, substances, or locations in an unused “state of nature.”

Classical proto-monetary and monetary commodity goods such as shell beads and metal bars and coins begin to take form only with the raw materials for these items and their associated production tools being removed from a state of nature. Seashells by the seashore are not yet objects suitable for a peace offering to the clan across the valley. Carved shell beads arranged on strings are skill- and labor-intensive craft items. Both production tools and raw materials for the final products must pass through multiple processes before a suitable product emerges. And so it is with locating and transforming metallic ores.

However, before it comes into existence, a rival digital commodity, with bitcoin as the prototypical example, must likewise be produced through specific technical processes, although these processes differ dramatically from those of material commodities. If one is unfamiliar with the nature of these production processes, however, they can easily seem fraudulent or at best unreliable or mysterious.

The key distinction, then, is not the presence or absence of “artificial” production, which must take place in either case, but the *types* of discoveries, materials, and production processes required to bring the respective types of goods into existence. Successful production requires, respectively: 1) the rearrangement of scarce physical matter into a suitable material good or 2) the arrangement of information in such a way that a rival digital good is made available.

A unique characteristic of commodity money vis-à-vis special contractual or administrative status

Commodity money is also distinct from fiat and other categories of money in that it can be valued on the market without special distinctions of legal status. Monetary commodities

18 See the open-source, peer-to-peer OpenBazaar project (openbazaar.org).

19 See Tucker Sep 2014 on some extended potential implications of this.

20 As in Selgin’s working paper on synthetic commodity money (2013).

can be traded, can facilitate indirect exchange, without reliance on any legal, legislative, or even contractual status that would distinguish them from any other ordinary good on the market.

This contrasts most starkly with the bases of modern fiat and bank-credit monies in a long-evolved mesh of legal privileges and exemptions without the ongoing support of which such units could be expected to lose most or all of their trading value. Other historical monetary objects such as banknotes also relied on some legal status such as legal tender designation, preferred official acceptance, or the contractual promise to redeem.

“Can be” is chosen to acknowledge that particular metallic coins in given historical contexts were often also legally designated in some way. However, such privileges arguably served functions such as monopolizing profits to particular mints or restricting coin designs to those that advertised a particular ruler. According to economic analysis of the competitive characteristics of monetary commodity goods themselves, such laws may have been to this degree extraneous to the native economic and technical suitability of the items to fulfill monetary functions such as facilitating indirect exchange.

This suitability was present, even if in most cases commodity monies *also* carried some official designation that also influenced their valuations, for better or worse. Advocates of the state theory of money, tracing back to Knapp (1905), claim that it was the designations rather than the goods that were always the essential factors in money. However, even if the sweeping claim that intervention was always involved in commodity money in every historical setting were granted, this would still not necessarily establish that, in the absence of such intervention, commodity money and other forms could not have otherwise come into being. It could suggest instead, for example, the existence of some compelling and concentrated advantages to be gained by rulers becoming involved in and attempting to dominate such a field at

their earliest opportunity. As Mises wrote in a 1917-1918 critique of Knapp’s work, “Facts do not speak; they need to be spoken *about* by a theory (1953, 510).”

Monetary commodity goods contrast with monetary objects that *must* rely on *some* contractual or administrative status to function in a monetary role. This includes, each in its own distinct way, money certificates, fiduciary media, token monies, fiat monies, and credit monies—that is, everything in the TMC scheme other than commodity monies.

“Sachgeld” as a category of unintermediated monetary good

Linguistic connotation differences may provide additional clues to differentiating economic from historical concepts of commodity. “Commodity money” is a standard translation for the German *Sachgeld*, and was also used in TMC. *Gelt* is money. *Die Sache* is a “thing” in either a concrete or abstract sense, which contrasts with *das Ding*, a “thing” exclusively in a material sense. Alternative senses of *die Sache* and associated compounds include abstract senses such as in “the matter at hand,” “the facts of the situation,” and “the main or most important point or issue.” *Sachgeld* in modern dictionaries comes across as goods that were used in an exchange or social-currency role historically, or simply the earliest forms that monetary objects took.²¹

By clarifying *Sachgeld* in a more strictly economic sense, a commodity money could be viewed as a money traded without the need for intermediations such as fixed-rate substitution promises, legal tender status, or other counterparty dependencies. *Sachgeld* can—and bitcoin famously does—trade on the open market in a monetary role without any such privileges. If the central *economic* meaning of *Sachgeld* is

21 zahlenbilder.de; wirtschaftslexikon24.com/d/sachgeld/sachgeld.htm.

“a good that itself functions directly in a monetary role,” this would still contrast with the other categories, except that the more abstract sense is also able to account for bitcoin with no additional qualification. Money in itself contrasts with money by extension—through fixed-rate substitution promises, credit relationships, and any variation of the trust, reputation, or “full faith and credit” of any counterparty.

Bitcoin is not “backed” by anything. It is not a perfect or imperfect substitute for anything else. For users, bitcoin *is the tradable good itself*. This is not the “in itself” thinking of the old-time populist “metalism” based on an intrinsic concept of value, but rather specifies within a subjective-value context that *this*—in this case, a bitcoin, rather than something else by extension—is actually the economic good that is being valued.

Materiality hijacked a ride on an otherwise purely economic concept, commodity, at least until further differentiation and precision were called for. The arrival of bitcoin calls for the removal of materiality as an essential part of the separate economic concepts of goods, scarcity, and commodity.

The foregoing suggests retaining a single category of commodity money, as it is contrasted with all other monetary types in the original TMC fashion.²² To address new innovations, subtypes of such commodity money may be specified as “material” and “digital.” Analyzing other distinct issues, such as the aggregate production elasticity of specific items,²³ can then proceed as a discussion of those characteristics.

Substitutes, third-party services, and end-user opt-out costs

A central task of TMC was to separately analyze the nature, valuation, and general

economic effects of the various types of money and their substitutes. However, the technical characteristics of bitcoin do not suggest a similar scope of demand for such substitutes as have been associated with metallic commodity monies historically. The widespread use of paper-note and account-entry substitutes for precious-metal-linked money units, as well as the use of debt ledgers, which often also recorded debts in commodity-linked units, were among the conditions setting the stage for the eventual emergence of modern money. Today, the old material “fettters” no longer place any limits on the expansion of unit production, that is, inflation. Yet fiat and bank-credit monies only arrived fully in their positions as “modern money” after very long historical processes in which substitution rates between commodity and representation generally degraded, and finally reached zero only in 1971 (Hülsmann 2008, Huerta de Soto 2009).

The use of precious metals in the definition of monetary units places certain cost limitations on unit inflation by money producers. However, the use of metallic monetary units in extended trade must rely on measures such as ledger entries, money substitutes, and clearinghouses to enhance divisibility and transferability and lower transaction costs. Yet these are precisely the conditions that expose users to the degrading relationships between good and circulating substitute that appear repeatedly in historical records. This extends from recurring debt cancellations in the case of debt ledgers (ancient creditors left with broken pieces of ledger tablets) to runs on fractional reserve banks in the case of banknotes and deposit accounts (customers left with mere memories of account balances). In contrast, bitcoin requires no substitutes to deliver advanced monetary features and conveniences directly to users.

With some third-party bitcoin companies such as payment processors and exchanges, user account credits are likewise at risk of degrading in their linkages to bitcoin. Bitcoin

22 Hülsmann 2012 clarified later patterns of misinterpretation as relating to translation errors.

23 A central concern, for example, in Selgin 2013.

substitutes do exist, but they do not appear likely to grow into generally circulating media, particularly compared with historical precious-metal-based unit substitutes. A silver-denominated account entry or other representation can be more versatile in different types of trade than a silver coin. With bitcoin, however, use of substitutes may not improve much, or at all, on bitcoin's own native transaction cost and versatility characteristics. Substitutes could even subtract net value due to superfluous counterparty risk.

The bankruptcy of a bitcoin exchange, such as the high-profile Mt. Gox collapse of February 2014, is a prime example of the kind of counterparty risk from which the Bitcoin protocol was designed to protect users. A key stated point of the design was to obsolete traditional intermediary parties in financial transactions, the "trusted third parties" in Nakamoto 2008. However, Mt. Gox exchange customers did not maintain direct control of bitcoin. They instead traded it for account credits within a third-party system. When Mt. Gox collapsed, it became clearer to more observers that customers had been holding, not bitcoin, but bitcoin substitutes, Mt. Gox-brand bitcoin account credits, which turned out to be largely irredeemable for bitcoin (Graf Feb 2014).

Centralized exchanges in general, some of which have long had considerably better reputations than Mt. Gox, remain reasonable options for trading bitcoin against local currencies. However, the direct earning of bitcoin for goods and services is growing with time and market penetration, while decentralized peer-to-peer exchanges that enable user retention of direct bitcoin control could also become more competitive over time. Meanwhile, several exchanges have developed and implemented blockchain-based public proof-of-reserve procedures that seek to periodically demonstrate that a total amount of bitcoin corresponding to the total of their issued internal account credits is currently within their direct control.

Bitcoin's greater optionality for users

Users can manage and spend bitcoin either directly or with the aid of third-party services.²⁴ Direct-use options include Bitcoin Core, MultiBit, and Armory, software with which users generate, manage, and back up their own signing keys. Mobile apps with direct key management are also available. In contrast, a prominent example of a third-party wallet, storage, and payment processing service, Coinbase, generates, secures, and controls signing keys and issues users with electronic account credits. A prominent hybrid service is Blockchain.info, which aids users in managing their own keys with client-side encrypted cloud-syncing. In addition to these solutions, multi-signature wallet software such as Copay, and also Armory, can be used to require signatures from two or more distinct keys rather than just the usual single key. This enables security designs such as third-party authentication services and multiparty corporate controls that rely for their effectiveness directly on the blockchain.

This primary availability of direct-use options sets up a critical contrast with conventional financial services—any bitcoin user can avoid or opt out of any third-party bitcoin service. Whoever has the signing keys is the controller of bitcoin stored with those keys, and users can choose to manage their own keys directly. A comparable opt-out from conventional financial services is much more costly, rendering one "unbanked" and reliant on less convenient and more expensive options (or no realistic options) for purposes such as remittance and online commerce participation.

Bitcoin's higher optionality for consumers means they can more easily sever ties with not only one bitcoin company in favor of another, but with any and all third-party bitcoin services. Even if all such third-party services were to be licensed and organized into bank-like cartels

24 Current details at: bitcoin.org/en/choose-your-wallet

on a national or even supranational basis, bitcoin users could still opt out of the services of the entire cartel, not just any particular member of it, by using direct key-management methods. Choosing the third-party service option “none of the above” is thus far more accessible to bitcoin users than to conventional financial services customers. This is a comparative factor likely to impact consumers positively and enhance competition and innovation, including in third-party services themselves, which must contend to offer some added value over direct key-management options.

Conclusion

The Misesian dualist grounding of economic theory in the formal concepts of choice and action, as distinct from the exterior, technological form of particular goods and services in specific times and places, proves useful in classifying the novel monetary innovation called bitcoin a century after the first appearance of *The Theory of Money and Credit*. Action-based definitions of goods, scarcity, and commodity help avoid distraction from the differential technical characteristics of monetary goods,

and return attention to characteristics defined strictly in terms of economic theory.

Historical commodity monies and bitcoin, despite their large and apparent *technical* distinctions of implementation and production, are from this standpoint much more akin to one another than they might at first appear. The simplest solution for theoretical classification may be to take the existing category of commodity money, divide it into material and digital subtypes, and proceed from there with additional differentiations depending on which variable characteristics are to be addressed.

Whatever the balance of historical investigation suggests was the case with monies at various times and places in the past, bitcoin is actually today a “pure” global commodity money, an unmediated monetary good. Bitcoin is a rival digital good, unexpectedly produced from within a world of otherwise nonrival goods, and then separately and freely taken up by end-users in a monetary role. Not enshrouded in any fog of history, bitcoin may be among the best-documented instances of a monetary commodity trading free of the rent-seeking certifications, imprints, legal privileges, and declared preferences of any ruler.

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John Micklethwait & Adrian Wooldridge,
The Fourth Revolution: The Global Race to Reinvent the State

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John Micklethwait & Adrian Wooldridge, *The Fourth Revolution: The Global Race to Reinvent the State* (New York: Penguin Press, 2014)

A revolution is about to shake the world – that is what John Micklethwait and Adrian Wooldridge think. The first is the editor-in-chief of *The Economist* and the second that magazine’s management editor. In their latest book *The Fourth Revolution: The Global Race to Reinvent the State*, Micklethwait and Wooldridge argue that the Western democracies are on the verge of a revolution that will usher in new, yet more classically liberal, kind of state. In so doing, they tell an illuminating, if incomplete, tale of the stages that the modern state

has gone through in arriving at its current precipice. But they do not go far enough in taking full advantage of the opportunity presented by the prospect of regime change to press the case for a market society.

As the title of the book indicates, the revolution that we are to expect will be the fourth. That begs the question of what were the first three. Devoting the opening third of their book to what actually turn out to be three and a half revolutions, Micklethwait and Wooldridge offer a brief history of Western government

from the Enlightenment era to the present. The first revolution came about with the creation of the nation-state, a feat intellectually engineered by Thomas Hobbes. Before the 17th century British philosopher appeared on the scene, the authority of the state in the Western world (i.e., Europe) was limited by the nobles ruling local territories along with the Church in Rome holding the keys to immortal life. In *Leviathan*, Hobbes delivered the arguments that would prove decisive in weakening these rival centers of power, basing the state's authority in a social contract embracing all individuals agreeing to give up their natural freedom to do as they please in return for peace and security. With consent, rather than divine right or inheritance, now serving as the font of legitimacy, the modern state became what it continues to be to this day – that is, the sole body in society defining the ultimate terms under which everyone occupying a circumscribed territory is permitted to act. In the second revolution, presaged in the writings of John Locke and Adam Smith but carried through by John Stuart Mill, the state's duties came to include not simply the maintenance of security, but the protection of individual liberty as well. In the 19th century, when Mill lived, the British government repealed impediments to freedom of commerce such as the Corn Laws and the Navigation Acts, while reducing its own fiscal weight on society. Between 1818 and 1846, Micklethwait and Wooldridge tell us, tax revenues actually fell even though population rose by 50%. William Gladstone, who served as Britain's Prime Minister and Chancellor of the Exchequer, bragged about how he was, "saving candle-ends and cheese-parings in the cause of the country" (p. 52).

Yet the very same thinker that figured prominently in the second revolution ended up playing a key role in the movement towards the third. Earlier on in his intellectual odyssey, in his book *On Liberty*, Mill enunciated the principle that individual freedom should only be restricted when it entails harm to

others. By the end of his career, however, Mill was seriously contemplating socialist ideas. A cavalcade of other writers, influenced as well as by the German philosopher G.W.F. Hegel, echoed this shift in an ideological evolution cemented in the early 20th century by Beatrice Webb, whom Micklethwait and Wooldridge call the godmother of the contemporary welfare state. The fruit of the third revolution, this state claims to lend substance to the ideal of freedom by securing everyone at least the basic minimum of material resources to pursue their own conceptions of happiness. With the Great Depression and World War II buttressing the ascendant faith in big government, the Western developed nations all erected welfare states, of one extent or another, as public expenditures went from around 10% of GDP prior to World War I to representing, on average, almost half the size of the economy by 2011. In what Micklethwait and Wooldridge call the third and a half revolution, this time under the intellectual aegis of Milton Friedman, a concerted political effort was undertaken during the 1980's and 1990's to reduce the sway of government in economic life. But this only produced a respite in the state's growth.

The best part of this recounting of the past is the role that Micklethwait and Wooldridge attribute to ideas. While acknowledging the force of political and economic events, the authors do well in focusing on the ways that a select group of thinkers instigated social change by shaping people's world-views in their respective eras. Also valuable is their observation that the state more than withstood the free-market campaigns led by U.S. President Ronald Reagan and British Prime Minister Margaret Thatcher. Even now, one still hears the dubious assertion, from both the left and right of the political spectrum, that their legacy is that of a chastened state.

A patent defect in the book's historical sections, though, is that the totalitarian state is not included among the stages that modern

government took. Micklethwait and Wooldridge defend this by noting that the Marxist variant of totalitarianism was founded on a political philosophy that looked forward to the abolition of the state. They are right that Marx saw anarchy as the culminating phase of human progress, but his thought also included the concept of a transitional socialist government. Needless to say, such a state was installed for generations in numerous countries – and still is in a few places – to very deleterious effect. As for the fascist variant of totalitarianism, the authors seem to excise it from their evolutionary narrative on the grounds that it did not prove enduring. That is true, but fascism destroyed millions of lives during its time in power and the memory of those atrocities haunts our politics still. Micklethwait and Wooldridge present a history of government that is too narrowly Anglo-Saxon in its coverage.

They become less parochial in describing the contours that the state is likely to assume with the fourth revolution. Now how do we know this is coming at all? According to the authors, it is principally because the welfare states built by advanced Western nations are fiscally unsustainable. We have reached this pass precisely because those nations are democracies. Elected politicians have powerful incentives to offer the populace an extensive menu of benefits in order to win votes; they also have powerful incentives not to raise the tax revenue necessary to finance these benefits in order to avoid losing votes. As a result, democracies are genetically liable to profligacy, borrowing what taxes will not cover until the debt accumulates to levels that eventually cause the government's creditors to demur. And with public debt to GDP ratios either nearing or above 100% in many countries, Micklethwait and Wooldridge figure that we are almost at the end of that trajectory.

Given this sobering view of democracy, it is not surprising that they sympathetically consider the alternative constructed by Lee Kuan Yew in Singapore, a nation that Freedom House

politically ranks as merely “partly free”. Not having to cater to popular demands, Singapore has a lean state in which social programs are precisely targeted to the poor and vulnerable, rather than being showered on the middle classes as they are in the West, while at the same time ensuring that individuals do not become dependent on government largesse. The fatal flaw, however, of a more authoritarian system like Singapore is that it must heavily rely on the presence of a wise and virtuous leadership for it to work effectively. But that is rare to come by in this world. Micklethwait and Wooldridge are right about democracy's fiscal shortcomings. But that regime does at least have the advantage of economizing on wisdom and virtue, inasmuch as the self-interest of politicians will usually suffice to make them pay attention to the public will.

Consequently, matters look a bit more promising when Micklethwait and Wooldridge subsequently turn to the Nordic countries as a model for revolutionizing the state. To many, this will seem like a call to fortify the third revolution, in light of the still widespread perception of Sweden and Norway as beacons of the welfare state. But as the authors point out, both countries were compelled by an economic crisis in the early 1990's to retrench their governments, outsource the delivery of social services like health and education to the private sector, and free up their economies. Micklethwait and Wooldridge also cite the Nordic countries' adoption of information technologies to enhance the productivity of the public sector, drawing on this to predict that such efficiencies will come to characterize the state that will emerge out of the fourth revolution. Admittedly, it is nice that Sweden's government spending to GDP ratio has fallen by 18 percentage points over the past two decades – but it is still 49%. Governments need to slim down much more than that. No doubt, too, that information technology holds promise, but public officials have limited impetus to

exploit it, not being subject to market exigencies to generate profit. Political pressure of the sort imposed by an economic crisis can only go so far.

Beyond that, a tectonic shift in the climate of opinion will have to occur in order to maintain and channel the political will necessary to reduce the influence of government in society. Micklethwait and Wooldridge recognize this: “Modern politicians are like architects arguing about the condition of individual rooms in a crumbling house ... We need to look at the design of the whole structure” (p. 21). They advance a number of solid proposals, like doing away with the crony capitalism by which favored industries receive government subsidies. They also issue a compelling plea to bring the value of freedom back into the center of our politics, quoting the British historian Thomas Macaulay: “Our rulers will best promote the improvement of the people by confining themselves to their legitimate duties” (p. 225). Problem is, Micklethwait and Wooldridge define those duties to encompass not just the defense of people’s life and

property against domestic and foreign incursion; not just the financing of infrastructure projects for which the private sector cannot be expected to provide funding; but also the social insurance functions of the welfare state. When it comes to health care, for example, they insist that the government be the sole payer, whereas with state pensions their chief suggestion is to increase the retirement age. But even the most cursory examination of the government’s accounts will show that the social insurance role is what has primarily driven public expenditures upward. Micklethwait and Wooldridge ought to have given more thought to the myriad ways that civil society, as opposed to the state, could protect individuals from the risks associated with living in a dynamic market order.

The future is shrouded in mystery, to borrow a cliché, but this book furnishes a reasonable basis to believe that a politico-economic revolution might well be in the offing. But we should be hoping, not for a synthesis of the second and third revolutions, but instead for a restoration of the second.

James Rickards, The Death of Money: The Coming Collapse of the International Monetary System

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James Rickards, *The Death of Money: The Coming Collapse of the International Monetary System* (New York: Portfolio Hardcover, 2014)

The men and women working at the Eccles Building in Washington D.C. have sliced, diced and, with quantitative easing (QE) pureed the dollar, but it keeps on ticking as the world's reserve currency. America's central bankers have bravely thrown themselves in front of the deflation train by quadrupling their balance sheet. Paul Krugman believes the Fed has been less than heroic, and instead, downright timid. He taunts Austrian economists, wondering where's the hyperinflation you guys said was imminent?

James Rickards doesn't see it Krugman's way. In his book *The Death of Money*, Rickards says Fed policy "is an invitation for disaster." Everything the Austrians are predicting will come true, just not in the order they have been forecasting. The book is a follow up to author's *Currency Wars* published three years ago where Rickards chronicled the first two currency wars and explained how currency war III was just beginning. He says much has changed since he wrote that book, but not for the better.

Anarcho-capitalists will notice right away that Rickards isn't one of us. He may be disgusted with central bankers but the author has great reverence for the military and has done work for the CIA and other government agencies. He's no fan of Edward Snowden and the beginning of book is meant to convince you that Rickards is working for the good guys in the global financial wargames. In the end he offers ways for government to solve the mess it made. Nonetheless, *The Death of Money* is both interesting and valuable.

The military may be clued into financial warfare but Treasury and Fed officials still have their heads stuck in equilibrium models that assume rational and efficient markets, "that have no correspondence to real markets."

Market crashes, flash and otherwise, prove Rickards' contention that "Capital markets today are anything but fail-safe. In fact they are increasingly failure prone." This has much to do with the hubris of today's central bankers, who are "both bold and arrogant in their efforts to bend markets to their will." Rickards calls them for what they are, central planners, and they will create failures like all central planners do.

Instead of markets functioning properly, the author explains, "Market participants have been left with speculation, churning, and a game of trying to outthink the thinkers in the boardroom at the Federal Reserve." Today's markets are stymied by "the dead hands of of the academic and the rentier [who] have replaced the invisible hand of the merchant and the entrepreneur."

It's ironic that Lord Keynes in *The General Theory* described financial markets the same way, as "a game of Snap, of Old Maid, of Musical Chairs—a pastime in which he is victor who says *Snap* neither too soon nor too late, who passes the Old Maid to his neighbour before the game is over, who secures a chair for himself when the music stops."

Rickards speaks of today's controlled and perverted markets through the lens of what

Adam Smith, F.A. Hayek and Charles Goodhart had to say; central planning is not only undesirable it's impossible.

Rickards emphasizes that economic order emerges spontaneously from economic complexity instead of being imposed by central bankers and their policies. So what we have now with central bank central planning is disorder and continuous malinvestment.

Ex Fed chair Ben Bernanke was keen to keep his eye on the financial markets, famously telling a Jackson Hole crowd in 2011 the Russell 2000 was up 30% since QE had been announced, "I do think that our policies have contributed to a stronger stock market, just as they did in March of 2009," Bernanke said, believing higher stock prices increased consumers propensity to spend, what academics call the wealth effect. Rickards has his doubts about all of this, citing a study that the wealth effect from an increase in housing prices can vary from 1.7% to 21%, a spread wide enough to cast doubt on the whole notion.

So while Fed-created money has gone into financial assets, why hasn't it gone into consumer prices? Rickards believes America has exported its inflation. As trading partners support their exports, they print money to "soak up the dollar flood coming into their economies in the form of trade surpluses or investment." Americans get the cheap goods from overseas, foreigners get the inflation.

A continuous theme in *The Death of Money* is the battle central bankers are waging with deflation. The bankers are deathly afraid of prices sinking while debts, especially the U.S. government's, remain high. Technology, cheap goods from emerging markets, and demographic shifts are pushing prices down, while central banks print to keep prices up.

Cheap goods make everyone more prosperous, right? Yes, but, "If the Fed relented in its money printing, deflation would quickly dominate the economy," Rickards writes, "with

disastrous consequences for the national debt, government revenue, and the banking system.”

Rickards’ point about government revenue is that real incomes go up if salaries stay the same but prices fall. The same is true if salaries increase and prices increase by a lower percentage. The difference is that government can’t tax an increase in real wages when prices drop, but it receives more tax revenue on increased salaries and higher prices.

To get investors off the sidelines after the ‘08 crash Bernanke referred back to his academic work. “It will pay to invest...when the cost of waiting...exceeds the expected gains from waiting,” Rickards calls this passage the “Rosetta stone for interpreting all of Bernanke’s policies...” After 2008, Bernanke pushed rates to zero, thereby increasing the cost of waiting.

The author even found this revealing Bernanke quote, “It would not be difficult to recast our example of the ...economy is an equilibrium business cycle mold. As given, the economy... is best thought of as being run by a central planner.”

Rickards spends three chapters discussing the world’s other principal currency players, China, Germany, and the BRICS and BELLS countries. While some see China as an emerging power, the author emphasizes the country’s malinvestment. Instead of creating capital, “China is destroying wealth with this model.”

In discussing Germany, Rickards explains the staying power of the euro with “Markets are powerful, but politics are more so.” He poohpoohs Euro sceptics who are stuck to Keynes’s sticky wage theory. Wages will fall and “Over the next ten years, the EU is destined to evolve into the world’s economic superpower.”

Russia won’t prosper because oligarchs and politicians steal everything except just enough to keep the game going. China is a big polluter stealing technology, and India continues to be strangled in its own red tape. The author has much rosier view of Spain and Italy, calling them “true economic giants.”

Rickards is well known for supporting a gold standard. He dismisses the idea there isn’t enough gold, it’s all about the price he contends. Murray Rothbard told us the same thing in class back at UNLV. Murray said you could have a gold standard with just one ounce.

Rothbard was friends with Howard Buffett, congressman from Nebraska, who was a staunch gold standard advocate. Buffett’s son, Warren, is anything but, constantly dismissing gold as worthless. But Rickards makes the case that Buffett turned to hard assets after the ‘08 crash when he bought Burlington Northern Santa Fe Railroad. “A railroad is the ultimate hard asset,” writes Rickards. Don’t have enough money to buy a railroad? Rickards says a small investor “can make the same bet by buying gold.”

Of course there is no gold standard and instead the U.S. central bank creates dollars to buy Treasury debt and increase inflation. And with nothing stopping it, Rickards lays out a way for the Fed to print the country out of its debt jam. If inflation can be increased without increasing borrowing costs the debt to GDP ratio will decline. But if there is no GDP growth government borrowing is unsustainable.

Rickards says it’s not about the absolute level of government debt that triggers a crisis as Carmen Reinhart and Kenneth Rogoff contend, but the trend. If there is no growth and politicians won’t reduce spending, the Fed must inflate.

This sort of financial repression worked after WWII, bringing the U.S. debt-to-GDP level down from 100% in 1945 to less than 30% by the early 1970s. It’s a tricky operation where plenty can go wrong. Asset-liability mismatches and counterparty risk in the unfathomable \$650 trillion derivatives market has pushed systemic risk to the limit.

When it all comes tumbling down who will bail out the bailouters? Rickards penned a surprising chapter speculating on an IMF monetary takeover. The shadowy creation of Bretton

Woods, expanded its currency, the number of SDRs (Special Drawing Rights), considerably after the 2008 crash to bailout Europe. Christine Lagarde and her deputy director Min Zhu will be ready when the next crisis comes. After all, SDR issuance is only limited by central banker imagination. “They [SDRs] are fake money,” Dr. Zhu explains, “but they are a kind of fake money that can be real money.”

If you are sanguine about the world monetary system, Rickards’ book, with his talk of crashes and civil unrest, will rattle you.

He proposes ways to put the system on sound footing, but they are politically untenable. Gold bugs may stand and applaud the idea of setting the yellow metal’s price at \$7,000 per ounce but that world would not be a pretty place.

Readers want writers to tell them what to do, and the author obliges, providing seven signs the crash is coming and five investments to weather the storm with. But, he admits his crystal ball is cloudy. Nobody knows what day they’ll die. It’s the same with money.

Mariana Mazzucato, The Entrepreneurial State

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Mariana Mazzucato, *The Entrepreneurial State* (London: Anthem Press, 2013)

On the 4th August 2013 Martin Wolf, the celebrated *Financial Times* columnist, reviewed this book in glowing terms. It was, he wrote, “a brilliant exploration [of] government ... not the private sector, [as] the entity that achieves the greatest breakthroughs.” This book established, Wolf wrote, that it is the state that provides the research and investment that underpins the drugs and biotechnology industries. It is the state, even, that underpinned the achievements of two iconic companies, Google and Apple. And it is the state’s research that gave us fracking.

The book does indeed make those claims, but unfortunately they are false – and they are falsified by a key passage in the book itself, on page 26:- “top pharmaceutical companies are spending decreasing amounts of funds on R&D at the same time that the State is spending more ... this is free riding.” So it is. Yet Professor Mazzucato’s solution to the problem is, paradoxically, even more government money for research.

It is now over a decade since Walter Park of the American University, the OECD and I reported, independently, that the international

data showed that the government funding of R&D simply crowded out its private funding. The US, for example, was *laissez faire* in research until 1940, but by 1890 it was already the richest (and therefore the most technologically-advanced) country in the world, and in the absence of government money it produced scientific and engineering giants such as the Wright brothers, Edison and Tesla. Grievously, the introduction of government money for research did not increase the US's long-term rates of economic growth or of total factor productivity, it simply crowded out its private funding.

But Professor Mazzucato denies the existence of crowding out in science funding, because she defines crowding out (page 24) as the state using “up savings that could have been used by the private sector for its own investment plans.” But that is a narrow definition which allows Professor Mazzucato to thus claim that by definition (page 26) free riding is “not the ‘crowding out’ effect.” But that is exactly what it is, as even Professor Mazzucato's natural supporters such as Paul A. David, Bronwyn H. Hall and Andrew A. Toole confirmed in their classic review of the field “Is public R&D a complement or substitute for private R&D? A review of the econometric evidence” (*Research Policy* 2000, 29: 497-529.).

Professor Mazzucato dislikes venture capitalists. She believes that they capture a disproportionate share of the profits of innovation, and that they make false claims to courage and risk taking and entrepreneurship. Indeed they do. But it was the Professor Mazzucatos of this world who created venture capitalists. The proper home of research is in-house in industry, but because governments have been persuaded to put research where it shouldn't be (ie, in the universities, which are institutions that lack capital or manufacturing facilities) the market had had generate this new industry of venture capital to harness innovation to manufacture.

Professor Mazzucato dislikes industry's contemporary short-termism, and on page 178 she laments that “in the thirties a corporation like DuPont [could invest] for a decade in the fundamental research that led to nylon.” But in the thirties governments in the US did not fund long-term fundamental research, so companies did it themselves. Now that governments do fund long-term fundamental research, industry needs no longer do so: yet again Professor Mazzucato advocates the very policies that lead to the outcomes she deplors.

Professor Mazzucato claims that government, working with industry, can be entrepreneurial and thus help stimulate economic growth. That is true, as was confirmed by the Glorious Revolution in England and Wales, the Golden Age in the Netherlands and the city states of Renaissance Italy *inter alia*. When government has been captured by the mercantile classes then it is indeed entrepreneurial in the interests of commerce. But Professor Mazzucato is dismayed by tax avoidance, tax evasion, tax havens, excessive executive compensation, transfer pricing, bankers' bonuses and all the other ills that modern capitalism is heir to, and she overlooks that these have been generated by states that have been *too* sensitive to the needs of industry and *too* entrepreneurial in the interests of capitalists: we need a smaller, less entrepreneurial state, one that – in the interests of free markets – ceases its relentless corporate welfarism to focus on reining in individual capitalists, not on subsidising them.

And in advocating ever-more government action, Professor Mazzucato never considers opportunity cost. Indeed, she never invokes the concept, she only praises government for its courage and risk taking which, she freely acknowledges, means it's not worrying about the costs and likely commercial returns on (our) money being spent by politicians and bureaucrats. For Professor Mazzucato, the state's indifference to cost-effectiveness is a virtue.

This book is confused. As Adam Smith pointed out back in 1776 in his *Wealth of Nations*, there is no evidence that science is a public good, and for as long as the Professor Mazzucatos of this world maintain that it is, they will continue to advocate policies that generate the very outcomes that they – and most of us actually – deplore.

As for Martin Wolf: the world has followed his intellectual journey from supporting the Labour Party to advocating free markets to a latter-day Keynesian distrust of those self-same markets. Nonetheless, there is no evidence that science is a public good, so it needs no government support.