# THE 21ST CENTURY CASE FOR GOLD:

# A NEW INFORMATION THEORY OF MONEY

BY:

George Gilder

American Principles Project

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# FOREWORD: WHY A NEW CASE FOR GOLD? MONEY, GOLD, AND TIME

> Time is the coin of your life. It is the only coin you have,
> and only you can determine how it will be spent.
> Be careful lest you let other people spend it for you.
> —Carl Sandburg

Are the scarcity and value of money rooted in the passage of time—the residual resource that remains scarce—as goods and services become more abundant?

Is money a measuring stick that gauges the value of economic activity? Or is it a magic wand wielded by central banks to summon new economic growth?

Is money chiefly a source of information? Or is it an embodiment of wealth that can be created out of thin air and distributed to the financial institutions closest to government?

In the midst of a siege of capitalist stagnation and demoralization,

this monograph addresses the crucial questions of money and wealth. Many leading economists assert that entrepreneurial creativity and new technology are climbing a wall of diminishing returns. The long saga of capitalist triumph is said to be giving way to an era of creative sclerosis.

For too many of the best and the brightest, conservatives as well as liberals, the debate over monetary reform and, in particular, a gold standard, is ancient history.

From Paul Krugman's columns to National Review's conservative cerebrations, monetarists imagine that the absence of severe inflation falsifies the idea of a gold standard or any other monetary constraint outside of the wisdom and discretion of bankers. A consensus of establishment theorists uphold the principle of shielding the Federal Reserve from politics in order to allow the central bank to continue on its vital path of monetary manipulation.

To understand our current economic stagnation, we need to step back from the current debate and ask a broader question: What is money? And in particular what is its role in a new 21st century information age economy?

The reigning official opinion, ratified in 2012 by a bipartisan panel of economics experts assembled for the University of Chicago's business school and published on a Wall Street Journal blog, is "No Support for Gold Standard. . ."[1] Forty-three percent of these economists surveyed disagreed with the gold standard and an additional 57 percent strongly disagreed. That adds up to 100 percent. You can't get more consensus than that.

But this consensus is rooted in a deeply flawed understanding of the nature of money. This error is giving way to the monetary insights of the new information theory of economics and its

experimental offspring, Bitcoin.

On the panel, Chicago's Richard Thaler asked, "Why tie to gold? Why not 1982 Bordeaux?" This essay answers that question.

MIT's Daron Acemoglu gave the most sympathetic answer: "A gold standard would have avoided the policy mistakes of the 2000s, but [it is] still likely that discretionary policy is useful during recessions." But this essay explains why monetary policy has not prevented the greatest recession since 1930 and is contributing even today to starving the real economy of the capital it needs to grow jobs and wages for the middle class.

Both conservative and liberal economists who support the monetary status quo are operating from a false theory of money. Milton Friedman, who may have been the most formidable 20th century economist, coined the heart of the theory of money that is driving Quantitative Easing (QE) around the world despite no evidence of economic effectiveness.

But in his later days, Friedman retreated from his original analysis. And, in any case, Friedman is the last man who would want his ideas to turn into dogmas, protected from empirical critique.

The key to understanding good monetary policy is to address the question: What is wealth, and how is it created? What is the role of money in the creation of wealth?

A new information theory of economic growth leads to new insight into monetary policy. Most educated people understand that knowledge leads to wealth creation, but this understanding is incomplete. It is not that knowledge creates wealth—wealth, in its deepest form, is knowledge. Matter is conserved, as physics teaches us. The Neanderthals had every natural resource we have.

Wealth is created by the learning curves that result from a million falsifiable experiments in entrepreneurship by economic actors in mostly free market economies.

If knowledge is wealth, growth is learning. The most important role of money is as the measure of that learning. Money is the channel that carries the information to investors, workers, small businessmen, major corporations and entrepreneurs. All need to gauge the success or failure of their attempts at growth.

Manipulating the value of money, whether by printing currency or artificially suppressing interest rates, does not create wealth. Instead, it is the equivalent of manipulating the data of a scientific experiment after it takes place, distorting the information economic actors need to create new wealth. Understanding the new economic paradigm of information theory leads us to recognize that inflation is only one of many bad economic results of monetary policy that distorts the value of money.

When central banks and governments manipulate interest rates and currency values, we do not necessarily have hyperinflation. Instead, the current Federal Reserve policies have turned Wall Street investment banks into subsidiaries of the government that make money not through entrepreneurial risk-taking but through government wealth shuffling. By bidding up the value of current assets with government debt and inhibiting the creation of new assets, existing policies stifle growth and portend new crises. Youth unemployment climbs above 25 percent. Amid theories of "secular stagnation," new high-technology businesses languish without access to the Initial Public Offering (IPO) market and angle to be absorbed by bloated rivals. By most measures, workers have not received a real raise since 1993.

Meanwhile, Wall Street bank profits, effectively guaranteed by government policy, return to previous highs. Currency trading to

set the measuring stick of monetary values yields a hypertrophy of finance. Transacting $5.4 trillion every twenty-four hours, foreign exchange markets are now scores of times larger and even more volatile than the markets for real goods and services that they are supposed to measure. Rather than promoting enterprise, banks harvest the profits of currency changes, imposing a volatility toll on businesses that have to hedge all their activities against the chaos of floating moneys.

The older case for gold sprang from the idea that its value as money derives from its objective value in economic activity. But this view has it exactly backwards. Researches in Bitcoin and other digital currencies have shown that the real source of the value of any money is its authenticity and reliability as a measuring stick of economic activity. A measuring stick cannot be part of what it measures. The theorists of Bitcoin explicitly tied its value to the passage of time, which proceeds relentlessly beyond the reach of central banks.

Bitcoin is a major experiment in new Internet infrastructure, but gold works the same way in the global economy. Gold can function as money because it operates outside the financial economy as an index of the time it takes to extract it from the earth. Because it becomes more costly and time consuming to extract thinner and deeper lodes of the metal from more remote places, gold remains a lodestar amid the monetary turmoil. The cost of extraction rises almost in proportion to the advance of mining technology. Gold thus cancels capital and technology and becomes almost a pure measure of time.

The source of the value of money is time—irreversible, inexorably scarce, impossible to hoard or steal, distributed with remorseless equality to rich and poor alike. As an index of time, gold imparts the accurate price signals needed for sustained economic growth and expanded opportunity.

These insights impel an imperative agenda of monetary reform. Money is not chiefly power—it is information. While government power can increase monetary volume, it cannot enhance monetary value. Value is an expression of entrepreneurial knowledge. The quantity theories of money must be replaced by an information theory of money that preserves the currency as an objective medium of measurement rather than as the government's latest message. As a vessel of knowledge rather than an instrument of power, the new theory ultimately leads us to money rooted in time. It will bring us to a new consideration of the necessary role of gold in a global Internet economy of information.

# PART ONE: FRIEDMAN AND THE ENIGMA OF MONEY

In early 1988, under the auspices of the Cato Institute, I visited China with the world's leading expert on the theory of money, Milton Friedman. More than a decade earlier Friedman had won a Nobel Prize for his famous and influential theory of monetarism: one key to growth is government central banks' regulation of the supply of money.

At the time, China's economy was stagnant. Everywhere in China, money seemed scarce. While prices soared, poverty was rampant. One year later, China's rulers would dispatch tanks against student protesters at Tiananmen Square. The only Chinese prosperity was in off-shore islands such as Hong Kong and Taiwan, with lower inflation rates and per capita money supplies that dwarfed China. Nearby Japan commanded the largest money supply per capita in the world and was rich. Was that a clue? Who knew?

Surely Milton Friedman knew. I thought I would ask the world's greatest monetary economist and Nobel Laureate the

answer to some of these enigmas of money.

As the billion Chinese emerged from 40 years of Maoist oppression, however, Friedman had other ideas, chiefly some advice for the Chinese government. He counseled the Communist leaders, as a top priority, "to get control of their money supply."

No one ever won an argument with Milton Friedman, so I readily confess that I did not win one then, or later, over the power of government-controlled money in an economy. As we bounced in buses through the streets of Shanghai, Milton answered my every question with peremptory aplomb: "Inflation is always and everywhere a monetary phenomenon." But what if government spending and taxes were the fastest growing prices, as I had written in Wealth and Poverty? Friedman insisted: "Control the money supply and you can control inflation, regardless of government fiscal policy."

I continued to resist the idea that a Communist regime full of control freaks in gray military garb would benefit from advice from the world's leading libertarian thinker on the need to take control of anything, let alone money. But at that time, I could summon neither the words to refute Friedman nor the insights to grasp the enigmas of money.

My own counsel for the Communists skipped money altogether and focused on freedom. Recalling Mao's duplicitous appeal to Chinese intellectuals "to let a hundred flowers bloom," I commented: "This statement showed [Mao's] incomparable misunderstanding of the powers

of the Chinese people." I called for an efflorescence of entrepreneurship: "Let a billion flowers bloom."[2]

When asked what would happen in 1997, when Hong Kong would revert to the rule of mainland China, I said: "1997 is the year that Hong Kong will begin to take over China." At the time, I had no real sense of how this would happen. But Premier Deng Xiaoping and Shanghai mayor Jiang Zemin led a movement to duplicate the success of Hong Kong in "free zones" all along the coast of China. It was these free zones modeled on Hong Kong that produced what we all know now as the Chinese miracle. I said that a Chinese revival of freedom would make China the world's largest economy by 2015, the year in which I am now writing. By some measures, this prediction is close to coming true.[3]

What does this success have to do with monetary policy? I had learned from the late Stanford Professor Ronald McKinnon that "financial development"—the entrepreneurial creation of banks and other financial infrastructure—was vital to economic development.[4] But far less significant were aggregate numbers, such as the money supply produced by the power of government. What mattered were freedom, property rights, tax rates, and the rule of law that enable the growth of knowledge and wealth.

Milton Friedman has passed away, but he continues to win all arguments in his great books of free market thought, from *Capitalism and Freedom* to *Free to Choose*, which continue to outsell mine by large margins.[5] But with all due respect for the great economist, I would now like to point out that on the issue of money, despite his inexorable forensic prowess and

his Nobel Prize for monetarism, he has been proven wrong.

This monograph on the new information theory of money will explain how and why. It will also explain monetary systems that can fulfill Friedman's libertarian dreams far better than his own concepts of "monetarism."

State control of money has become a bastion of government economic centralization wreaking havoc on capitalist economies around the globe. By controlling money supplies, central banks and their political sponsors determine who gets money and thus who commands political and economic power. Unsurprisingly, these establishments back entrenched economic and political interests against their rivals, contributing to new, unchallengeable concentrations of wealth.

Since the economic crisis of 2008, Washington has used monetary policy to effectively nationalize the Wall Street banks and subsidize their borrowing. Enormous sums of investment money are diverted from the real work of learning that builds wealth, into currency manipulations and "investments" in government debt—the once great Wall Street banks in turn subsidize the political campaigns of their Washington benefactors. If Friedman had lived to see what monetarism has birthed, he would disown his intellectual stepchild.

The world also adopted Friedman's concept of allowing currencies to "float" against one another. This float has become an oceanic global market with a trading volume of some $5.3 trillion every 24 hours that dwarfs in size all

markets for goods and services.[6] Yet floating currencies have neither succeeded in taming financial crises nor enhanced world trade nor abated political conflict. No one can show that they approach real values, since their massive gyrations—the yen-dollar rate, for example, changed for decades at an average rate of around 4 percent *a month*—come without any significant change in comparative purchasing power or other measures of competitiveness. Yet centralized, government-controlled money is more entrenched than ever.

Refuting this rare Friedman error is vital to the future of the very freedoms that Friedman dauntlessly championed throughout his career.

Monetarism is an economic theory based on the famous equation, which I wear as I run in my Milton Friedman T-shirt, declaring that "MV=PT." More simply, this equation can be stated as MV=Total Output: The money supply times its velocity or rate of turnover equals prices times transactions, or very roughly, nominal gross domestic product. Money supply is "purchasing media," or what you use to buy stuff. How often each dollar is spent over any timespan represents its velocity.[7]

Despite many refinements and multiple versions—M1, M2, M16, and MZM, as if a panoply of weapons—the money supply is usually defined as cash, checking deposits, and money market accounts. Supporting these is the Fed's monetary base—its "high-powered" money consisting of bank reserves and cash. The bank reserves support bank loans, which can multiply the money supply and support

economic expansion. Many of the bank loans, however, have been boomeranging back to Washington to sustain government consumption.

The turnover of money of all definitions sustains GDP, or more accurately GDE (gross domestic expenditures), Mark Skousen's valuable measure of all spending across the economy. Renamed Gross Output and adopted by the Federal Bureau of Economic Analysis in December 2013, GDE includes intermediate spending on capital goods and commodities rather than only the final sales indexed in GDP.[8]

Friedman and his many disciples persuaded economists across the political spectrum to believe that in this equation, MV=PT, the ruling factor is "M." Control the money supply and you command a lever that can move the entire economy in desired directions. You can maintain nominal or measured GDP (without adjusting for inflation) at any desired rate of growth. Hence, his advice to the Chinese leaders, "Get control over your money supply."

Monetary theory explains why the Federal Reserve Board in the United States has a mandate from Congress not just to serve as a "lender of last resort" in crises, but also to combat inflation and promote full employment. These goals imply that the Fed controls the effective money supply. They imply that the amount of money can both determine the level of prices (inflation) and influence the levels of employment and nominal growth. Those ideas constitute the creed of monetarism. They suggest that even in a fully free-market economy the central bank is the one institution that must

maintain top-down control.

Since every currency has a central bank, the prevailing monetarism enables different monetary policies in each nation or region. Separating national economies, this system favors currencies floating against one another, with their values reconciled by a global market of currency exchange. Thus, a global currency is "minted" by currency traders in a strange new form of seigniorage. Under the prevailing theory, money becomes a self-referential system ultimately controlled by the sovereign in each nation that issues currency. Sovereign moneys compete with one another in markets around the globe.

By assuming that control over the money supply gives the government power to provide jobs and lower prices in each country, monetarism, like Keynesianism, invites and virtually obliges a government monopoly on money.

In general, however, people do not trust the sovereign and its political entities with so powerful a weapon as monetary policy. So the power is taken from the voters and diffused to independent panels of experts and trusted third parties such as the European Central Bank and the Board of Governors of the Federal Reserve System. Thus, monetary theory not only denies free enterprise—it also impugns democracy.

For "M" to rule, however, in the equation MV=PT, money must have an inelastic element to multiply or push against. Velocity (or money turnover) must be reasonably stable and unaffected by changes in "M." That is, people must spend their currency at a relatively even and predictable

rate, regardless of the supply of money, and banks must loan money chiefly as it is made available by the central bank rather than as it is demanded by entrepreneurs with promising ideas. Otherwise, the people (including bankers) could counteract any given monetary policy merely by changing the rate they spent or invested the dollars. Why prevailing monetary theory disparages this possibility has long been an enigma to me.

Friedman developed a shrewd and plausible answer. He posited that annual velocity is reasonably constant at around 1.7 times per year. He explained this number as a reflection of deep-seated human psychological propensities and summed them up with his famous "permanent income hypothesis": *current* "liquidity preferences" (desire for cash) and their inverse, the savings rate, depend on *lifetime* savings and income targets. Essentially, you save until you hit your target, and then you spend. During your youth you tend to save, and in your old age you tend to dis-save. Thus, it is not the availability of investment opportunities or changes in the interest rate or tax rate that determine savings, nor is it even exciting new consumption goods or inviting savings vehicles, but instead it is the fixed intrinsic psychology of human beings.

The permanent income hypothesis seemed plausible on the surface. No one in here but us sociologists. But another word for liquidity preference is velocity. Friedman supplied a sociological explanation for velocity that put it outside of economic policy. With velocity more or less fixed, the money supply rules. Thus, despite all his acute misgivings about government power and superb critiques of government

programs, Friedman ended up encouraging the idea that the federal government's control of money provides a lever for federal experts to regulate and stabilize the economy. (Disliking the elitist implications of Fed control, Friedman himself proposed binding the central bank to a predetermined monetary rule, such as annual increases in the money supply of 3 percent, reflecting average economic growth.)

Liberal economists, such as Paul Krugman, eagerly accept the implication of the monetarist creed, while conservative economists pile on. The eminent John Taylor of Stanford wants to tie the Fed to a Taylor Rule based on announced targets for inflation and unemployment.[9] Even *National Review* editor Ramesh Ponnuru and former Republican Treasury economist David Beckworth strongly endorse monetarism in the flagship conservative magazine.[10] They continue to chastise the Fed for inadequate expansion of the money supply through the "Great Recession" beginning in 2007, when the monetary base of the Fed's so-called "high-powered money" began an expansion from $800 billion to $4 trillion.

In 1976, Friedman suffered a crippling intellectual trauma that seriously affected his thinking for the rest of his life. The King of Sweden in Stockholm awarded him a Nobel Prize for economic science, specifically for his errors—his monetary theory and his permanent income hypothesis. In an intellectual lapse common among Nobel Laureates, Friedman continued to defend these ideas long after their validity had collapsed empirically.

We now know without a doubt from empirical evidence that velocity is not constant. Not even close.

Through most of the 21st century, velocity has been anything but constant, falling like a rock one year, soaring like a rocket the next. The money multiplier—a velocity enabler measuring how much economic activity the Fed's monetary base or "high powered money" supports—swings between 3.1 and 12. Over the seven years following the 2007-2008 financial crisis, the US monetary base rose from $800 billion to $4 trillion, but velocity plummeted. In Japan, velocity has been sinking for two decades, after soaring wildly in the 1980s. In the United States, as Louis Gave of Hong Kong's GaveKal asserts, "velocity is eminently volatile and impossible to forecast." [11]

Jacques Rueff is widely known as "one of the best central bankers France ever had" and as the author of the immortal lines: "Inflation consists of subsidizing expenditures that give no return with money that does not exist." [12] In a speech on Rueff in 1996 to the French Parliament, gold standard champion Lewis Lehrman explained: "All of Jacques Rueff's experience as a central banker had taught him…that no central bank, not even the mighty Federal Reserve, can determine the quantity of bank reserves or the quantity of money in circulation…In a free society, only the money users—consumers and producers in the market—can determine the money they desire to hold [or] vary the currency and bank deposits they wish to keep…" [13]

But if velocity is not a fixed constant, then people (as consumers and investors and lenders) could counteract

any given monetary policy merely by changing the rate at which they spent or invested the dollars. In recent decades, this is what we seem to have done, compensating for and neutralizing every change in the money supply with a nearly equal and opposite change in turnover.

In 2003, three years before his death, the great Milton Friedman finally acknowledged, in an interview with the *Financial Times*: "The use of quantity of money as a target has not been a success. I am not sure that I would as of today push it as hard as I once did." [14]

Velocity is not an effect of psychological forces outside the economy. It is the active means by which economic agents—people—control money. Velocity is freedom. It expresses the public's appraisal of economic opportunities and opportunity costs. Velocity comes in two forms—pro-growth and anti-growth rises. In anti-growth moves, people flee financial assets into consumables and collectibles, real estate, and financial shuffles in zero sum inflationary surges, which are not technically gauged as velocity but certainly reflect monetary turnover. Positive accelerations of velocity come when investors plunge into actual companies and drive a rapid learning curve of opportunity and progress. In neither case does the central bank control money. We control it.

If we control money, it means that money does not require a sovereign source. It can reside outside the political system. It does not need central bank management. The energy and effort diverted into trading more than $5 trillion every twenty-four hours to "mint" a global paper currency could be spent instead in productive enterprises.

Currencies around the world do not have to be separated and allowed to float against one another. In a world where capital can flow freely because it is all expressed in one standard of value, trade does not have to balance. Capital and trade are fungible factors. When one goes up, the other goes down. More mobile and flexible than goods and services, capital movements can drive trade movements. A Chinese company has to choose whether to use its dollars to buy a good or to invest in the U.S. Today, many Chinese avidly want a stake in America, its technologies and its constitutional rule of law. Investments across borders thus shape the trade balance (rather than the other way around as most economists assume).

As history teaches—even if it is often forgotten—it is possible to have centuries of expanding trade under a stable monetary standard that rewards work, savings, and enterprise over politics and pull. With a stable monetary standard, trade almost never balances.

The needed reforms entail treating money not chiefly as power but as information. While government power can increase the volume of money, it cannot enhance the value of money.

# PART TWO: THE GREAT RECESSION AND CENTRALIZED CONTROL OF MONEY

This decade of the financial crisis—the "Great Recession," with constant rumors and alarms of war—brought an epochal confrontation between the dollar and gold. At first, through 2011, gold surged and the dollar merely survived. Gold touters and gold bugs claimed vindication. In a series of ardent and incendiary books and speeches, the brilliant libertarian polemicist Peter Schiff predicted the total destruction of the dollar and the massive appreciation of precious metals.[15] Internet screeds seethed with predictions of the collapse of all fiat or paper currencies.

Many of the pitches and hustles aimed to sell various gold-based products. But the doomsayers were honest in their belief that the dollar could not survive the Fed's fivefold increase in its dollar holdings of "high-powered" reserves. Many imagined that China and other holders and users

of massive dollar reserves would join to overthrow the American dollar's hegemony as the world's reserve currency.

And then, against all odds, as understood by hard money economists and bullion enthusiasts, what eventually cracked and crashed was not the dollar at all, but gold. In two years between 2012 and 2014, the precious metal lost 40 percent of its value against the dollar. The dollar went on an awesome tear against nearly all the world's currencies and commodities. Today, it handles more than 60 percent of world trade, denominates more than one half the market cap of world stocks, and partakes in 87 percent of global currency trades. [16]

To advocates of paper, the lesson seemed unanswerable. Even in a global monetary crisis, exacerbated by wildly loose monetary policy in Washington, with quantitative easing following stimulative buying, and with an explicit zero interest rate policy (ZIRP), the "full faith and credit of the U.S. government" behind the dollar roundly trumped the intrinsic value and scarcity of gold.

Paul Krugman's *New York Times* column gloated mercilessly. He seemed to have a point. He rubbed in his argument by regularly quoting Milton Friedman's case for floating currencies. [17] Friedman held that floating currencies could respond to real changes in the economy far faster and more easily than real factors could adjust to a fixed standard. With an acute imbalance of trade, it was radically more efficient to change simply one outside price—the exchange rate of the currency—than to change every internal price, every wage, every pension and salary, every cost of every grocery and

rent—one at a time—across an entire economy.

Such radical surgery occurs when a nation adopts economic policies that disable its businesses in international competition. Rather than merely devaluing the currency so the nation could import fewer foreign goods and export more goods overseas (thus rebalancing its trade), a nation under a gold standard would have to change its most self-defeating policies. Otherwise, the miscreant country would have to force down, all at once, its levels of wages, salaries, costs, prices, and government—nearly impossible in democratic politics.

Krugman clinched his argument by comparing the experience of the United States with that of Europe during the Great Recession. Europe attempted to enforce the rule of a single currency, the Euro, on seventeen nation-states—no floating permitted. This campaign seemed to mimic on a continental scale the impact of a gold standard globally. Krugman pointed out that U.S. states varied as drastically in their economic performance as European states did, with states such as Texas and North Dakota booming with energy gains while Florida and Nevada, for two examples, crashed with the popping of their real estate bubbles. But in the U.S., states that suffered the worst impact from the crash benefited from federal cushions supplied by more prosperous states. [18]

Federal benefits for welfare, medical care, education, social security, unemployment, disability, disaster relief, and dozens of other subventions compensated for recessionary tax revenue losses and cutbacks in state programs. The $800 billion Troubled Asset Relief Program (TARP) bailed out

state governments. Meanwhile in the European common market, or Eurozone, countries such as Greece, Ireland, Spain, and Portugal were each expected to endure acute shrinkage of their social services and welfare systems in exchange for relatively modest aid from Germany and other solvent Eurozone economies. When the dollar surged in 2014 against nearly all other currencies and no inflation was salient, the ideas of Krugman and his allies seemed to have prevailed.

Led by the dollar, floating paper currencies both outperformed gold and trumped the European experiment with many nation-states forced to adapt to a single standard of value. As Krugman argued, gold is simply a single standard applied to the world. Surely, Krugman said, citing Milton Friedman, the unitary gold standard would wreak global havoc resembling the havoc inflicted by the unitary Euro standard.[19]

Why, then, are we still talking about gold? Why after all these decades of fiat money functioning pretty well most of the time, why considering the fantastic performance of the U.S. economy over the last forty years, the astonishing creation of wealth and improvement in physical well-being since we left the last remnants of the gold standard behind, considering as well that none of the dollar's serious rivals are linked to gold, why do investors still treat gold as the most serious alternative to paper money? Why reconsider using gold as the monetary standard?

The reason is not a mere irrational nostalgia for a misremembered "golden age." The reason is a decade and a

half of economic failure so crippling and pervasive that it led to a global revulsion against capitalism. Leading economists such as former Treasury Secretary and Harvard President Larry Summers and Robert Gordon of the National Bureau of Economic Research concluded that the world's economies are entering an era of "secular stagnation," marked by a possibly permanent decline of entrepreneurial innovation and technological advance.[20] Peter Thiel, by all odds the world's most visionary venture capitalist-philosopher, declared that of four possibilities for the world economy—recurrent collapse, plateau, extinction, and technological takeoff—"the hardest one to imagine [is] accelerating takeoff toward a much better future."[21]

Inflaming the global economic doldrums is a forced transfer of wealth from Main Street to Wall Street so gigantic that it sharply skewed global measures of the distribution of wealth and income, bringing to a halt 50 years of miraculous and broad based advance in global living standards. At the root of these catastrophes was a drastic abuse and debauch of money and banking led by U.S. and European megabanks.

The expansion of federal regulations and other laws had increased federal control of credit and skewed it away from technology and manufacturing and toward real estate. The Basel process in Europe extended these policies overseas.

In a hypertrophy of finance, an ever-increasing share of the global profits migrated to incestuous exchanges of liquidity by financial institutions transfixed by the oceanic movements of currency values. By trivializing banks, government policy moved them from a spearhead of investment in business to

an obsequious role borrowing money from the Fed at near-zero rates and lending it to the Treasury at rates as high as two percent, yielding a tidy risk-free profit expandable through leverage and protected by implicit and explicit government guarantees.

By intimidating the financial sector with constant litigation and becoming addicted to fees and fines, government regulators have turned banks into their harem of well-fed eunuchs, periodically whipped and blandished and, finally, stultified. During the spurious expansion of the early 2000s, government policies, together with complementary litigation by non-profits, pushed U.S. banks to bet the bulk of American investment capital on *housing*, essentially a consumption good already in over-supply. Banks and policy-makers then spread this error to Europe, pushing mortgage-backed securities on Irish, Spanish, and even German banks.

For these egregious errors, private and public, U.S. bankers collected $5 *trillion in bonuses* over a seven-year period.[22] Also profiteering on the crisis was Washington, which expanded regulations and controls under the amorphous Dodd-Frank blob of laws and even enriched housing subsidies under Fannie Mae and Freddie Mac. In October 2014, as if nothing at all had been learned, the required down-payments for taxpayer-guaranteed mortgages were dropped back down from 5 percent to 3 percent.

Meanwhile, as leading economist and former senior Treasury and State Department official David Malpass has documented, crucial U.S. manufacturing and technology companies have been on a capital starvation diet since 2008

as private sector credit shrank as a share of GDP.[23]

Government money has shielded banks from many of the effects of these blunders and from the impact of mild but persistent CPI inflation. But average American households have gone through an economic wringer as their medical, fuel and food costs surged.[24] Doggedly opposed by the Administration and the academy, fracking technology together with the strengthening dollar offered economic relief, but the damage had been done. Their real incomes and net worth incurred a steady deterioration with falling labor hours, anemic employment growth, and the breakdown of families.

This persistent disaster would not have been possible without the concession by conservatives (with the delighted concurrence of liberals) that money is the one great exception to their general opposition to government monopoly—that among all the powers of the earth, only the power over money does not corrupt. Milton Friedman was wrong to think that control over the money supply would empower governments beneficently to stabilize its value. Instead, government could exploit their monetary control to steer money and credit away from productive enterprise and toward pet projects, political donors, and perverse policies.

This monetary coup, changing money from the medium of economic activity to the message itself, thwarted economic growth, punished savers, and rewarded prestidigitory finance over innovation. Casting a shroud of uncertainty over all valuations, monetary manipulations shorten the time horizons of the economy. In information theory, the

dominant science of our age, the medium sending messages of its own—static on the line—is called noise. Noise in the channel reduces the channel's capacity to transmit accurate information.

By obfuscating all economic activity, government money causes *inequitable* distribution of wealth. Unlike mere inequality, these arbitrary government favors and privileges for producers of everything from ethanol and windmills to mortgage-backed securities and oceanic currency shuffles are actually destructive to both the morale of capitalism and to the economic growth that fuels the opportunities of the "middle class."

This result is not surprising or even accidental. The actual purpose of both Keynesianism and Monetarism, as well as every coin-clipping King or Emperor in the history of the world, is to transform money, a measure of wealth, into wealth itself. It is driven by the delusionary dream that the government can create economic wealth for its rulers to spend. But changing the measuring stick has never improved the process of building economic value or anything else that has to work.

# PART THREE: WHAT BITCOIN CAN TEACH

Today, the established theories of top-down money face serious challenges from digital alternatives on the Internet, and from the perennial appeal of the case for gold. Both of these forms of money offer escape from the centralized regime of monetarism. Both offer monetary systems that affirm Friedman's cogent theories of freedom, rather than his erroneous ideas of control.

Gold has been ascendant in Asia, which has become the new spearhead of world economic growth and capitalism, with tax rates widely running between one half and one third of those in the West.[25] China's government take has sunk to only 17 percent of GDP (compared to the US level of 26 percent).[26] In 2014, China was importing a record $70 billion worth of physical gold, passing newly capitalist India as the world's leading gold importer and implicitly relying on gold as monetary ballast for its floundering banks.[27]

To the chagrin of conventional economists in the U.S., China has mostly opted out of the floating currency regime and effectively affixed its currency to the dollar. For this refusal

to float, defending the dollar against Washington's devaluers, China has been rewarded by a huge increase in trade with the United States. But by muting currency changes, China incurs continual charges of "currency manipulation" from American politicians and government officials who believe that currency manipulation is sacred when it is performed by their own central bank.

Meanwhile, around the globe, transactions are shifting toward the Internet. Although online purchases remain between six and seven percent of all commerce, Internet trade is expanding rapidly.[28] On the Internet, technological change accelerates; digital currencies, such as Bitcoin and its imitators, are gaining ground; and impatience mounts toward the prevailing mazes of bureaucratic moneys, fees, finagles, security rigmaroles, defaults, and escrows.

To buy something on the Internet, you usually have to give the supplier sufficient information—credit card numbers, expiration dates, addresses, security codes, mother's maiden name, and so on—to defraud you, or even to usurp your identity. Then, this information has to be protected at high cost in firewalled central repositories and private networks that represent an irresistible target for hackers. With transactional overhead dominated by off-line financial infrastructure, micropayments are uneconomic, and the Internet fills with mendacious free goods, bogus contracts, and pop-up hustles. Some 36 percent of Web pages are spurious, emitted by bots to snare information from unwary surfers.[29] At the same time, Silicon Valley moves toward an "internet of things," sensors and devices—from heart monitors and "smart grid" gauges to automated cars

and heating systems—linked across the net and needing automated transactions without off-line intermediaries. Reform of world money is less a far-fetched dream than a rising imperative. Gold and digital currencies converge to provide a new solution to the enigma of money.

Gold, however, remains the leading player. Even the digital currency leader Bitcoin sprung from a previous scheme called Bitgold. Bitcoin is a distributed, global form of money that operates peer-to-peer across the net with no top-down control. Rather than protecting information at various centralized points, Bitcoin publishes all transactions and propagates them across ordinary Internet links without personal identifiers that can be hacked. Modeled on gold, its quantity is inexorably limited, as it becomes more difficult to "mine" with the passage of time. It is not a competitor to gold but an Internet money that simulates the properties of the monetary metal and offers a path toward a gold inspired standard for the Internet.

Understanding any kind of money still entails coming to terms with the meaning of gold. In the new information theory of money, the crucial clue turns out to be the deeper significance of Friedman's error: the role of velocity.

# PART FOUR: MONEY IN INFORMATION THEORY

Money is the central information utility of the world economy. As a medium of exchange, store of value, and unit of account, money is the critical vessel of information about the conditions of markets around the globe in both time and space.

In my last book, *Knowledge and Power: The Information Theory of Capitalism*, I found that wealth is knowledge and growth is learning, and that both are governed by the rigorous science of information.[30] The denizens of the Stone Age commanded all the material resources we have today. The difference between our age and the Stone Age is the expansion of knowledge. Knowledge expands through testable learning, "learning curves," proceeding through entrepreneurial experiments.

Growth in wealth stems not from an efflorescence of self-interest or greed, but from the progress of learning. It is accomplished by entrepreneurs conducting falsifiable experiments of enterprise, with the outcomes measurable by

reliable money.

From Bell Labs in New Jersey to Intel and Cisco Systems in Silicon Valley and Qualcomm in San Diego, engineers follow these principles through the discipline of Information Theory. Its prime author was a rambunctiously creative engineer, Claude Shannon, from Bell Labs and MIT. In 1948, fresh from major cryptographic work during World War II, he published a set of technical concepts for gauging the capacity of communications channels to bear information. Defining information in a noisy channel resembled finding the real message enshrouded in cryptographic codes. [31]

Shannon resolved that all information is most essentially *surprise*. Unless messages are unexpected, they do not convey new information. In an analogy to thermodynamic *entropy* as disorder, Shannon dubbed this measure entropy. An orderly and predictable mechanism, such as a determinist physics or Adam Smith's economy as a "great machine," embodies or generates no new information. [32] By putting surprise at the center of the system, Shannon offered a way to address the surprises of human creativity within an economic model rather than outside it. Without surprises, time is low value and boring. Entropic surprises are what lend energy and directionality to time and economies.

Shannon's surprises, however, come in the content of the economy, not in its carriers. If a carrier is to bear surprising contents, it must itself be unsurprising. It must be possible to differentiate the signal from the channel at the other end, the contents from the conduit, the word from the wire. The conduit must not change surprisingly or it is hard for it to

carry the information. Only if the channel is changeless can the message in the channel communicate changes. On a constantly changing channel, communication and creativity founder in an ocean of noise.

In economics, money is part of the conduit or carrier. If money is to foster learning and knowledge, it cannot itself be surprising. Part of the channel for capitalist activity rather than part of the content, money must be the measure rather than what is measured. It is the fixed medium rather than a flexible message, a stable matrix for the market rather than an active marketable item.

Summing up the new information theory of money is an eightfold canon:

1. *The economy is not chiefly an incentive system*, but an information system. It requires a reliable standard of value rooted in the irreversibility of time.
2. *Creativity always comes as a surprise.* If it didn't, socialism would work. Information is defined as surprise.
3. *Information is the opposite of order.* Capitalist economies are not equilibrium systems but dynamic domains of entrepreneurial experiment.
4. *Money should be a standard of measure for the outcomes of entrepreneurial experiments.*
5. *Interference between the conduit and the contents of a communications system is called noise.* Noise in the currency makes it impossible to differentiate the signal from the channel.
6. *A volatile market shrinks the time horizons of the economy.* Gyrating currencies and grasping governments are deadly

to the commitments of long-term enterprise.

7. *Analogous to entropy, profit or loss represents surprising or unexpected outcomes.* Analogous to average temperature in thermodynamics, the real interest rate represents the average returns.
8. *Velocity is not a constant.* Therefore, the effective money supply is not controlled by the central bank but by the free decisions of individuals as they accumulate knowledge.

The key to economic growth is surprising knowledge acquired through falsifiable experiments of free enterprises. Business must be open to bankruptcy as well as to profit. This learning process is stultified by government manipulation of money through guarantees and other exercises of power designed to stimulate economic growth or protect assets.

Surprisal—what Shannon called "entropy"—is both a measure of freedom and criterion of creativity. It is gauged by the message sender's freedom of choice. The more numerous the possible messages that can be sent, the more uncertainty at the other end about what message was sent and thus the more information there is in the actual message when it is received.

Information theory treats human communications or creations as transmissions down a channel in the presence of the power of noise, with the outcome measured by its "news" or surprise. Information is defined as entropy and consummated as knowledge. In a knowledge economy, stable money is central to the standards of measurement.

In entrepreneurial experiments, the governing constraint is

the scarcity and irreversibility of time. With infinite time, anything is possible. Finite time imposes the necessity for choice and prioritization. Time is embodied in interest rates (the time value of money), in budgets, in contracts, and in accounts. In economics, time is chiefly represented by money. In the deepest sense, money is time.

This is not merely a trivial trope on Ben Franklin's aperçu "time is money." Instead, it stems from the necessary scarcity of money. As an instrument for keeping accounts, setting priorities, and evaluating opportunities, money must be a measuring stick rather than a magic wand. It cannot be expanded or contracted at the will of the sovereign. In order to explain a willingness to exchange real goods and services for it, money must be strictly limited in quantity.

Paradoxically, to serve as a store of value, money cannot be hoardable. If money is not invested or spent, it rapidly becomes worthless, as no goods are produced that it can purchase. Time is the quintessential Heraclitean stream in that it cannot be hoarded. Time is the basis for Say's Law—supply creates its own demand, and in one way or another, depending on policy, savings are always invested.

As an economy grows, with ever more abundance deriving from ever more learning, only one resource grows relatively scarce in proportion. That resource is time. It is the most real and irreversible of all constituents of value.

The expansion of per capita wealth and income in an economy means an increase in choices and possibilities, ways of using your time, and claims on your attention. Although

some new goods and services increase your efficiency and some extend your years of good health, the growth of an economy inexorably presses in on the residual resource—the hours in your day.

These hours (and minutes and seconds) are what you actually spend or waste, invest or splurge, save or sleep away. Money offers an accurate measure of earnings and expenditures chiefly as it reflects these costs of time, gauged in two irreversible ledgers—physics and biology: *the speed of light* and *the span of life*. If it does not represent these fundamental scarcities of human life, our economics will diverge from reality and betray us.

More and more goods and services are generated and used in less and less time. Governments can pretend that some goods intrinsically cost more (gasoline or gold) or that some should be free (medical care) or that some items are becoming more expensive (education, medical instruments). People with political power can push particular prices up or down (tuitions, taxes, or interest rates, housing or high fructose corn syrup or the costs of launching a new business). But time remains irreversibly scarce and dictates that real costs go down in proportion to the learning curves across the economy.

Even financial inequalities do not affect the underlying scarcities of time and attention, speed of light and span of life, playing out across the real economies of our days. Time is remorselessly egalitarian, distributed with rough equality to rich and poor alike. Registering the radical increase in equality around the globe is a massive flattening

of comparative lifespans.[33] The rich cannot hoard time or readily seize it from others. It forces collaboration with others.

Static measures of inequality of wealth and incomes are deceptive. Under a rigorous time regime, it takes work to accumulate the knowledge that builds wealth. Learning entails labor. The top quintile of households contains an average of six times as many full time workers as the bottom quintile.[34] The more "wealth" commanded by an individual, the more time is entailed in managing and investing it. Most wealth is illiquid, defended by barriers of time, property rights, covenants, corporate structures and payment schedules at the heart of investments and economic growth. To extract wealth prematurely—to "liquidate" it—is a costly and disruptive process that entrepreneurs only rarely undertake.

Muddling much of economics is a mirage of money itself as power, as if the supply of money itself can impel economic activity. Monetarism (control of money), Keynesianism (control of spending), and Mercantilism (control of trade) all foster the illusion that government power can drive economic growth and wealth creation.

What government can do (and does do) under this illusion is redistribute wealth, usually to the already rich and other politically favored inside players. Government can properly create the conditions under which knowledge—yielded by millions of falsifiable experiments in entrepreneurship—is created. But the lessons too many people learned under Communism still comprise the central economic lesson:

power cannot order wealth—new knowledge—into being.

Recognizing the fallacy of the reigning monetarist creed requires recognizing that the negative effects of government monetary policy are not limited to inflation.

Interest rates, for example, register the average expected returns across the economy. With a near zero interest rate policy, the Fed falsely zeroes out the cost of time. This deception retards economic growth. Rather than creating new assets, low-cost money borrowed from tomorrow bids up existing assets today. It creates no new learning and value, but merely destroys information by distorting the time value of money. Charles Gave of GaveKal explains: "When the bust arrives, assets return to their original values, while debt remains elevated…the stock of capital shrinks…and real growth slows." [35]

In the name of managing money, the Fed is trying to manipulate investors' time—their sense of present and future valuations. But time is not truly manipulable. It is an irreversible force impinging on every financial decision we make. The Fed policy merely confuses both savers and investors and contracts the horizons of investment, which in some influential trading strategies have shrunk to milliseconds.

Among the critics of the status quo of freely floating currencies, two mostly complementary solutions have emerged: the creation of new currencies; and the return to gold, the venerable historic standard monetary element.

From the perspective of information theory, the two solutions converge. Both are attempts to create a regime of irreversibility: the assurance that transactions or contracts cannot be reversed, counterfeited, or nullified by private actors' double-dealing or by public entities inflating the currency or countermanding contracts. The medium of exchange, standard of value, and store of wealth cannot be subject to arbitrary change from outside.

Irreversibility is a function of time. Government control of the distribution of money and credit gives rise to endless opportunities to rerun the race against time in a way that the government's favorite children always win. The principal attraction of both gold and recent attempts to create digital money is precisely that both solutions give us a money as irreversible as time itself.

The second law of thermodynamics ordains that entropy as disorder always increases and cannot be reversed. You cannot reconstruct an egg from an omelet or reuse the energy that heated your house or that flowed kinetically over Niagara Falls. It is entropy that imparts an arrow of irreversible time to the physical world. Thermodynamics runs one way, irreversibly, and defines the essence of time.

Sound money means hostility to time travel. You do not want others to go back and re-spend the same money that they already have given you or reverse the transactions that you have made. You do not want your customers to bounce their checks or your bank or government to bounce yours. Sound money is the equivalent of scientific integrity: the system must not permit the manipulation of data after the

experiment has taken place.

Gold achieves irreversibility through its refractory chemistry (79 protons in the gold parade) and the time-based entropy of extraction. As master of the mint in 18th century England, Isaac Newton spent much of his time proving that gold could not be hacked, counterfeited, or reverse engineered from other elements.[36] As Nick Gillespie of *Reason* magazine has observed, Newton was not an alchemist so much as an "anti-alchemist."[37] Bitcoin and other digital currencies offer similar irreversibility through complex mathematics and software, based on a time-stamped public "block chain" of transactions. Modern-age Newtons make constant efforts to hack Bitcoin.

Gold and Bitcoin both exclude from the measuring stick the advance of physical capital or technology and even the learning curves of labor. If the measuring stick changes in response to economic progress, it cannot measure that progress. In order to bear creative changes, it must not change itself. In order to have a gauge that is exempt from the turmoil of markets, it must be rooted outside those markets. It must somehow cancel capital, technology, and learning. Like the electromagnetic spectrum, which bears all the messages of the Internet to and from your smart phone or computer, it must be rooted in the absolute speed of light, the ultimate guarantor of the integrity of time.

Dominating our own era, and revealing in fundamental ways the nature of money, is the Information Theory of Kurt Gödel, John Von Neumann, Alan Turing, and Claude Shannon. Information theory tells us that information is

not order but disorder—not the predictable regularity that contains no news, but the unexpected modulation, the surprising bits. But human creativity and surprise depends upon a matrix of regularities, from the laws of physics to the stability of money.[38]

Information theory has impelled a global ascendancy of information technology. From worldwide webs of glass and light to a boom in biotech based on treating life itself as chiefly an information system, a new system of the world is transforming our lives. Its roots are not in the necessary carriers of predictable physics and chemistry but in the creativity and disorder at higher levels of the hierarchy of life. Information theory operates on the epistemic plane where human beings conduct falsifiable experiments that yield learning and accumulate knowledge.

The lesson of information theory—the new System of the World—is that irreversible money cannot be the measure of itself, defined by the values it gauges. It is part of a logical system, and, like all such systems, it must be based on values outside itself. It must be rooted in the entropy of irreversible time.

It is revealing that when Bitcoin innovators Satoshi Nakamoto and Nick Szabo sought to invent new forms of money, they explicitly designed algorithms that nullified the effects of technological advance in computer technology. As Moore's law improved the computer systems used to validate transactions and integrate them with the Bitcoin block chain, for example, the "proof of work" challenge in the algorithm becomes proportionately more difficult and the reward

smaller.

Bitcoin "miners" could gain their specified rewards, but they could not use their super-fast devices to accelerate their own transactions or capture greater personal returns from them. Regardless of the evolution of computer technology, every group of transactions in the block chain and every new Bitcoin would require a ten-minute span to verify and integrate, mine and mint. Devoid of the outside influences of capital and technology, the source of Bitcoin value becomes the pure irreversible passage of time.

The Bitcoin theorists based this principle on the immemorial experience of gold. Largely by happenstance, gold has mostly cancelled capital and technology. As mining and extraction technology improved, the exhaustion of the "easy" nuggets near the surface required probing on to ever deeper and more difficult lodes. Throughout history, with few contrary episodes such as the discovery of the Potosi bonanza in Peru in the 17th century, the increasing difficulty of mining new deeper gold has nullified all advances in the technology of mining. As a result, gold has served as a gauge, perdurable and pure, of the time consumed in extracting it. Today, it costs close to $1,200 to mine a new ounce that sells for about that amount.

Contrast this cancellation of capital in gold and Bitcoin with the system of international currency trading that dominates contemporary money. Now at $5.3 trillion per day, currency trading dwarfs all the globe's stock markets and is 25 times greater than all trade in goods and services.[39] To deal with the floods of monetary change, banks spend half a trillion

dollars on information technology, decisively leading all other sectors in computer outlays.[40] The work of maintaining the measuring stick now costs 20 percent more in computer equipment than all the world's information technology for manufacturing new goods. Moreover, that work yields a volatile but steadily rising proportion of all banking profits.

In other words, our current floating rate system fails to cancel capital, technology, and learning. Instead capital, technology, entrepreneurial ingenuity, and government power together largely determine the earnings in the financial system. In a form of private seigniorage—the profits from creating money—the largest traders capture hundreds of billions of dollars or dollar equivalents every year from setting the measuring stick. Therefore, it is not a measuring stick at all, but an ocean of currencies that banks surf for profits. The banks extract these profits as a kind of volatility tax on the companies that use them to hedge currencies.

Enacting a gold standard, complemented by a Bitcoin or other Internet digital currency standard, would eliminate all this profitable froth. Under the gold standard, trading imbalances are nearly meaningless. Flowing freely to redress any imbalance, capital is more mobile than goods and services and can determine the balance of trade. Under the gold standard, the world enjoyed some two centuries of ever expanding global trade and investment without any semblance of balance on the current account. Americans, for example, ran trade deficits year-in and year-out for two hundred years, while rising to dominance in the world economy."[41]

# PART FIVE: THE HIGH COST OF MANIPULATING MONEY

The current world monetary and economic system favors this new Wall Street currency regime over both Main Street and Silicon Valley. Once symbolizing a wide range of research, analysis, and support for the independent enterprises of America, the new Wall Street simply means giant banks informally nationalized by Washington.

DeutscheBank, Goldman Sachs, Morgan Stanley, UBS, Citibank, JP Morgan Chase, and their ilk, eminent institutions all, are full of dazzling financial prestidigitators. But they are too big to fail and too dependent on government to succeed. Their horizons are too short to enable the falsifiable knowledge that alone constitutes entrepreneurial wealth and growth. They now make profits chiefly through what they call "proprietary trading," with a time horizon measured in minutes and weeks rather than years and decades. They impart liquidity but not learning. They are profitable because of a vast transfer of wealth away from workers and savers (including residential real estate as savings) toward bankers.

These institutions have accepted an insidious bargain where they thrive by serving government rather than entrepreneurs.

Under its current zero interest rate policy, Washington has debauched the dollar as a store of wealth or reliable standard of value. It has vitiated savings as a source of income, and it has rewarded financial manipulation over entrepreneurial investment and learning. Government by policy now favors the short-term arbitrage and rapid trading of the big banks over the long-term commitments that create employment and growth. Shrinking the horizons of economic activity, the result is a predatory zero-sum economy that destroys the jobs and depletes the incomes that sustain Main Street and the middle class.

For most of us, wildly changing prices and currency values are a menace. They confuse enterprise and learning and thwart the enduring commitments and investments that shape our lives and prospects. But the new Wall Street—and its computer driven trading—benefit massively from volatility. Gyrating currency values and stock movements, whether up or down, mean opportunities for arbitrage and fast trading. The new Wall Street harvests these gains through cheap borrowing from the Fed and accelerated cyber-buying and shorting of currencies and securities.

The new Wall Street wants volatility, with the downsides protected by government. Main Street and Silicon Valley want stable currencies for the benefit of work, savings, and long-term investment, with the upsides protected by the rule of law.

The new Wall Street mostly welcomes Luddite environmental regulations that thwart manufacturing and promote litigation. But regulatory overreach and litigation paralyzes Main Street and all but the lawyered leviathans of Silicon Valley.

The new Wall Street revels in the spiral of guaranteed loans to college students that expand the ledgers of banks and the investible endowments of universities. Main Street and Silicon Valley suffer from the debt-driven flight from marriage and entrepreneurship of entire generations of debt-burdened college graduates (or worse, non-graduates).[42]

Favoring financial power over entrepreneurial knowledge, these government policies have crippled the U.S. job machine that led the world in the 1980s and 1990s and sustained income growth for nearly all Americans.

Over the last twenty years, initial public offerings (IPOs) that create new jobs and prosperity have sharply declined compared to mergers and acquisitions that by comparison tend to shrink employment growth. In the 1990s, there were 20 IPOs for every merger and acquisition; since the turn of the century, there have been eight M&A events for every IPO.[43] Not only are large companies buying up their own shares, but they are also buying up the shares of their potential competitors. With the number of shares and rivals shrinking, the price of the remaining shares may move up. But the benefit to elite company stock values comes at the cost of a stagnant economy, without new company competition and learning, jobs, and growth.

By favoring a volatile environment of rapid trading, shorting, indexing, and arbitrage, current monetary and economic policies cultivate a hypertrophy of finance. The last five years have seen a 30 percent rise in the financial share of GDP, with as much as a 40 percent share of profits going to the financial sector.[44] But falsifying the yields of all this bloat of banking is a maze of government guarantees and subsidies, regulations and privileges. If government guarantees an investment, it is not falsifiable and cannot yield learning or economic growth.

Huge chunks of the industry of finance now shun any serious attempt to fund the industries and learning curves of the real economy. Apart from providing liquidity, the short term trading activities that prevail in the financial world yield virtually no new knowledge and thus are exploitative of wealth rather than creative of it.

Part of the problem is what I call the "outsider trading scandal." Hounded by government insider trading witch-hunts and "fair disclosure laws," investors must follow the government rule of "*don't invest in anything you know about*." For the public, the only investment idea that governments devoutly support is "invest in the state lottery, where no one knows more than you do."

Outside traders use market statistics and quarterly earnings correlations to guide ever more evanescent transactions. Since entrepreneurial learning comes from deep inside companies and requires intimate special knowledge, bans on insider trading or knowledge impel investors away from close company analysis and productive finance.
In the face of the mazes of protean SEC rules and

computerized investigations, it is simply foolhardy for a bank or hedge fund to base their public investments on real unique inside knowledge. Nearly anyone who understands a company is barred from investing in it. Basically prohibited from buying shares in the companies they know best, for example, are members of company boards of directors, who can always be judged to possess some incriminating inside insight. They are only safe if they lose money.

The SEC astoundingly favors boards that know nothing about the companies they rule and have no stake in them. Lawyers and accountants proliferate. The SEC thus stultifies investment by pushing it into the hands of arrogantly ignorant outside traders.

Under this fatuously self-defeating regime, the returns have migrated to large conglomerateurs and private equity players who benefit from perfectly legal insider trading in every one of their investments. Cagey private equity investors now can make lucrative gains by taking small public companies private and removing all the costly government-imposed impediments of redundant legal compliance and accounting pettifoggery.

Warren Buffett's Berkshire Hathaway and Jeffrey Immelt's General Electric, for two prominent examples, are not real corporations but legal insider traders who allocate investment among diverse company holdings that they understand intimately. Similarly, venture capitalists and private equity players never make an investment without intimate investigation of every inside nook and cranny.

Guided by deep inside knowledge, venture capital is the most valuable money in the economy. Launching learning curves across a wide span of innovations, venturers have seeded companies that now produce some 21 percent of GDP, 65 percent of market cap, and a probably under-estimated 17 percent of all jobs. [45]

But venture capital represents a tiny proportion of less than two tenths of one percent of total capital. Deploying most capital are leviathan companies like Berkshire Hathaway, General Electric and other global players. They are a net positive force in the economy, but most of them contribute comparatively little to the innovation process that yields real economic growth, jobs, and learning.

Even mutual funds and other stock market investors are increasingly shunning actual investigation of particular firms. Intimidated by the SEC, many funds do virtually no analysis of companies beyond the computerized parsing of balance sheets and quarterly statements for data used in fast trading algorithms.

Mostly barred from venture capital or private equity, the public-at-large is widely counseled to invest their money in "index funds." These yield no more knowledge and learning than the state lotteries do. Purchasing a sampling of all the stocks in the market without any research on specific companies, indexers give the public some exposure to the gains of the insider trading conglomerateurs. But they provide less than no benefit to the learning processes that create growth and wealth. Index funds are parasites on the research done by actual investors.

Index funds are even worse than they look because they base allocation not on the expected yield of the investment but on market cap. As companies grow overvalued, they become an ever-larger share of the holdings of the funds. The anomalous rise of Apple to the world's most valuable corporation has saved the careers of thousands of managers. Momentum prevails until it stops. But as economist Charles Gave of GaveKal puts it, "In a true capitalist system, the rule is the higher the price, the lower the demand. With indexation, the higher the price, the higher the demand. This is insane." [46]

Yet as pioneered by the much-laureled John Bogle at Vanguard and favored by the SEC's insider trading phobias, these parasitical and distortionary index funds directly extinguish knowledge and learning in the economy. Vanguard now passively "manages" some $2.9 *trillion* of assets with zero contribution to the investment process. Rather than investing in the market, they parasitically infest and congest it. Rather than creating wealth and jobs, they destroy them.

Dwarfing all positive investment by "insider traders" and knowledge brokers are the financial power brokers in the major banks. Thriving through leverage and arbitrage, fast trading and risk shuffling, they have long had access to virtually unlimited funds at near zero interest rates and have mostly been anointed as too-big-to-fail by government. In effect, the federal government through the Federal Reserve Bank and scores of other regulators has socialized the downside of these institutions. This has enabled them to do what they call "creative risk-taking." But what in fact they do is cockeyed extension of ever more cantilevered loans and

compound securities with only tiny slivers of actual equity at risk. Real entrepreneurial risk-taking is totally unrelated to mere hypertrophy of leverage with implicit government guarantees.

A huge portion of this trading depends on the monetary carnival of floating currencies. Let me repeat the amazing numbers: The international currency trading desks shuffle some $5.3 *trillion* in currencies every twenty-four hours. Currency trading is a hundred times the trading volume of all the world's stock markets put together and is twenty-five times the volume of international trade in goods and services.[47]

Funded by low interest rates and riding on volatility, this speculative frenzy often consists of value-subtracted interventions in global markets. George Soros has several times scored multi-billion dollar paydays betting against some imperiled currency, from the British pound and the Thai baht to the Indonesian rupiah. Benefiting from the volatility of prices and currencies and backed by government policy, these outside trading financial players contribute virtually nothing to the growth of knowledge and learning in the economy. Their profits thus come at the expense of Main Street and the middle class.

During the doldrums decade of the "Dot Com" crash and the great financial recession, from 2000 to 2010, the socialized big banks feasted on zero-interest-rate money from the Fed, bought a total of many trillions of dollars worth of government bonds, and harvested the spread. From the Fed, they received over a trillion dollars of surreptitious largesse.

For their services to the government amid a failing economy, they paid themselves salaries and bonuses estimated to total $5 *trillion*, or one third of an entire year of national GDP.[48]

These gains for bankers and governments were defrayed by the taxpayers and shareholders and even retirees through the zero interest rate policy (ZIRP).[49] When something is free, only the well connected get much of it. Main Street is far back in the queue. Zero interest rates resulted in easy money for high-leveraged Wall Street speculators, cheap money for the government, and parched credit for entrepreneurial small businesses that generate nearly all new jobs and learning.

Velocity is frequency in money—how many times a dollar turns over in a year. This makes money, in that sense, a wave phenomenon. Since the power of a wave rises with the square of its amplitude, large and long investments would be exponentially more significant than a series of small trades. Wavelets would be exponentially less potent than tsunamis. Thousands of fast trades do not add up to a program of high-impact investment for the economy.

Small and temporary anomalies are unsurprising and low entropy. Profits that reflect mere leverage or borrowing power do not usually contribute to the learning process. They reveal willingness to accept a level of calculable risk, rather than singularities of creative learning. Such profits are predictable and thus low entropy.

Stanford Nobel physicist Robert Laughlin's critique of the science of frothy phase changes has an analogue here in the currency traders' search for momentary correlations.

Parsing the chaotic ebullition of water as it comes to a boil, for example, is a fool's errand called "chaos theory."[50] As Shannon knew, *in principle*, a creative pattern of data points—reflecting long and purposeful preparation and invention—is indistinguishable from a random pattern. Both are high entropy. Parsing of random patterns for transitory correlations fails to yield new knowledge. You cannot meaningfully study the ups and downs of the market with an oscilloscope. You need a microscope, exploring inside the cells of individual companies.

Currency values should be stable. In information theory terms, they should function as low entropy carriers for high entropy creations. But the oceanic currency markets are full of Laughlin froth to be parsed by computers for short-term anomalies. With leverage, these trades may accumulate to massive profits. But these profits do not contribute much to the processes of entropic learning that constitute all economic growth in an economy of knowledge.

In addition, the trading in currencies can have massive impacts on emerging markets in which the trading excursions are large in comparison to the total supplies of a national currency. Soros' tragi-comic currency trades, jeopardizing entire national economies and then nobly saving them when opportune, are an absurd aspect of the hypertrophy of finance. Protecting these invasive trades from more scrutiny is only the fetishistic belief of economists in floating currencies run by central banks and husbanded by international organizations of witless experts.

A monetary reform could free banks from their current

trivialization as government tools and endow them again as crucial vessels of investment. In any banking system, the reason the maturities do not match is the divergence between the motivations of savers and the sources of the value of savings. Savers attempt to preserve their wealth in a liquid form, where they can retrieve it whenever they wish. But the laws of irreversible time ordain that money cannot stand still or uncommitted without losing value.

For its perpetuation and expansion, the wealth in banks is utterly dependent on long-term investments in perilous processes of learning—real investments in companies and projects that can fail and go bankrupt at any time. The role of banks is to transform the savers' quest for security and liquidity into the entrepreneurs' necessarily long term illiquidity and acceptance of risk. Without banks performing this role, economic growth flags and stagnation prevails as Summers and Gordon observe.[51]

Explaining the sources of Britain's world dominance in 19th century trade, Walter Bagehot in *Lombard Street* (1873)[52] pointed to the vastly larger agglomerations of capital in London banks: "A million in the hands of a single banker is a great power; he can at once lend it where he will, and borrowers can come to him, because they know or believe that he has it. But the same sum scattered in tens and fifties through a whole nation is no power at all: no one knows where to find it or whom to ask for it. Concentration of money in banks, though not the sole cause, is the primary cause which has made the money market of England so exceedingly rich, so much beyond that of other countries."

Bagehot, the *Economist* editor-in-chief, saw the power of leverage as a force for economic diversity and dynamism, enabling small entrepreneurs to outperform established capital. He gives the example of a start-up using leverage to outperform an established company avoiding risk. Even while paying back its loan, or equity investment, the startup can disrupt the established player by offering new and cheaper goods. "The egalitarianism of money," he wrote, "how it likes ideas better than it likes established capital, is very unpopular in many quarters."

Bagehot compared banking with enterprise: "Real money is a commodity much more coveted than common goods; for one deceit that is attempted on a manufacturer or merchant, twenty or more are attempted on a banker. The banker must always be looking behind him seeing he has enough reserves. Adventure is the life of commerce, but caution—I had almost said timidity—is the life of banking. Merchants use their own capital rather than other people's money."

"Banking is a profitable trade," he concluded, "because bankers are few and depositors myriad…No similar system arose elsewhere and in consequence London is full of money and all continental cities are empty as compared with it."

The 19th century sage warned against bailing out banks. "The cardinal maxim [of banking policy]," he wrote, "is that any aid to a present bad Bank is the surest mode of preventing the establishment of a future good Bank."

He commented on the anomaly of central banking: "A bank of issue, which need not pay its notes in cash, has a charmed

life; it can lend what it wishes, and issue what it likes, with no fear of harm to itself, and with no substantial check but its own inclination."

Bagehot had many ideas for a more ideal system. But he concluded: "A system of credit which has slowly grown up as years went on, which has suited itself to the course of business, which has forced itself on the habits of men, will not be altered because theorists disapprove of it, or because books are written against it."

His final observation remains hard to deny. "Dependence on the [central bank] is fixed in our national habits."

There is a difference, however. Bagehot was writing of Britain under Isaac Newton's gold standard and system of the world. The currencies central banks manage today have no anchor in gold and thus suffer from the same self-referential circularity that imperils all logical systems unmoored to outside foundations of reality. In the U.S., unmoored money can be manipulated at will by the Federal Reserve in the interests of its sponsors in government and their pseudo-private cronies.

These manipulations bring huge transfers of wealth. With government guaranteeing the large banks but not the small ones, the leviathans can expand their leverage and transform small and temporary arbitrage opportunities into outsized profits. Floating money thus changes the culture of capitalism. By unmooring money, the governments of the world ended up favoring finance over enterprise and shortening the horizons of the economy.

Collectively, these policies erode the incomes and opportunities of what are termed by class-conscious academics as the middle and lower income groups. Registering these effects is the rise in the living costs of the lower strata compared to those of the higher ones. Comprising the bulk of the costs of the poor and middle are necessities such as housing, food, healthcare, and fuel. As Charles Gave has calculated,[53] the period since the year 2000 has been marked by a sharp rise in food, rental, healthcare, and fuel prices compared to the broader CPI.

The gap between the CPI and Gave's "Walmart CPI" expresses the differential impact of monetary policy on the rich and on the poor and middle cohorts of earners. This difference represents a regressive tax on the relatively poor. Measuring the tax is the difference between the two indices of inflation. Deflated by the CPI, median family income dropped roughly five percent since the year 2000—as compared to roughly 17 percent when deflated by the Walmart CPI. Since the lower income groups command few assets—stocks and bonds—they have gained scant if any benefits from the new policy. Meanwhile, doing well has been a tiny minority at the top that feeds on volatility for outsized financial earnings largely guaranteed by government.

This process of immiseration of the middle and lower classes now threatens our entire economy. Economists have long noticed the accelerative impact of rising incomes that push ever-larger proportions of the population into higher income groups. Growth quickens disproportionately as the bulge of the population passes income thresholds where

large purchases such as new houses, college educations, or automobiles become feasible. Now the opposite danger looms, as family incomes drop below these trigger points, causing sharp cutbacks on discretionary purchases. Washington bureaucrats may enjoy using debt at near-zero rates to finance their ethanol and windmill subsidies, manipulative medical insurance splurges, agricultural bribes and early retirement bonanzas. They may think they can promote exports by depleting the dollar and blaming the Chinese. But the costs mount as the middle class faces a rising crunch and the lower income groups face ever-rising prices. The government responds by issuing more debt to pay for food stamps and housing subsidies and putting ever more citizens on disability payments. But the result is a depleted and demoralized American economy with an ever-shrinking share of the population engaged in the work force and 37 percent on food stamps.[54]

The source of the rising prices of the commodities bought by the lower income groups is the collapse of the value of unmoored money. For centuries, the price of fuel has closely tracked the price of gold. A prolonged surge in fuel prices began in 1971 with President Nixon's decision to end the gold convertibility of the dollar at $35 an ounce. With the dollar price of gold spiraling upward, the oil cartel demanded more dollars for its oil. The result was long queues at gasoline stations and the drastic inflation of the 1970s that ground down the standard of living of the poor and middle income groups.

Gold is the most monetary of elements because its cost is most closely tied to the time entailed in its extraction. All

of the approximately 170 thousand metric tons of gold that have accumulated through the centuries are still available today. Virtually all the world's gold reserves are known. This available supply dominates the price. At the margin, gold's value is determined by hours alone, not labor plus capital.

Despite technological advances and population growth, the stock of gold rises every year, never falls, and has averaged two and one half percent annual growth for centuries.[55] Thus, gold has been the only commodity whose future price is always equal to the spot price plus the rate of interest over the time period. A million paper dollars held since 1913, when the Federal Reserve Bank was created, would be worth $20 thousand today—down 98 percent. A million dollars of gold in 1913 would now be worth $62 million.[56] Aligned with irreversible time, gold is the monetary element that holds value rather than dissipates it.

Many food and housing prices are set by the cost of time and labor. If gold's value is constant, then all other prices can become variables around that constant. Just as the North Star provides a fixed reference for celestial navigation and astronomy, gold provides a fixed reference for the value of the galaxy of goods and services.[57] The break of the tie of the dollar to gold broke the link to time, devalued labor, and is at the root of the decline in the middle class in America.

When the tie to gold ended in 1971, as John Tamny observes in his trenchant new book, *Popular Economics*, the "malaise" decade was launched.[58] Oil and commodity prices spiked. The Chicago Mercantile Exchange started a financial futures market for commodities largely to enable hedging by

farmers whiplashed by gyrating prices. Hedge funds began their long boom. The yen went from 360 per dollar to 100 per dollar. The U.S automobile and air transport industries collapsed as the oil price soared. Governments pushed real estate as a haven from dollar depreciation, turning the U.S. economy from an industrial powerhouse into a financial and consumption casino.

With no global standard of value, currency trading, now at more than a quadrillion per year, became the world's largest and most otiose enterprise. It gobbled up the profits of seigniorage, while the public sought shelter in housing speculation and suffered a rise in inflation of key middle class costs—food, fuel, medical care, and education.

A 21st century monetary policy now means not only a new tie to gold but a new System of the World, marked by the power of information and velocity.

# PART SIX: VELOCITY = FREEDOM

During this era, the most sophisticated writing on money has come from the digital currency and cryptological researches that engendered Bitcoin. In order to develop Bitcoin, this movement first mastered and transformed the theory of gold. In the process, it cast new and penetrating light on the importance of velocity and time.

The leading philosopher of the movement is Nick Szabo, who named his first proposal for a digital currency "Bitgold." A shrewd analyst and historian of the evolution of money and long a suspect in the "who is Satoshi?" sweepstakes, Szabo threw a wrench into the Drexlerian nanotech movement in the 1990s, with its dream of building new molecules from scratch using nano-replicators. Szabo offered a prize to anyone who could create a *macro*-replicator out of Lego blocks or other toy-like potential replicators. If you can't build a macro-replicator, you probably cannot build one with nano-pincers and electron microscopes.[59] No one won. Since then, Szabo has been focusing on the easier enigmas of money and gold.

Several Internet surveys by textual analysts have

shown Szabo's prose above all others to conform to the idiosyncrasies of Satoshi's Bitcoin paper. In the early 1990s, he was known for canny ruminations on strategies for network anonymity and pseudonymity. Now, from time to time, he writes a pithy and original blog on money matters under the rubric *unenumerated*[60] but is otherwise scarcely or skittishly represented on the Internet.

According to Szabo, money succeeds not because it can capture all the dimensions of multifaceted value but because it obviates such impossible calculations. Although much free market thinking holds that money measures the value of goods, that assumption is simplistic. The value of goods can hugely exceed their prices. Much of the value in an economy comes from what is called by economists "consumer surplus"—the difference between what we actually pay and what we might have been willing to pay.

Money can never be an accurate gauge of the intrinsic worth of goods and services. It facilitates exchange. Any way of freeing an economy from pre-planned barter hugely benefits human welfare. "Measuring something that actually indicates value is hard…Measuring something that is related to value and immune to spoofing is hardest of all," writes Szabo. "To create anything of value requires some sacrifice…Since… absent a perfect exchange market of globally optimized barter, [we can't] directly measure the value of something, we may be able to estimate it indirectly by measuring something else."

That something, Szabo saw, was *time*. "Time measures *input* rather than *output*… sacrifice, rather than results."

Szabo understood that the recognition of money as time freed the slaves. The invention of reliable and recognizable timepieces—clocks and bell towers—liberated workers from the bondage of piece-work. Piece-work entails regimentation to count the pieces and favors quantity over quality, slavery over free labor.

Time as money is a crucial insight behind the value of gold and the creation of Bitcoin as a form of digital gold. But the theory is incomplete without an understanding of velocity. According to Szabo, velocity is the critical element differentiating money from commodities. Over the course of human history, various commodities evolved from mere consumables into collectibles and thence into wearable décor and jewelry. On occasion, in a phase change, some of them became "wampum" and clamware, shells and exchange. Thus we "shell out clams" to buy stuff. As Szabo explains, that change into money occurred when the value of a thing as a transactions medium eclipsed its value as a collectible, when it increases "the ratio of velocity to current value."

He points to the history of New Amsterdam (New York), where a 17th-century Dutch entrepreneur had his bank arrange a large debt in wampum. The Indian baubles had crossed the velocity barrier to become a vessel for indirect transactions—real money.

Many people believe that money must begin as a commodity—like wampum or gold—and then evolve into a transactions medium. But once wampum became money, Szabo argues, its role as jewelry was eclipsed. It became as irrelevant as gold jewelry is irrelevant to gold money. Money

is not something else. It is not a commodity. It is intrinsically a unitary measure of value.

Many critics thought Satoshi had ruined the system by refusing to guarantee results. They wanted the computational puzzles to accomplish goals that they deemed desirable, such as calculating complex protein folds for cancer therapy, or SETI for the discovery of other intelligent beings in space, or fathoming intricate feedback loops in the models of global warming. But a currency generates value by its uses as purchasing media, measuring stick, and store of value. These uses of time cannot be measured by money if they are ingrained in the production of money. Gold is money not because it is shiny and beautiful but because it has the properties of a transactions medium that enabled it to achieve take-off speed as money. As Richard Vigilante of Whitebox Advisors observes with Chestertonian aplomb, "Money is not valuable because it is really jewelry; jewelry is valuable because it is really money." [61]

Money is a matter of velocity—the turnover rate of the transactional media. It has to be sufficiently more valuable for its transactional role than for its other uses, or it never can become money. It functions in the frequency domain and can be measured there with its velocity and amplitude. The power of monetary investments rises by the square of the amplitude of the learning curve they launch.

The basic point affirmed by Szabo is the same point I contested with Friedman in China. In economics, velocity rules. In moral terms, velocity equals our freedom. We rule, as we learn.

# PART SEVEN: WHERE 'HAYEKS' GO WRONG

From Italy's financial community arises a different critique of prevailing monies, one that applies not only to fiat currencies like the dollar and the Euro, but also to gold and its digital imitators. Let us take this critique seriously and see what we learn about it using our new information theory of money.

Ferdinando Ametrano has seen currencies come and go. He can look the dollar in the face and detect botox in its apparently smooth Ben Franklin jowls. A self-described "fat, short, bald and ugly" nerd in his forties, with red glass frames and fashionable bristles, Ametrano began as a physicist. Like so many "quants," he is a master of the interplay of math and matter. In 2010, he invented the open source QuantLib framework for monetary math. As he describes it, "QuantLib is a free, open-source quantitative finance C++ library for modeling, pricing, trading, and risk management in real-life."[62] Derivatives traders use it around the world to guide their decisions.

Sounding like Steve Forbes, Ametrano stresses, "When the value of money changes…it is not just the value of one good that is changing, but the unit against which every other good is measured." He warned, "If high inflation is money's heart attack, persistent deflation is money's cancer." [63] Both gold and Bitcoin, he declared, show a fatal deflationary bias.

"In the last twenty years," he pointed out, "it has become more and more clear that the banking system built around fiat currencies is not adequate to the new digital realm defined by mobile communication, Internet, and social networks…As everybody gets used to carrying around in their mobile phones powerful computers, hours of video and audio entertainment, and immediate access to an immense amount of information, the expectation has arisen to be able to pocket a whole efficient and fair monetary, financial, and banking system along with it." [64]

Yet, as he describes it, gold and digital gold cannot play this role because of their deflationary bias.

To back up his critique, Ametrano summons Friedrich Hayek. The eminent Austrian offered similar objections to a proposal for private money backed by gold: "It would turn out to be a very good investment, for the reason that because of the increased demand for gold the value of gold would go up; but that very fact would make it very unsuitable as money." [65]

Ametrano adds: "The unfeasibility of a bitcoin [or gold] loan is similar to that of a bitcoin or [gold] salary: neither a borrower nor an employer would want to face the risk of

seeing her debt or salary liabilities growing a hundredfold in a few years." [66]

He concludes: "This is the cryptocurrency paradox: In the successful attempt to get rid of any centralized monetary authority using the Bitcoin protocol, the bitcoin currency has inadvertently thrown away the flexibility of an elastic monetary policy."

In a presentation to the Bank of Italy, Ametrano rejected the idea that Bitcoin will lose its instability with wider adoption: "This is indeed true, but not at all sufficient for stable prices, as demonstrated by the need of monetary actions to stabilize even globally accepted currencies such as the Euro and US dollar." [67]

One can imagine the eminent men of Banco Italia nodding solemnly at this observation. But Ametrano is a devout Hayekian and does not like arbitrary policy from central banks any more than he likes arbitrary deflation from a distributed peer-to-peer currency.

As an alternative, Ametrano presents the idea of a new kind of coin that he dubs Hayek Money. Let's call them "hayeks." These coins overcome the putative volatility of gold or Bitcoin as units of account by continually rebasing the value in response to changes in a commodity index. He would have all the wallets in the digital coin system regularly increment or decrement the number of units in accord with the movement of the index. If you had 50 hayeks when the index was at 100, you would have 100 hayeks when it went to 200.

In response to objections that these quantitative changes in individual wallets are alarmingly novel and unorthodox, the Italian guru points out that central banks now do the same thing. They routinely manipulate their own digital wallet—the "monetary base"—expanding it during deflation and reducing it during inflation. As Ametrano observes, these actions of the central bank affect all the holders of the currency, depleting the accounts of debtors during contractions or of creditors during inflations.

As the Austrian school of economics explains, these actions also impart immediate benefits to the banking institutions that carry them out, affording them profits from what is called "seigniorage": the gains from issuing money. These gains stem from the difference between the coin's cost of production and its value. The central banks and government treasuries win most of these gains. But these quantitative changes also lavishly benefit any early borrowers or lenders of the government money who can act before related price changes propagate through the economy.

Central banks currently change the money supply through a Rube Goldberg contrivance of open market operations buying and selling treasury notes, "quantitative easing" through purchase of private bonds and other assets, adaptive "twists" of yield curves and maturities, reserve requirements regulating bank leverage, and interest rate manipulations that change the cost of money.

These measures deny most of the users of the money any *pro-rata* increase in their quantities during inflations and inflict borrowers with the full brunt of contractionary policy

(they have to pay back their loans with more valuable units than they received). In the late 1990s, an unexpected 26 percent deflation (increase in the dollar's value) bankrupted a thousand companies that had incurred large debts in the multifaceted process of building out the Internet with advanced fiber optics.[68]

By contrast, Hayek money would automatically expand or shrink the money supply in an entirely equitable and proportionate way, distributing these changes across the entire range of coin holders, with no preference for cronies, affiliated banks, or other special interests.

Hayek money is the proposal of a libertarian. Hayek is the cynosure of libertarians, and he wishes currency to become market based. Escaping the distortions of monopoly and sovereignty, management of hayeks could rely on an automatic formula. If it didn't work well, other entities would launch competitive currencies. Hayeks might return the world to the Edenic realm of "free banking" during the 19th century. Free banking might have failed as the country was unified by railroads and telegraphs, but today it may well become possible again on the Internet.

Hayek money is the proposal of a banker who believes in the power of monetary policy. And Ametrano's system would be based on the analysis of an economist who believes in the validity of price indices.

The issuance of new coins would be governed by the change in the prices of a basket of commodities. It could comprise precious metals such as gold and silver, standard foodstuffs

such as wheat and soy, and energy units such as "Brent crude oil" and natural gas. All these items benefit from their relatively immutable unit definitions. Whether troy ounces of gold or British Thermal Units of energy or standard bushels of wheat, these items—so it is maintained—have not changed in character or essential quality for a century.

As an economist with a specialty in quantification, "a quant," Ametrano also believes that the appropriate index could be modulated by inclusion of other relatively scientific price level indices such as the general inflation corrective, the Federal Reserve's GDP deflator. Also available are the Personal Consumption Expenditures (PCE) inflation indicator of the Department of Commerce, or the Consumer and Producer Price Indices (CPI and PPI) tracked by the Department of Labor. As the Fed explains, the most common type of inflation measure "excludes items that tend to go up and down in price dramatically or often, like food and energy items." For these, "a large price change in one period does not necessarily tend to be followed by another large change in the same direction in the following period…. Core inflation measures that leave out items with volatile prices can be useful in assessing inflation trends." [69]

Ametrano's excellent paper incorporates, with stark lucidity, the fundamental weaknesses of the prevailing theories of money. They are all trying to find some stable proxy in the real world to "peg" to. "Two families of Hayek monies" might peg to different commodities, writes Ametrano: "gold, as the immemorial monetary element," and "petroleums, grains and industrial metals." But we already know of Ametrano's and Hayek's ambivalence about gold, and "petroleums, grains and

industrial metals" show more volatility. After all, grains and petroleums are precisely the items that tend to be excluded from "core inflation."

Thus hayeks would move the focus of monetary policy from quantitative changes to changes in the composition of the commodity index. That is already happening in the world of the dollar, with "hedonic" adjustments and other technical adaptations of the CPI. It takes armies of accountant-economists, in several branches of the U.S. government and similar entities at the OECD, UN, World Bank and other institutions, to track all the price movements in the market. Pursuing the calculation of "purchasing power parity," they try to gauge which changes signify the "real" level of prices. MIT includes literally millions of prices around the world in its comprehensive index called "Beta." Giving up on all these perplexities, the *Economist* sometimes throws up its hands and resolves on a global "Big Mac" index. Others prefer a "Brooks Brothers Index" tying the price of a business suit to an ounce of gold. [70]

Under the "Hayek" regime, the management of the basket on which all valuations and arbitrage will rely becomes all-important. The central question in political economy would then become the procedure and timing of basket management. We already know that Ametrano (and putatively Hayek) have impugned gold in this role because of its deflationary bias. Ametrano proposes a commodity price index determined with a "resilient consensus process that does not rely on central third party authorities." He seems to prefer an index heavily influenced by the prices of grains and Brent crude oil and makes an effort to show that such an

index would result in relatively stable prices.

Ametrano quotes Hayek: "Changes in the importance of the commodities, the volume in which they were traded, and the relative stability or sensitivity of their prices (especially the degree to which they were determined competitively or not) might suggest alterations to make the currency more popular."[71] An extreme example, says Ametrano, "would be a major breakthrough in green energy that would make petroleum useless." So much for Brent crude.

What Ametrano sees as an exotic possible breakthrough in energy technology, however, is in fact the condition of the entire entrepreneurial economy. All existing goods and services are vulnerable to innovation. Innovation, as Schumpeter insisted, is the very law of capitalism. To treat it as some kind of exceptional or anomalous event is a fundamental error.

The information theory of capitalism defines growth as *learning*. Its microeconomic manifestation is the learning or experience curve in individual businesses and industries. Perhaps the most thoroughly documented phenomenon in all enterprise, learning curves ordain that the cost of producing any good or service drops by between 20 percent and 30 percent with every doubling of total units sold. The Boston consultancies, the Boston Consulting Group and Bain and Company, charted learning curves spanning the entire capitalist economy, affecting everything from pins to cookies, insurance policies to phone calls, transistors to lines of code, pork bellies to chicken broilers, steel ingots to airplanes.[72]

Growing apace with output and sales is entrepreneurial learning, yielding new knowledge across companies and industries, bringing improvements in every facet of production, every manufacturing process, every detail of design, marketing and management. Crucially, the curve extends to customers, who learn how to use the product and multiply applications as it drops in price. The proliferation of hundreds of thousands of applications for Apple's iPhones, for example, represented the learning curve of the users as much as the learning curve at Apple.

The most famous such curve is Moore's Law, which translates into a doubling of computer cost effectiveness every 24 months. It has been recycled by the solar industry in the form of "Swanson's Law," showing the decline of the cost of silicon photovoltaic cells from $76 per watt in 1977 to fifty cents per watt in 2014. Inventor futurist Ray Kurzweil has put all these curves together in an exhaustive catalog that reaches a climax later in this century as a so-called "singularity," when the capabilities of computers by many measures will surpass the power of human brains.[73]

All these curves are simply other manifestations of the learning or experience curve, which documents the essential identity of growth and learning as a central rule of capitalism. This process has marked the history of human beings since the Stone Age. Yet it is only rarely addressed by economists. In a famous paper in 1992, William Nordhaus of Yale showed that economists failed to measure the most dramatic new abundance of the 18th through 20th centuries—a one hundred thousand-fold drop in the cost of light, gauged in labor hours expended per lumen-hour.[74] Nordhaus extended

the curve from cave fires and candles to electricity and the power grid. It is now manifested in light emitting diodes that extend the power of light into ever more vivid and ubiquitous programmable display technologies of all kinds.

Sound management of money cannot focus on finding stable elements among existing goods and services that are endlessly multifarious and changing. These very changes are what money must measure. The only feasible goal of policy is to foster neutrality between the past and the future. This entails equity not between industries or localities but chronological equity: equity not in space but in time.

What Ametrano is advocating, with all the confidence of his expertise, is submission of monetary policy to the interests of the most static and stagnant interests in the economy—the very parts that have passed beyond their learning curves onto a plateau of drifting costs defended by expanded political lobbies. This is what "commodities" are. It is rear view mirror monetary policy reflecting the need of recumbent sectors for protection against more creative domestic and foreign rivals.

By seeking to impart a bias of inflation to prices, the commodity basket tends to a zero-sum vision that fosters trade wars of devaluation. The basket of commodities is the one part of the economy that operates as a zero-sum-game. As it erodes through the advance of innovation, its prices tend to drift upwards, skewing the time value of money.

The redemptive force of gold is its neutrality in time and thus its orientation toward the future. Hayeks would substitute an anachronistic commodity basket for a predictable deflation

based on the scarcity of time and abundance of learning.

Commodities are by definition low entropy, but if all valuation and arbitrage is based on them, politics will converge on the basket and its composition. What is the composition of a representative basket of goods? It is the backward looking selection of products that were important in the existing economic configuration. It is a representation of the economy of the past, consisting of mature products and ingredients. These are goods that have already attained volumes that put them beyond the fast moving parts of their learning curves. As the key element in a monetary index, commodities impart an inflationary bias to economies, penalizing the future, rewarding borrowers, and punishing investors.

The genius of gold is not to root valuation in some politicized process of sampling the past, but to root it in the residual scarcities in a capitalist economy of abundance. The deflationary bias reflects the reality of a capitalist economy of abundance and creativity playing out against the irreversible passage of time.

To the Austrian economics of subjectivity, time provides an objective foundation. In reaching for commodities in which to anchor his system of value, Ametrano should have ended with gold, with its intimate links with the irreversibility of time. In the end, a test of Bitcoin or any other block chain will be the price of gold. If, in a mature Bitcoin system, the gold chain massively bifurcates from the block chain, it will signify a disorientation of values. As in Bitcoin itself, the majority of users will decide which branch bears economic

truth.[75]

Since its creation in 2009, Bitcoins' price movements have been 80.4 percent correlated with the gold price.[76] Bitcoin's relatively tiny float has imparted much greater volatility. But its following gold down in 2014 should not have been alarming. If and when Bitcoin matures into a meaningful currency, its kinship with gold, rooted in *time*, should become increasingly manifest.

# CONCLUSION: A WRINKLE IN TIME

Time is the coin of your life. It is the only coin you have,
and only you can determine how it will be spent.
Be careful lest you let other people spend it for you.

—Carl Sandburg

Money as time may be a lumpy lemma to swallow. Surely money is many other things, from purchasing media to standard of value to store of worth. Money is involved in irreversible contracts and transactions, bonds and bids, and it transmits signals of conditions far beyond its locality. A friend once asserted to me that everything in the social sciences is either wrong, or self-evident. Is money as time an example of both?

Time may seem no more implicated in most of the facets of money than air or water is. Is money as time merely a figure of speech or glib epigram?

I don't think so, because I don't think money is merely a functional tool. Like Ayn Rand, who wanted a dollar sign embossed on her coffin, I believe money possesses transcendent significance. Because we use it to prioritize most of our activities, register and endow our accomplishments of learning and invention, and organize the life-sustaining work of our society, money engages at a deeper level than a mere payments system. It expresses a system of the world. That is why I link it to Kurt Gödel, Alan Turing, and Claude Shannon's Information Theory.

All of these thinkers attempted to define their philosophies in utilitarian and determinist mathematics. Addressing pure logic as math, Gödel concluded that even arithmetic cannot constitute a complete and coherent system. All logical schemes have to move beyond self-referential circularity and invoke axioms outside themselves.

Turing explored the possibility of a complete and self-sufficient logical machine and found it an impossible dream. His "Turing Machine" defined the abstract logical architecture of all computers. But all computers must depend on what Turing called human "oracles" to define their symbols, instructions, and programs and to interpret their output, which as a stream of off-and-on currents or charges is ostensibly meaningless.[77] Shannon set out to create a purely mathematical definition of information and ended up providing a logical scheme of communication that is grounded in human subjectivity and creativity at every point.

As a complex expression of logic and information, money represents an obvious frontier for Information Theory. As a

logical scheme, it must be founded on an axiomatic domain beyond itself. It cannot endure as a trivial tautology—where its value stems from what it buys and is valued by it. That route always ends in a crash or inflationary binge, demanding the crisis management tools of government institutions.

As a paramount expression of our computational and networked economy, money is an information system. Shannon's value neutral definition of information as entropy or surprise liberated thousands of engineers to create computer and network systems—the cybernet fabric of our civilization. They did not concern themselves with the value, factuality, truth, consistency, or importance of the communication they enabled.

Today, however, the Internet is suffering the effects of these necessary limitations of engineering science. The net has to resort to trusted third parties outside it to sustain its transactions. The resulting extra costs bar micropayments. Internet offerings thus gyrate between free hustles and egregious gouges. The net also exhibits an inability to prioritize its activities, certify its claims, value its services, administer its ubiquitous "contracts," or notarize titles. The Internet offers crowning testimony both of Shannon's genius and the Gödelian incompleteness of his work.

Now, for the first time since the inception of our information society, we are moving toward what might be termed a new system of the world. At its heart is the development of a new monetary firmament based on strata of reality deeper than the minutes of the latest meeting of the eminent governors of the Federal Reserve Board. Bankers, politicians,

academics, and bureaucrats alike must stop treating money a manipulable tool of policy.

Essential to any system of the world, money extends its sway over monarchs and presidents, parliaments and prime ministers, generals and imams, despots and democrats. All must bow to a system of laws and constraints that subordinate power to knowledge.

As Ludwig von Mises wrote, economics "did more to transform human thinking than any other scientific theory before or since," because "with good men and strong governments everything was considered feasible…[But with the advent of economic science] now it was learned that in the social realm too there is something operative which power and force are unable to alter and to which they must adjust themselves if they hope to achieve success, in precisely the same way as they must take into account the laws of nature."[78] Among the ascendant laws of nature in the new system of the world are the findings of information theory.

These laws intersect with physical and chemical laws and must be compatible with them. But economic laws cannot be reduced to their physical and material manifestations alone. The laws of money operate on a more exalted level. They stand higher in the hierarchies of knowledge and learning than the rules of physical factors and forces.[79] Money transcends determinism and enables creativity and freedom.

Austrian economists such as von Mises have long held that all value is subjective. Their logic remains firm. As Gödel discovered and Shannon implied, even a measure

of information depends on outside judgment and interpretation. This subjectivity of value, however, functions in a matrix of objective time. Time is the one economic factor that is irrefutably objective and thus lends objective substance to the subjectively driven movements of money.

Bounding every human activity is the inexorable influence of time. The winged chariot, the grim reaper, the forced march, the Heraclitean stream—all are common tropes in literature as in life. But money is about time in a more direct and far-reaching, integral, metrical, analytical, and dispositive way than any other human instrument, including even the clock.

The tie between money and time is most obvious in the case of loans and savings governed by the "time value of money," reflected by interest rates. These central capitalist functions still arouse anger and confusion. French moralist Thomas Piketty sums them up as the exactions of "capital" and the bounties of the "rentier."[80] Dismissing the linkage of time and money as optional and even reprehensible, Piketty follows in the footsteps of philosophers and kings, priests and scholars who for millennia have ruminated restively on the morality and legitimacy of interest payments.

For centuries both the Catholic and the Moslem faiths condemned the extraction of interest as "usury." Moral human beings were not supposed to be realistic about the time domain of life. The future, present, and past converged in heaven, in a moral universe occupied by high-minded thinkers. Aristocrats everywhere learned to deprecate practical men wielding ledgers and calendars, clocks and actuarial tables. Hitler's case against the Jews fed on the

idea that the yield of finance was somehow meretricious or extortionate, unnatural or treacherous.[81] Epitomizing lenders and savers in literature were Shylock and Scrooge. A lender was supposed to deny that all that mattered in the transaction was the date of the loan and when he could retrieve the money and loan it out again. Recognizing that money translates to time would make interest payments as obviously legitimate as they are.

The inverse of interest on the bank's loans is interest on savings or deposits, which are loans by customers to a bank or other firm. By the exponents of ZIRP (zero interest rate policy) and by Piketty and many other passionate touts of inflation to revive economies, these returns are also deemed optional or arbitrary.

Their arguments focus on the "maldistribution" of wealth or the unfairness of debt burdens, particularly when borne by democratic governments. By manipulating money as an instrument of policy, controlling the interest rates that they pay on their own debts, and fostering devaluation of their currencies, governments—and the economists who counsel them—are engaged in a futile and economically destructive war against time.

In physics, the source of the arrow of time is entropy: the second law of thermodynamics which ordains that the physical processes of the universe convert energy from usable forms to unusable forms, from potential energy at the top of the falls into kinetic energy flowing over the Hoover dam, into less available energy down the river to the sea.

Sadi Carnot defined entropy in the context of the invention of steam engines.[82] He calculated the flow of heat from hot elements to cooler ones and the impossibility of reversing the process without supplying new energy from outside. Journalists routinely cite their breakfast eggs or the creamer diffusing through their coffee as examples of the irreversibility of entropic processes. Economists and ecologists cite entropy as the reason for the alleged exhaustion of natural resources or the inability of the planet to sustain continued growth of human populations.

Ludwig Boltzmann was the first to link entropic processes to disorder and thus to information. Claude Shannon was the first to link disorder to informative surprise and thus to creativity. Hubert Yockey showed that even in biology it is intrinsically impossible to distinguish a set of random data from the data points of a series of creative surprises.[83] Physics today breaks down into a school regarding the Universe as randomness ordered only by an infinite multiverse and a school upholding a single universe ordered by creation and creativity.[84]

As shown by Information Theory, an entrepreneur launching an invention or new technology that unexpectedly changes our lives, or a scholar demonstrating a new theory with a falsifiable proof, or a scientist identifying a new source of energy in defiance of expectations all exhibit entropy just as surely and irreversibly as a glacier calving into the Arctic Ocean or an aged building shedding paint and shingles. Information entropy like thermodynamic entropy conveys disorder, not order. Order and determinism represent the fulfillment of expectations; they are low entropy, while

disorder and freedom are high entropy.

Information Theory does not espouse chaos or anarchy. Shannon demonstrated that it takes a low entropy carrier—a predictable channel with no surprises—to bear high entropy messages full of surprising content. Because a random stream of bits is indistinguishable from a burst of unexpected and surprising creativity, Shannon showed, you do not want an entropic or surprising carrier or a noisy channel. The reason much of the world's information is migrating toward the electromagnetic spectrum is its low entropy predictability guaranteed by the speed of light, the inexorable rule of time. Predictable electromagnetic carriers enable the receiver of messages to differentiate them from the carrier at the other end of the line.

The economics of information theory link money with time, the most fundamental and irreversible carrier in the universe. Money is not the content of transactions; it is the carrier. The use of money, however, enables the transmission of high entropy information. The worldwide webs of glass and light and air that comprise the low entropy channels of the Internet bear no more important or high entropy "news" than the worldwide web of price signals.

Ernst Mach's "principle" in physics holds that shaping the conditions at any point on earth are unfathomable forces across the entire universe summed at any particular point.[85] Mach's principle also applies to market economics on earth, and extorts its claims even in non-market economies. Every price is the expression of a worldwide fabric of other prices, conveyed by money, rooted in time. If the roots are torn up

by governments, pulling up the carrots to check if they are ripe, the price system will bring false messages and stifle the processes of learning and discovery that comprise all economic growth and progress.

Science has long understood the critical role of universal units of measurement in economics and industry. Builders of bridges and skyscrapers and electronic systems source components from companies around the globe. In order for these components to work with other components, their users must trust in immutable systems of measurement.

Under the Systeme Internationale of Units and Measures, the SI units comprise seven key metrics. Each is solemnly rooted and enshrined in basic constants of physics. These metrics are the second of time, the meter of extent, the kilogram of weight, degrees Kelvin of absolute temperature, the ampere of electrical current, the mole of molecular mass, the candela of luminosity. On these immutable foundations of mutual immutability are erected most of the machinery of global trade and commerce.

These units of measurement cannot float because they provide the metrics that enable construction projects, computer designs, food processing gear, networks, refrigerators, fuels, pipelines, research laboratories, microchip capital equipment, industrial sensors, lighting systems, medical instruments, fiber optic cables, railroad tracks, storage facilities, hospital equipment, and other complex systems, in industry and government alike, to interconnect and function to keep us alive.

As Richard Vigilante puts it: "When baking a cake, we don't measure the flour against the sugar or the orange against the vanilla. We don't say we need two butters of bacon or three apples of orange. No, we use measuring cups and spoons from outside. We use measuring cups precisely because no one thinks the best use of a measuring cup is to bake it into the cake." [86]

Throughout most of human history, statesmen and philosophers alike have understood that money is a similar metric. Just as a complex dessert requires a stable set of measures or the schematic for a computer chip entails that every critical dimension be accurate to the nanometer or even picometer, so the recipe or plan for a business project depends on the accuracy of all the prices charged for components and services.

Similarly in the global economy, the currencies cannot be integrated with the commerce; they must have their roots in an absolute grid of measurement outside the process of exchange. If prices are uncoordinated, they will lead the business astray, and it will not add value to the economy. It will not produce knowledge through testable learning.

The SI metrics powerfully corroborate the idea that fundamental to all immutable and irreversible standards of measurement is *time*. All but one of the seven key units directly resort to measurements constrained and defined, fixed and framed by physical constants governed by the passage of time. Thus the most fundamental of all the SI metrics is the *second*, which is inexorably determined by the speed of light in a vacuum. The rest of the measurements

all essentially derive from this basic time-constant of the universe.

The *meter*, for example, might seem to be a measure of space, but the SI roots it in the distance travelled by light in a vacuum during a tiny fraction of a second. As a measure of absolute temperature, *Kelvin* degrees are a reflection of frequencies bounded by the passage of seconds. The *kilogram* of weight is referenced to Planck's quantum constant—"h"—a universal unit used to convert quantum wave functions into Joules per second and hence to the speed of light. *Amperes* of electrical current are governed by electromagnetism rooted in frequencies per second. *Candelas* of luminosity are also Hertzian phenomena ruled by cycles per second.

The only exception in the SI table proves the rule. *Moles* of molecular mass escape a direct reference to time by being calculated by Avogadro's number. But masses—and energies—as Einstein taught us, are also finally expressions of the speed of light in the lordly latency of seconds.

Money as the key metric and information bearer in economics also can be reliable only to the extent that its value is rooted in time. As the only irreversible element in the universe, with directionality imparted by thermodynamic entropy, time is the purest of reference points for all values.

Contemplating a new system of the world begetting new forms of money, governments and central banks are now engaged in a feverish effort to prove the effectiveness of their manipulations, their inflations and devaluations, their asset buying splurges and their redistributive potlatches.

These efforts to resist and divert the irreversible flows of time and entropy are sure to fail. Governments and central banks do not even control their own monies. Quantitative tides of purchasing media are feckless before the choices of citizens who decide when to spend or invest any funds they command. Velocity and frequency trump the spurious time-manipulations of the Keynesian regime.

As the venerable monetary element, rooted in time and in the refractory geology of the planet, gold is gaining new supporters every year. Asian and Middle Eastern potentates are ignoring the constant detractions of gold as money and are increasing their holdings. Plans for new forms of the gold standard are proliferating. But the triumph of gold does not depend on governments. Collected by savvy savers everywhere, its price movements command the avid attention of millions of investors and traders. As a measure of value, it still far excels Bitcoin and other new currency projects.

The advances of gold and the Bitcoin derivatives have evoked fervent dissent. Critics tend to drill in on the key strength of both these currencies—their limited quantity and their irreversibility in time. The quantity of gold increases only slowly. But as Nathan Lewis and many others have shown, a gold-based currency can thrive in the absence of any gold holdings at all.[87]

Gold is a critical source of information for all the new coin, currency, and payment schemes proliferating among the new social networks in Silicon Valley and China. In sorting out currencies, gold will transmit a valuable signal. It remains the

monetary Polaris, adapted to a world of inexorably declining prices anchored in the abundances of goods and the scarcity of time. Countries that tie their money to gold will always tend to outperform those who submit it to the currency bazaar.

Bitcoin began with an algorithmic commitment to not exceed its target of 21 million coins. With a planned granularity of up to eight decimal places, enabling some ten to the 14th or 100 trillion units, there is no danger of the 21 million cap suppressing economic activity. Controlling Bitcoin, like gold and all other currencies, will be its users, in the frequency domain, locked into a specific algorithm of time.

The likely path of Bitcoin's advance begins on the Internet and only later moves to the domains of government currencies. As it gains momentum, its price will converge with the price of gold, and Bitcoin will become bitgold. It will establish the gold standard on the Internet as gold extends its monetary sway through the world economy. This movement increases the likelihood that currencies of liberty and creativity—low entropy carriers for a future of learning and opportunity—will survive and thrive.

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