

The Spontaneous Order of Markets and Money

Oluwasegun Bewaji^a

^aCognitive Macroeconomics

07 October, 2021

Abstract

This paper presents a philosophical understanding of the political-economy of markets and money as social contracts consisting of networks of contracts between individuals where the emergent technology that functions as money is defined by this network of contracts. At the core of this emergent nature of money are the basic legal concepts of contract law. By breaking markets and money down to their underlying contract law foundations, the paper illustrates fundamental implications for what constitutes value and the way we view money. Indeed, as networks of contracts, markets generate prices as emergent phenomena of negotiation rather than mechanistic mappings of input prices to output prices. As such market prices are quantum in the sense that the price of any product is ultimately unknown until a contract is negotiated explicitly or implicitly through custom. In markets, what matters is one's ability to negotiate value and what transpires as "money" arises from the contractual reach one has across these markets. To this end, money is any technology used to transmit information about the value associated with contractual obligations and must necessarily exist in a duality of abstract mathematical concepts and physical assets whose own value in contractual use is tethered to the credibility of the issuer to adhere to its contractual obligations. This duality in the nature of money, it is argued, raises questions on the stability or volatility perceived in the various forms of money from traditional fiat currencies to emerging digital currencies that may impact the strategic positioning of central banks, regulators, commercial financial institutions and payment systems operators.

1. Introduction

The field of economics in the realms of policymakers and mainstream academia is often considered as a “science” laden with an allure of clean mathematical forms, alphas, betas, gammas and other Greeks that the rational agent seeks to bring under submission. Nevertheless, this view of economics appears to ignore the origins of these equations. Economics has lost itself, and one important area that has been ignored is the understanding of money itself. Most of the models used by economists and policymakers do not take money explicitly into account; and as former Governor of the Bank of England Mervyn King noted [“most economists hold conversations in which the word money hardly appears at all”](#).

In what follows, I will describe what, in my opinion, may be a fundamental failing of mainstream economic thinking. That is, I will argue that mainstream economic thinking may be missing the mark because it seemingly ignores the nature of markets as a self organising and emergent networks of contracts. I will suggest that “money” is a tangible mechanism, asset, or technology we use to transmit information about “price” or “value” as a consideration in contracts in the legal sense. I use the legal construct because, at their core, all economic activity from retail store purchases to overnight loans and repurchase agreements (repos and reverse repos) entail the execution of a legally binding contract. Money is therefore any network-based asset or technology that acts as a ledger for all contracts and exchanges of consideration executed on a specific network up until the present contract that utilises that asset. Moreover, as consideration for contracts in the legal sense where both parties to a contract must exchange value, money is an instrument transmitting the value associated with the obligations of each contractual party as it relates to the contract. This is a slight rephrasing of the sentiment found in the 1996 Federal Reserve Bank of Minneapolis discussion paper by Narayana Kocherlakota titled [“Money is Memory”](#). However, while Kocherlakota sought to uncover the aspects of technology being

enhanced by the presence of money and thereby illustrate that money is nothing but a primitive technology mimicking memory, I attempt to extend his thinking by attempting to unpack the epistemology of this memory. This is therefore more of a philosophical unpacking of money rather than an economic analysis of money.

I further expand on Kocherlakota's thoughts by challenging the notion that money as memory has no intrinsic value of its own. That is, I will attempt to argue that, as a technology used for the transfer of information (i.e. the collective memory) about contracts, the value of money itself is not bound to the numbering system we use to account for "value" in those contracts. Rather, money is, itself, subject to the same natural laws as the things whose "value" we use it to measure. This view of money has significant implications for the very notion of fiat currencies as money, asset deposits held in e-wallets, and the emergence of cryptocurrencies and other digital currencies including Central Bank Digital Currency (CBDC)¹. This view of money also results in longer-term strategic opportunities for the payment systems operator role that is tethered to conventional wisdom and traditional modes of money. Note that this discussion is in no way a judgement call on the value proposition of any technology that serves as money, but rather a discussion of what money is itself and why each technology may ultimately have its own merits and value.

2. Philosophical Underpinnings: "the original economists were first and foremost philosophers"

Now, you might be wondering what exactly I mean when I say economics has lost itself? You may have also picked up a paper written by an economist and asked, what is economics, if not convoluted equations only a special class of individual understands? What if I told you the

¹ I make the clear distinction here between cryptocurrencies such as Bitcoin, Ripple, ZCash, LBC, etc and central bank digital currency, because CBDC in a centralised issuance model does not require the cryptographic settlement of transactions and is for all intents and purposes no different from fiat currency.

original economists were first and foremost philosophers? Eighteenth to mid-nineteenth century economists such as Adam Smith, Jean-Baptiste Say, David Ricardo, Thomas Robert Malthus, John Stuart Mill, Henry George, and David Hume, were all equally adept at speaking to the human condition and social contracts as they were to writing entire volumes of treatises on the price of an onion. To these luminaries, economics was not a dogma of utility optimization, but rather theories of largely self-regulating systems, governed by natural laws of production and exchange. Markets were social contracts whose existence were (rightly or wrongly) formalised according to philosophical thought. Mark Blyth in his book “Austerity: The History of a Bad Idea”, reduced the very notion of national debt to a “neurosis, exemplified in David Ricardo and [John Stuart] Mill’s contrasting positions on the naturalism of poverty and inequality, and the proper role of the state in using debt to manage the economy or in disciplining the poor.” In other words, both Ricardo and Mill were looking to explain the role a government should play in addressing inequalities that exist or emerge within markets by first understanding the natural laws through which those inequalities emerge in the first place.

2.1. “Early economists understood the distinction between the natural and the market”

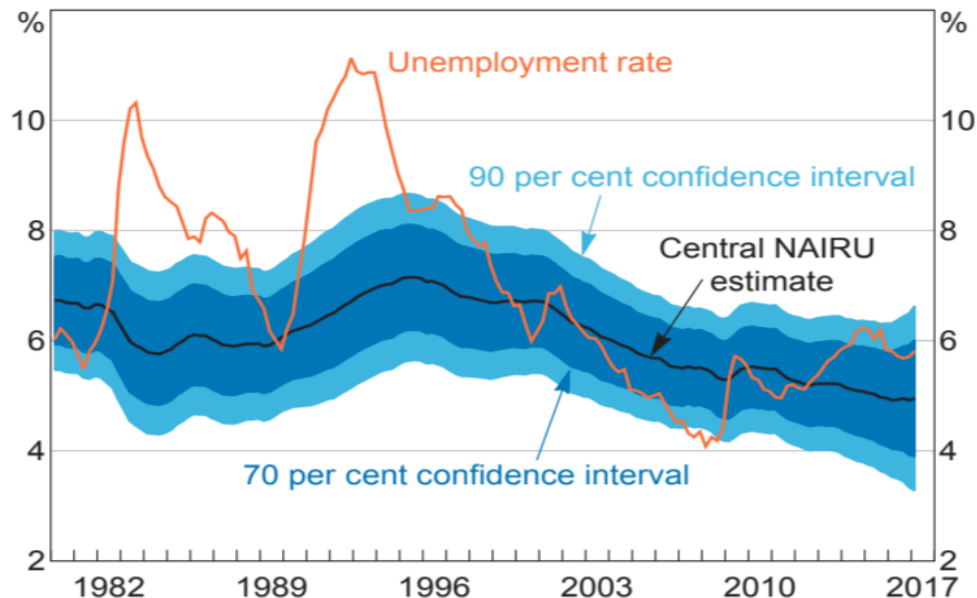
However, what are these “natural laws”? Indeed, while the founding economists jostled amongst themselves on a theory of value and the role of the state, the notion of the natural was always ingrained in their thoughts. For example, William Petty coined the distinction between “market prices” and “natural prices” as a means for thought clarification. This decomposition of the “price” was not merely a scientific exercise to be resolved with a preponderance of mechanistic equations grounded on efficient markets and rational actors, as the mainstream has treated it. Rather Petty’s two prices represent a much deeper question of the epistemology (i.e. epistemic relativism vs epistemic absolutism) of prices. That is to say, by decoupling “price” or “value” into the “market” (epistemic relativism) and the “natural” (epistemic absolute), Petty was raising a question of philosophy, not mere optimization. Adam Smith in “*Of the Natural and Market Price*

of Commodities" defined the natural price as the ordinary or average price of a commodity, in part determined by nature and circumstances in a society or neighbourhood, while the market price is defined by the forces of demand and supply of the commodity. In essence we can only estimate the natural but the market is the reality we exist in, and the two may or may not converge.

The non-accelerating inflation rate of unemployment (NAIRU) for which Milton Friedman and Edmond Phelps received the Nobel Prize in economics is more evidence of this.² NAIRU is a theoretical equilibrium level of unemployment that is not directly measurable yet policymakers base macroeconomic policies on short-term and long-term statistical estimations of it. In essence NAIRU is a natural law that is purely subjective in its practical applications and therefore at some point those statistical estimates will not map to the realities of unemployment in the labour market. Actual unemployment may consistently deviate wildly away from NAIRU to raise questions as to the efficacy of policies based on estimates of NAIRU which is itself a non-determinate quantity arrived at by theoretical assumptions about actual unemployment rates.

² NAIRU refers to the Non-accelerating inflation rate of unemployment: the frictional and structural unemployment rate at which no amount of fiscal or monetary policy injections can reduce in the short-term without a subsequent return to that unemployment rate but at a higher rate of inflation.

Figure1: NAIRU Estimate vs Unemployment Rate



Source: [Cusbert, T. \(2017\) Estimating the NAIRU and the Unemployment Gap. Reserve Bank of Australia Bulletin June 2017](#)

The macroeconomic policy battles between Keynesians, neo-Keynesians, Monetarists, the Saltwater and Chicago schools of economics can therefore be reduced to a disagreement over the dynamics and mechanisms by which the market price returns to its natural price; whatever that natural price may be if it even exists. However, in so far as both the market and natural prices are emergent from self organising networks of contracts, it is not clear that either are computationally knowable or concrete. Therefore, mainstream economic theories are merely speculative theories that work in one time period and under specific conditions and cannot be considered epistemic absolutes for policy making.

This is summed up in Nobel laureate, economist Robert E Lucas Jr, statement at the 2003 Presidential Address of the American Economic Association, that

“My thesis in this lecture is that macroeconomics in this original sense has succeeded: its central problem of depression-prevention has been solved, for all practical purposes, and has in fact been solved for many decades.”

Four years later, the global economy suddenly found itself leaping off a cliff into the Great Recession. Indeed, while Lucas was speaking with respect to the benefits derived from supply-side macroeconomic policies over and above any derived from short-run demand management macroeconomic policies, the global financial crisis and policymakers' responses to it proved economics not to be the clean mathematical science of definitive solutions it often comes across as. All models and theories are wrong, but some are just more useful than others at any given point in time.

2.2. "The natural price is unknowable, but the market price is quantum and known only at the point of negotiating a contract"

The Great Recession proved that axiomatized economic systems, just like German mathematical philosopher David Hilbert's ultimate philosophy and Karl Marx's notions of social and economic central planning under the dictatorship of the proletariat, or Sir Oswald Mosley's leadership principle, were once again foiled by Kurt Gödel's incompleteness theorems. Indeed, as Gödel pointed out, no system of logic or mathematics can explain itself if that system of logic relies on propositions that cannot be proven from within the system. In other words, neither the atheist nor the theist, despite their "scientific" propositions based on their philosophical materialism or theology, can prove the accuracy of their faith in the non-existence or the existence of a god until they are both dead.

Likewise, the price or value ascribed to an object of a contract between the parties to that contract remains entirely subjective and epistemically relative regardless of the economic models used to justify and measure that value. The final value exchanged through the transmission asset or technology ultimately has nothing to do with the natural or a long-term

equilibrium, but emerges from the ability of both parties to negotiate a favourable market price.³ This means that, as Hume suggests in his “*Of the Original Contract*”, markets are always in constant flux settling at a market price only insofar as that market price aligns one’s utility to that of the wider market. However, that the one’s utility is subject to an ability to challenge (say via a competitor or substitute product) the pre-existing social contract defining the market and to seek out an alternative, the market price at any given time is unstable, irrational, dynamic, systemically volatile, spontaneous, emergent in discrete quantities and therefore unlikely to be the natural price. This emergence of the market price is the mechanism Adam Smith referred to as the invisible hand.

In fact, if we further reduce contractual exchange to an even higher level of abstraction by noting that “labour without energy is a corpse, and capital without energy is a sculpture”⁴, then the idea that markets can or do value the same joule or newton metre of energy transferred under a contractual agreement uniformly across time and space from one application to the next at its natural price is absurd. Certainly one may ask, what makes a Mouawad 1001 Nights Diamond Purse a more valuable utility and use of energy than the average family home in Ontario, but the subjective valuation placed on the purse is part of the invitation to treat at auction where the market price is set by a series of competitive bids/offers and final acceptance.

3. “*Money is nothing more than a technology markets used to transmit information on value*”

Now, given that the natural price is unknowable and the market price is simply an emergent accounting quantity used to provide information on the value ascribed to a contract, a transmission mechanism for this information is required. This is where “money” comes into play.

³ To the extent that an economic good is an input of production to some other economic good, both of which trade at the market price, knowledge of the natural price is at scale a complex problem. This can be not least proved by applying the famous Turing halting problem as a reference point for logical deduction.

⁴ A quote from a Steve Keen lecture at <https://www.youtube.com/watch?v=f8KhlejNwyU&t=3308s>

Money is really nothing more than a technology markets use to transmit information on value. Of course, this lends to the statement that money is anything that is generally accepted to act as a medium of exchange and unit of account. This statement is axiomatic within economics and is often accompanied with explanations of the evolution of societies from barter to the use of shells, nails, tobacco, coins, etc., as less cumbersome mechanisms for exchange than logging cattle around to exchange for vegetables. However, anthropologically this notion of money evolving from barter has been proven false. Indeed, as Cambridge anthropology professor, Caroline Humphreys in her article on [Barter and Economic Disintegration](#) states, “[n]o example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money”.⁵

The emergence of coins and other commodities as mechanisms of accounting for value exchanged in contracts has been anthropologically shown in the literature to have occurred because kingdoms needed to contract for and fund castles, temples, and wars. Indeed, given these kingdoms commanded control over a larger geospatial domain than any other individuals within that geospatial domain, kingdoms were thus able to determine what physical asset or technology was used as consideration in these contracts due to the network of contracts they were engaged in. Moreover, as the superconnected nodes in the geospatial network of contracts, what these kingdoms used as consideration in their various contracts is therefore a material representation of the indebtedness of the kingdom as a party to these contracts. Money is therefore also a measure of trust in the ability (or energy if you will) of these kingdoms to fulfil

⁵ Other anthropologists such as Anne Chapman, [“Barter as a Universal Mode of Exchange.”](#) L’Homme 1980 v22 (3): 33-83), have further argued, as they fanned through historical records for empirical evidence of money and credit emerging from barter economies, that if pure barter is to be defined as only about the things, and not about the people, it’s not clear that it has ever existed. David Graeber in his book “Debt: The First 5,000 Years” offers a review of some of the anthropological evidence proving the emergence of money from barter to be a myth.

their debt. Money must thus instil confidence and value in the HODL⁶ strategy that is derived from the issuer of the money rather than its function as a mere accounting tool or medium of exchange.

Perhaps, this is one aspect of money often overlooked in the mainstream belief in money evolving from barter and thus avoiding the coincidence of wants problem. By ignoring the underlying contract, mainstream thinking around money assumes there is no such coincidence of wants regarding fiat. Such thinking, implicitly assumes the statutory force of legal tender laws precludes the desirability of holding fiat currency from transactions. This logic suffers from internal inconsistency by virtue of the fact that parties to a contract are able to price their preferences into the exchange of consideration under the contract. For example, consider a merchant selling a gold coin with current market value in fiat currency of \$1,000 and that the merchant is legally bound by legislation to always accept dollars when offered in a contract. Should this merchant expect, due to either fiscal or monetary policy, an increase in inflation of 10% within the next 24 hours, then that \$1,000 market value will only amount to \$900 of future purchasing power. Consequently, the merchant's desire to hold or accept dollars diminishes. However, given the binding of legislation, rather than rejecting dollars for the gold coin, if one assumes the merchant to be a rational economic agent, then the merchant would likely price-in the expected devolution of the dollar in terms of the 10% inflation and only accept offers of \$1,100 or more for the gold coin. As such the coincidence of wants is still embedded in the underlying contractual interaction.

This of course means that, as an accounting unit, money, even if it is government or central bank backed fiat currency, must exist in the world of virtual symbols expressing concepts (i.e.

⁶ Note that the term HODL, originating on December 8, 2013 in a drunken [post on the bitcointalk forum](#) by a user known as GameKyuubi in relation to his poor trading, is a deliberate misspelling of hold and refers to buy-and-hold strategies in the context of cryptocurrencies

numbers and mathematical equations) that exist outside of time and space. However, as the material body used to transmit messages within contracts (i.e. notes, coins, bank accounts, digital-wallets, etc) money must also reflect material realities as consideration exchanged in those contracts. As such money must in fact possess an intrinsic value or natural price and by extension a market price.⁷

3.1. “The intrinsic valuation of fiat assets to the parties in a contract is predicated on trust in governments and central banks associated with that fiat ”

Indeed, the value placed on contractual interactions with government and other national agencies such as central banks is a subjective assessment of the agency’s ability to transform energy into services or fulfilling its promises or debt. In other words, the value of any contractual interaction with government or central banks or derivative thereof through the use by others of its “money” as consideration is entirely dependent on trust in the agency of the government or central bank and by extension the assets they offer as consideration in contracts. This is no different from the trust ascribed to commercial banks that the wealth we store in the form of commercial bank liabilities (assets to us as depositors) such as chequing accounts, savings accounts, TFSAs, RRSPs, and the like will not be eroded. And for the goldbugs⁸ this valuation of trust in gold is predicated on the inherent and implicit trust in the scarcity of gold born from the failures of alchemists such as Sir Isaac Newton to convert base metals such as lead into gold and other precious metals.⁹ Indeed as George Gilder notes in his book, “Life After Google: The Fall of Big Data and the Rise of the Blockchain Economy”, the British Empire was built upon the security and foundation of the chemical irreversibility of gold and the British government’s

⁷ Indeed, as David Orell summarises, in “The Evolution of Money”, money intermediates between numbers and the real world; money is both physical and virtual, both positive and negative. This notion of money going positive or negative is seen in its virtual or mathematical state because parties to contracts can, as they interact contractually over time, go negative (debtors) relative to other parties (creditors) even though there is no such thing as a physical \$(-1) coin or negative bricks and mortar house.

⁸ A goldbug is a supporter of the gold standard and gold-backed forms of money

⁹ Newton, I (1728) "[A Treatise Of The System Of The World](#)", Royal Exchange.

ability to rivet the pound to gold at a fixed price; making the gold-based pound the best form of money. The gold-based pound sterling could be used in trade and the undertaking of long-term commitments without fear that inflation fueled by counterfeit or fiat money would erode the value of future payments.

To this end, while they may wield monopoly power over “money” governments and central banks are really no more special or distinctly outside the market or economy than any other economic agent and as such markets place a subjective value on their activities.¹⁰ Thus, if government issued debt or central bank issued fiat currency are to be valuable for or accepted as consideration in a contract, the contracting parties must trust that the value stored in the form of those fiat assets is not eroded.¹¹ A fiat asset to the contracting parties must therefore have some intrinsic value outside of the mathematical system of accounting they use it as. That is, to contracting parties choosing to hold their wealth in central bank issues fiat, while they avoid pitfalls of credit risk, liquidity risk and market volatility risk, they are still subject to long-term store of value risk and will place an intrinsic value on fiat accordingly.¹² Maintaining this fiat asset intrinsic value is ultimately why central banks engage in monetary policy (inflation targeting, exchange rate management etc) and governments monitor metrics such as foreign direct investment (FDI), stock market indices, and gross domestic product (GDP).

¹⁰ Indeed as Buffett, H, *Hon.* (1948) “[Human Freedom Rests on Gold Redeemable Money](#)” alludes to, the first acts of any tyrannical government (especially those of Lenin, Mussolini, and Hitler) was to assume full and complete control over what could be used as money. Hence their criminalising of the individual ownership of gold.

¹¹ Rothbard, M. N. (2008) “[What Has Government Done to Our Money?](#)” indeed views government and central banks centralised monopoly over money as an anathema to free markets and leads to the inevitable inflationary erosion of money and wealth. Rothbard goes as far as equating this monopoly over money to economic socialism as opposed to capitalism (pp 85-86).

¹² Ludwig von Mises in his 1949 [Human Action: A Treatise on Economic](#) refers to this store of value risk as the “Crack-up Boom” where the awareness by the masses of a deliberate inflationary policy of a monetary authority results in a flight to real goods and the fiat asset stops being accepted as contractual consideration

However, the intrinsic value of this subjective trust in fiat assets that governments or central banks exchange in contracts can only be measured against other similar assets or technologies and will necessarily be reflected at some point in their market value. The valuation of trust in fiat currencies for example, may occur under the petrodollar system in foreign exchange markets and the market price of fiat currencies relative to the US dollar. An erosion of trust would be met by a run on the currency in these markets. For example, a Venezuelan peso may have the same number value “1”, as a Canadian dollar coin, but the stamp of the state on the Canadian dollar is ascribed greater contractual value by the market than that of the Venezuelan state. Again, the weight given to the Canadian state over Venezuelan state by the market, is a measure of the value ascribed to the contractual obligations of both states (i.e. both states ability to do work or their GDP).¹³

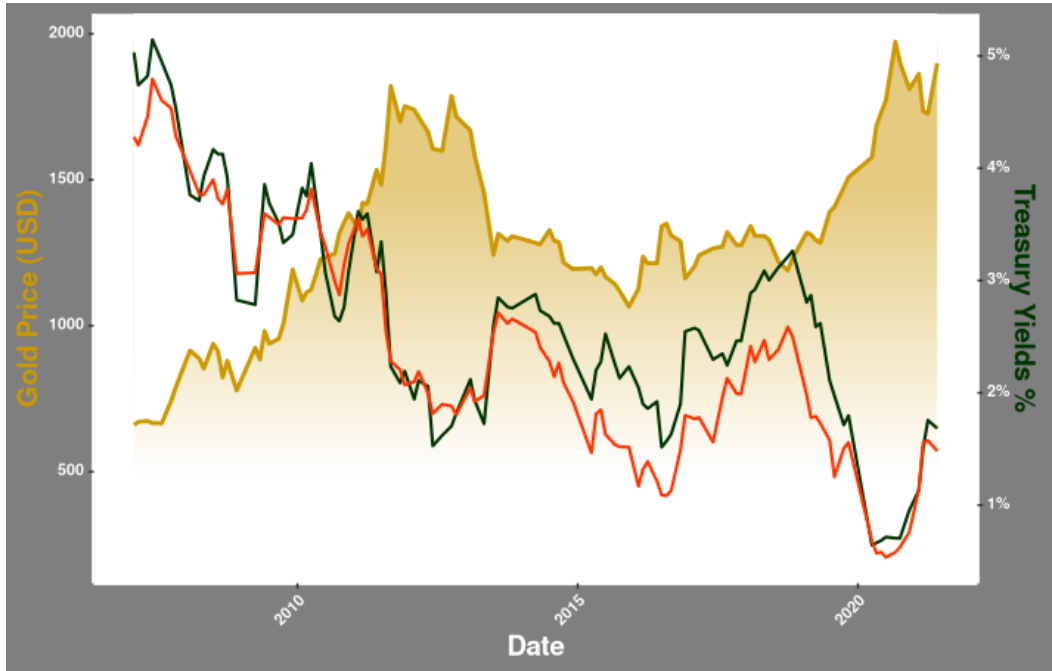
Likewise, the 16 September 1992 Black Wednesday forced withdrawal of the pound sterling from the European Exchange Rate Mechanism (ERM) was testimony to the lack of trust in the British government’s ability to credibly maintain a policy heading that would have kept the pound above the lower currency exchange limit mandated by the ERM. Indeed, Satoshi Nakamoto’s white paper on bitcoin spawn manifestos such as the topics covered in Allan Stevo’s *The Bitcoin Manifesto* that argues the need for an off-ramp from fiat due to perceptions that central banks’ and policymakers’ have a propensity towards unfettered cycles of credit creation and devaluations. We have observed a similar confidence play in the markets for physical gold and precious metals.

¹³ Notice that I am explicitly implying here that the state (government or its treasury agents, including the central bank and regulatory agencies) are economic agents with contractual participation in markets and must therefore be modelled accordingly by any useful economic model. The state is not an exogenous agent that controls markets, but a market participant itself providing services and products that must be priced by the market social contract; the state is neither evil (neo-classical/neo-liberalism, Austrian, etc worldview) or good (New-liberalism, Keynesian, Marxist etc worldview) it is just another economic agent operating in the market but with the large network of contracts to exert monopoly control on assets used as consideration in those markets.

3.2. “A decline in the purchasing power of fiat is an erosion of the value of contracted labour and capital held in fiat”

Something often overlooked in the discussion around confidence in central banks is the relationship between gold and precious metals prices and long-term treasury yields. As **Figure 2** shows, certainly for the past 15-years at least, there has been a negative correlation between treasury yields and the gold price.¹⁴ In the chart the red and green lines represent the Canadian and US 10-year treasury yields respectively. What we observe is that not only has there been a continued decline in long-term yields, moments of material drops in yields have been mirrored by similarly dramatic jumps in the gold price. These two observations provide an indication of wider investor or market sentiment about the long-term view of the economy.

Figure 2 Relationship Between Gold and Treasury Yields

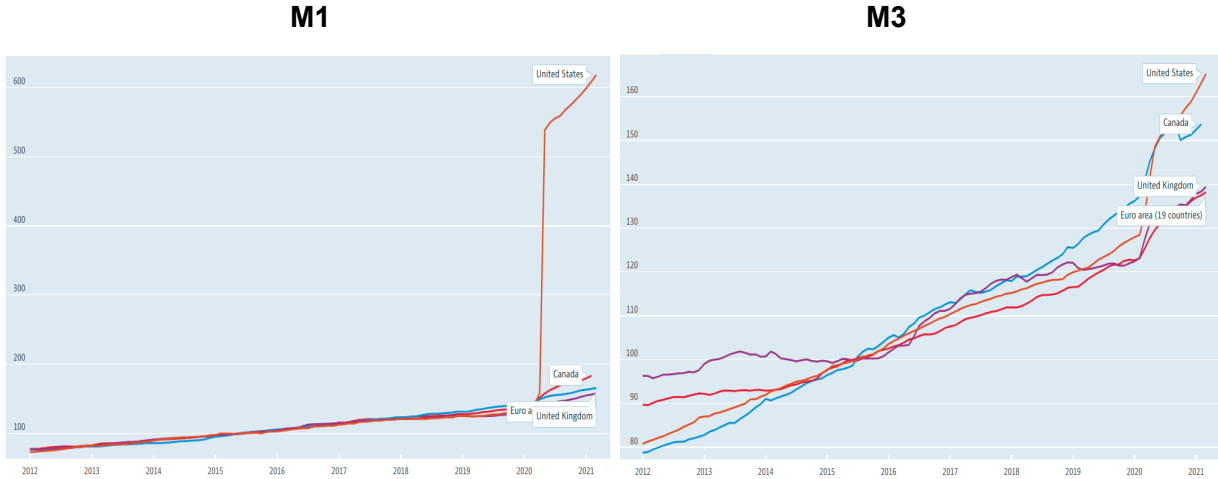


* US 10-Year Treasury Yields (green) Canadian 10-Year Government Bond Yields (red)

¹⁴ US treasury yields have been on the decline the 1980s for various reasons including central bank inflation targeting

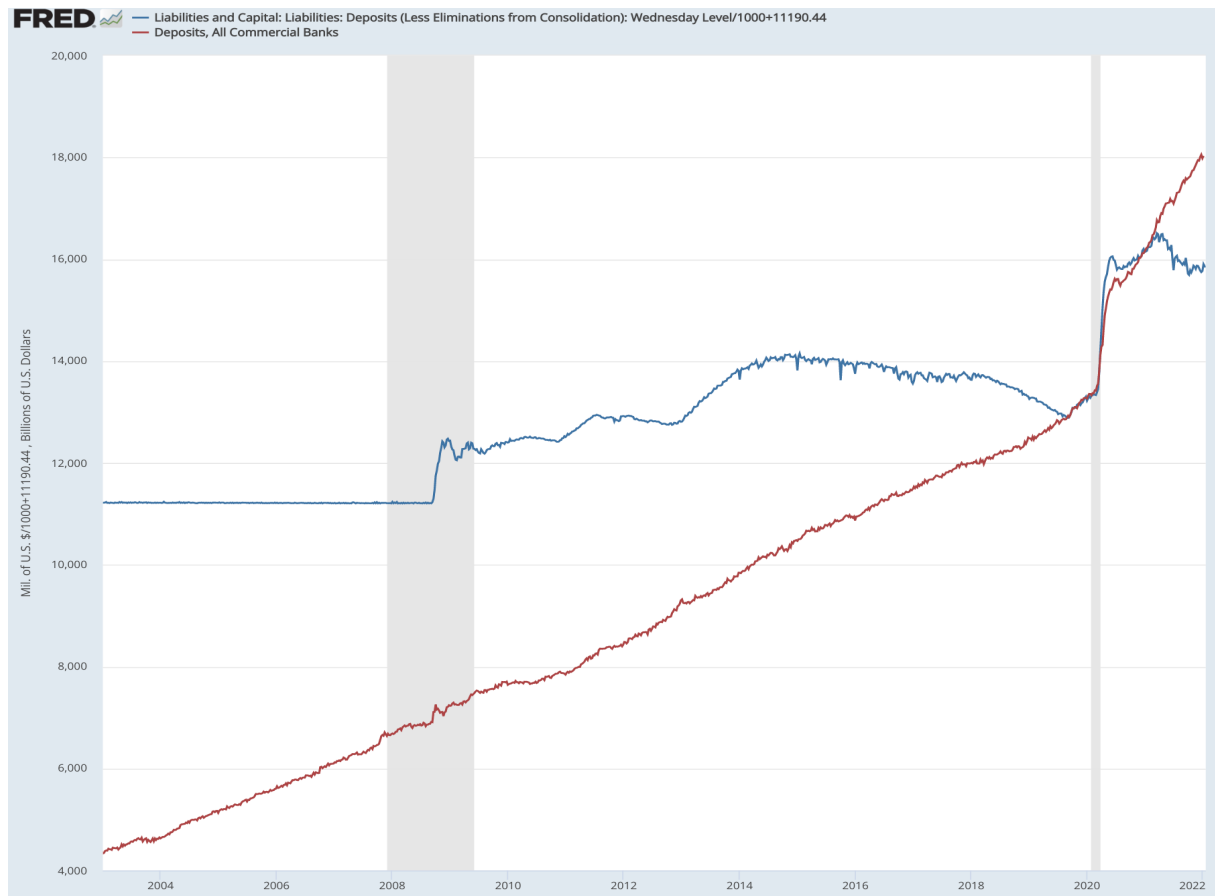
Firstly, declining yields suggest markets may not be as optimistic about the long-term economic conditions. Secondly, the period between June 2011 and August 2013 was marred by the European sovereign debt crisis, negative real interest rates, and Standard & Poors downgrading of US government debt. Since March of 2020 the COVID-19 pandemic that has now transitioned into an endemic has seen trillions in government spending and staggering rises in the settlement balances in both the US and Canada (see **Figure 3**) as well as US Federal Reserve deposits exerting a direct impact on retail money supply as measured by commercial bank deposits (see **Figure 4**).

Figure 3: Narrow Money (M1) vs Broad Money (M3) Supply Growth (2015 as index year)



Source: [OECD](#)

Figure 4: Central Bank Quantitative Easing (Blue) and Commercial Bank Deposits (Red)



Source: [FRED](#)

Indeed numerous market pundits speculating about impending spikes in inflation often point to the statistic that over 30% of all USD money supply, as measured by M2¹⁵, in circulation and approximately US\$25tn by governments globally were issued between March 2020 and May 2021 with more monetary and fiscal easing to follow.¹⁶ Preceding this was an August of 2019 BlackRock Investment Institute [report](#) calling for the Federal Reserve, and by extension global

¹⁵ M2 represents the money supply in circulation that includes M1 (i.e. cash and checking deposits), as well as “near money” such as savings deposits, money market securities, mutual funds, and other time deposits.

¹⁶ The real US 10-Year Treasury Constant Maturity Rate has been negative since June of 2019. Moreover, Professor Richard Werner in his 2014 paper “[Can banks individually create money out of nothing? - The theories and the empirical evidence](#)”, established for the first time in the economic literature that banks individually create money out of nothing. The money supply is created as ‘fairy dust’ produced by the banks individually, “out of thin air”. See also the concept of the Split Circuit System presented by Joseph Huber in his book “Sovereign Money: Beyond Reserve Banking”.

central banks, to engage in a policy whereby it “permanently increases its balance sheet to purchase government debt and facilitate the additional spending or directly inject money into the economy through a so-called helicopter drop”.¹⁷ Debt-to-GDP has consequently exploded in similar fashion (see **Figure 5**). Likewise has been the ongoing decline in the purchasing power of the US dollar (see **Figure 6**) and as illustrated in **Figure 7**, compound inflation has seen the Canadian dollar lose over eleven times its 1949 purchasing power (i.e. CA\$100 at the start of 1950 was worth CA\$1,126.23 by year end 2021). Thus, investors looking at current macroeconomic events are moving their wealth out of fiat into other asset classes, particularly scarce assets, such as residential real estate, farmland¹⁸, stocks, cryptocurrencies, and precious metals to name a few.¹⁹

Also note that, December 2015 to November 2016 during which gold also rallied were periods of significant political and economic uncertainty in the face of the Brexit Referendum and US presidential elections. In other words, just as people flee to central bank money in times of economic downturns, people also flee to gold when they lose confidence in central banks’ ability to secure the future value or purchasing power of their assets held as fiat. Since money is simply the technology through which parties to a contract store records of the value of their labours and capital exchanged in the contract, a decline in the purchasing power of fiat is an erosion of the value of contracted labour and capital held in fiat. The shift to alternative forms of money therefore makes sense. As of August 17, 2021 software company [Palantir Technologies acquired US\\$50m in gold](#) and is accepting gold in payment for its software following an earlier

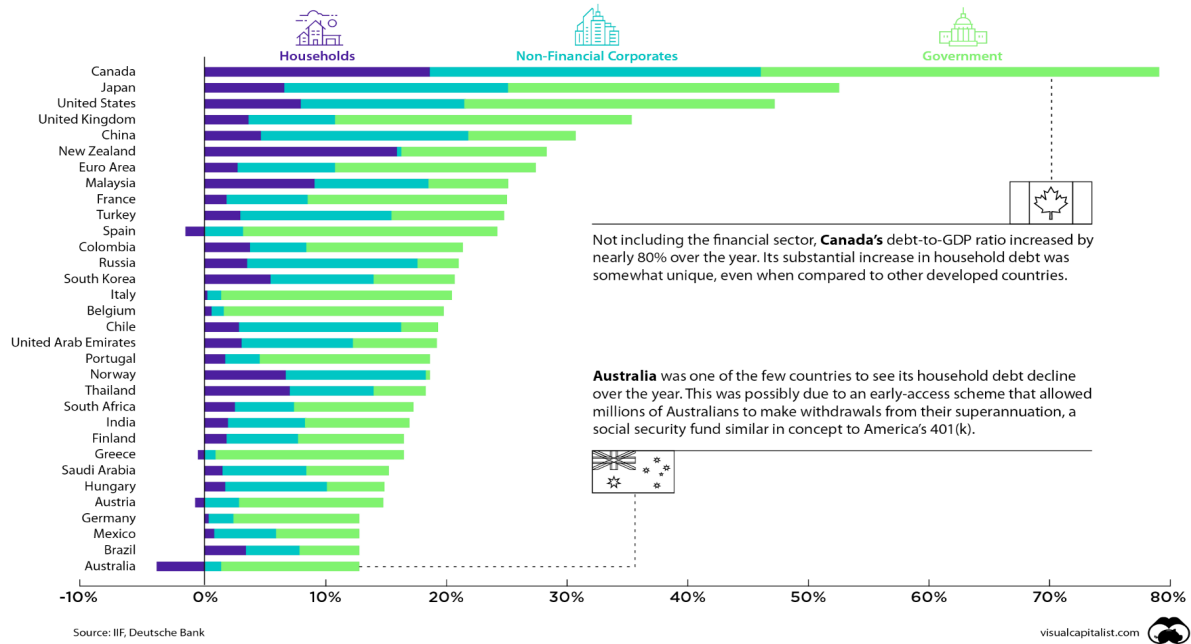
¹⁷ BlackRock (2019) page 9. It may come as no surprise that central banks began talking about using CBDC as a tool of delivering helicopter money directly into the hands of the public early on in the COVID-19 pandemic.

¹⁸ Bill Gates has become the largest owner of farmland in America while hedge funds such as Blackrock have moved into acquiring single family residential properties across North America

¹⁹ With cryptocurrencies we have seen the [list of publicly listed companies holding bitcoin](#) grow, [MicroStrategy shifting its treasury towards bitcoin](#), Cathie Wood of Ark Investment Management explaining how a [10% allocation of treasuries by S&P500 companies into bitcoin could result in a valuation of US\\$400,000](#) and [Elon Musk reiterating in a twitter Q&A his preference for cryptocurrencies over fiat](#).

announcement that it was accepting payments in Bitcoin to protect itself against “a future with more black swan events”.²⁰

Figure 5 2019Q4 to 2020Q3 Change in Debt-to-GDP Around the World

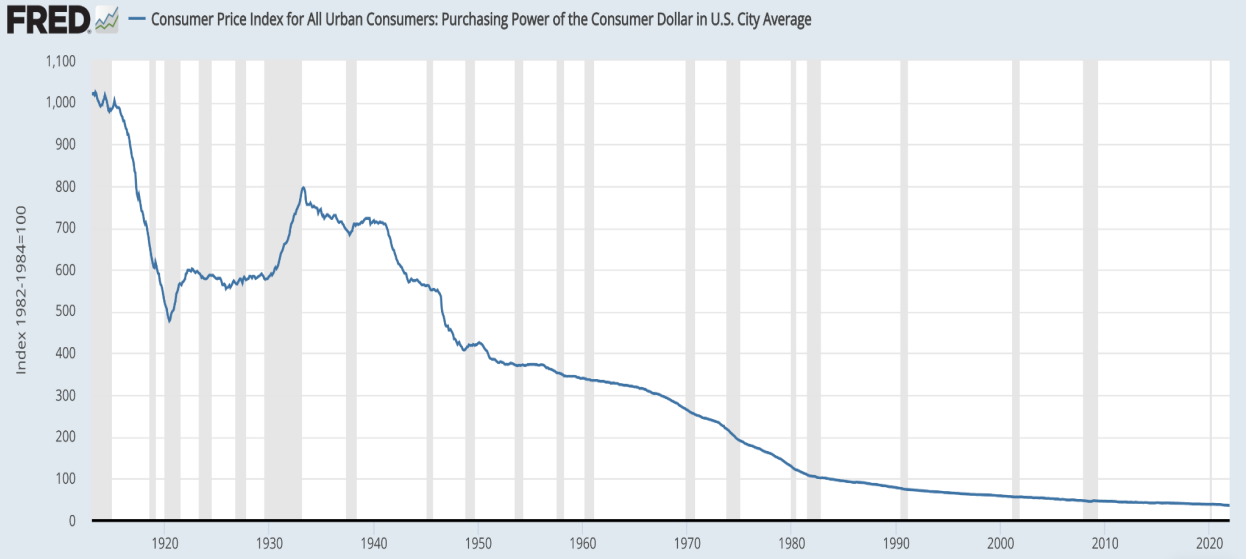


Not including the financial sector, **Canada's** debt-to-GDP ratio increased by nearly 80% over the year. Its substantial increase in household debt was somewhat unique, even when compared to other developed countries.

Australia was one of the few countries to see its household debt decline over the year. This was possibly due to an early-access scheme that allowed millions of Australians to make withdrawals from their superannuation, a social security fund similar in concept to America's 401(k).

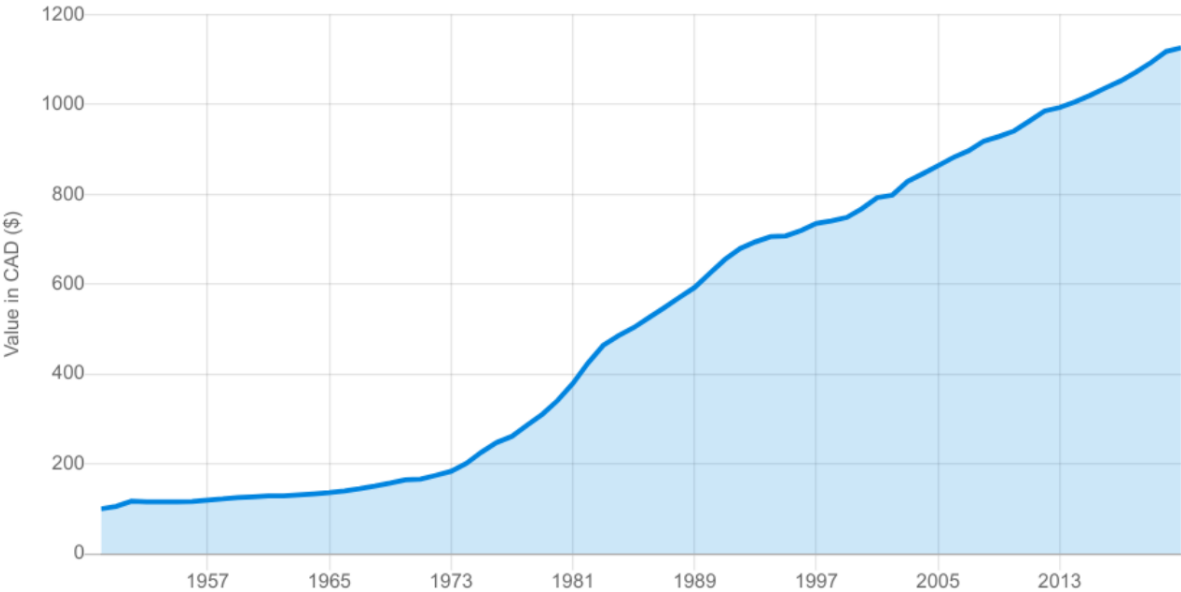
²⁰ A black swan event is an unpredictable event that is beyond what is normally expected of a situation and has potentially severe consequences. Black swan events are characterised by their extreme rarity, severe impact, and the widespread insistence they were obvious in hindsight.

Figure 6: Purchasing Power of the Consumer Dollar in U.S. City Average (1913-2021)



Source: [FRED](#)

Figure 7: Inflation timeline in Canada (1950-2021)**



** $CAD(\$)$ Final value = Initial value $\times \frac{CPI\ final}{CPI\ initial} = 100 \times \frac{108.56}{9.64} = \$1,126.23$

Source: [INFLATIONTOOL](#)

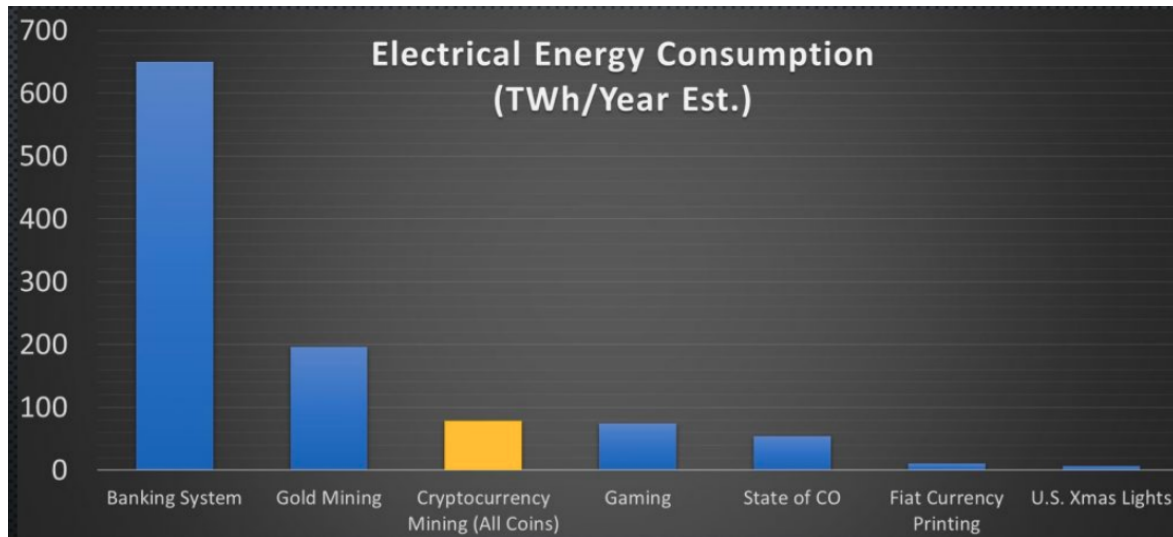
4. “The fear, uncertainty, and doubt (FUD) surrounding cryptocurrencies stems from a lack of understanding of what money truly is and how it is valued or created”

Many claim that the volatility of bitcoin’s price makes it ineligible as money. Certainly, such a view is understandable when one considers that, the Canadian dollar exchange with respect to bitcoin rose to \$25,149.28 by December 16, 2017 only to plummet to \$8,086.62 by August 14, 2018. Then as of May 3, 2021 sat at \$71,348.38 only to lose almost half of its value two weeks later. However, does this volatility really disqualify bitcoin as money or is it more a product of the dual nature of money as a mathematical concept and a tradable commodity with intrinsic value to its bearer?

Mainstream economists, regulators, and others who overlook the duality of money will subscribe to the former view and suggest cryptocurrencies need to be treated as securities and taxed accordingly or even banned for a variety of reasons. Such people see pricing dynamics of cryptocurrencies from the lens of FUD. However, I would contend that the FUD surrounding cryptocurrencies stems from a fundamental lack of understanding of what money truly is and how it is valued or created. Indeed the latest cries for banning cryptocurrencies are based on entirely unsubstantiated and grossly inaccurate claims of harming the environment (See **Figure 8**). In fact looking at the data itself, considering cryptocurrency networks are global and can facilitate cross border finance and trade, it is by far the opposite. Moreover, as Hass McCook’s [bitcoin energy use analysis](#) as well as [Square and Ark Investment Management have pointed out](#), the nature of bitcoin (and proof-of-work generally) mining leads miners towards cheaper renewable, and cleaner energy sources that produce much 50,000TWh of global wasted

energy.²¹ To put this into context bitcoin mining uses less than 0.1% of total global human energy production and 0.25% of wasted energy production.²²

Figure 8: Yearly Energy Consumption by Industry as of November 2019



Source: [Distributed Ledger Incorporated Crypto Networks and Proof of Stake vs Proof of Work – Part 2. Energy & Security](#)

Rather than overplay the speculative aspect of cryptocurrency market prices, I would contend that one bitcoin serves the same role of intermediating between numbers and the real world as does one Canadian dollar. What differs, however, is the intrinsic value and by extension market price we ascribe to them as physical or real world objects. For both precious metals and cryptocurrencies, this is the value markets ascribe to their scarcity and thus ownership, whereas

²¹ See reports by the International Energy Agency and Distributed Ledger Incorporated for assessments of energy usage in cryptocurrency networks that add some needed context to reports that bitcoin mining uses more energy than hundreds of countries

<https://www.iea.org/commentaries/bitcoin-energy-use-mined-the-gap> and

<https://distributedledgerinc.com/crypto-networks-and-proof-of-stake-vs-proof-of-work-part-2/>. Others have shown that cryptocurrency mining actually utilises unsold energy production surpluses rather than creating new energy generation

<https://thenextweb.com/hardfork/2018/08/28/bitcoin-drives-energy-innovation/>. Indeed a

cryptocurrency mining firm Ocean Falls Blockchain brought new life to the abandoned former paper mill town of Ocean Falls BC by purchasing electricity from the local hydroelectric private utility Boralex

<https://financialpost.com/technology/blockchain/amid-cryptocurrency-crash-a-canadian-ghost-town-take-s-a-chance-on-bitcoin>.

²² For a contextual history of energy usage and advancements in civilization, see also Vaclav Smil (2017) "[Energy and Civilization: A History](#)".

with fiat currency and by extension CBDC, it is the value ascribed to the contractual obligations (credit or debt) of the state or agency thereof.

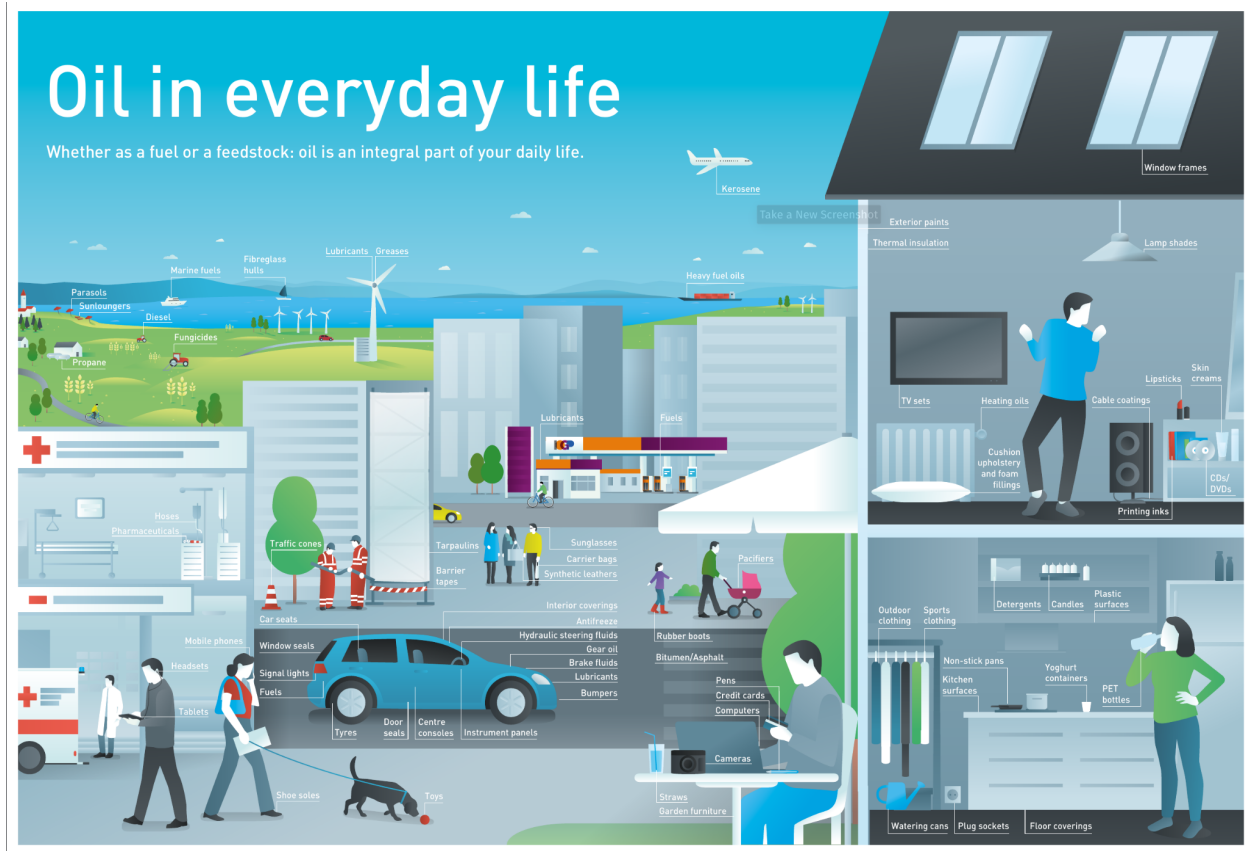
A further point of note with respect to the apparent price stability of fiat currencies and any CBDC that again links directly to the network effect of contracts the issuer is a party to is the notion of the petrodollar system. The 1970s witnessed a number of pivotal policy shifts, notably the Nixon Shock that saw President Nixon's administration suspend the dollar's convertibility into gold, the collapse of the Bretton Woods Agreement, the Group-of-Ten (G-10) Smithsonian Agreement, and ultimately the [U.S.-Saudi Arabian Joint Commission on Economic Cooperation \(USSAJCEC\)](#) of 1979.²³ Through the USSAJCEC, the U.S. as the largest importer of crude oil and Saudi Arabia as the largest exporter of crude oil and head of the Organization of the Petroleum Exporting Countries (OPEC) crystallised their 1973 agreement that saw Saudi Arabia accept the U.S. dollar as the only currency through which all its crude oil exports would be sold. The U.S. dollars used in the purchase of oil contracts were then recycled under the USSAJCEC as they were sent back to the U.S. as payment for contracts with U.S. companies engaged in infrastructure projects in Saudi Arabia and lead to higher wages in specific sectors while supporting Saudi Arabia's overall economy.

An important thing to note from the events of the 1970s is that, the creation of the petrodollar system ultimately resulted in all global currencies being pegged indirectly to the USD and by extension to crude oil. This is particularly significant for the perceived stability of central bank or government issued fiat currency because as illustrated in **Figure 9** the overwhelming majority of agricultural, manufacturing, and consumer products are downstream processes of crude oil

²³ Note that under the Bretton Woods system, the USD was the only currency redeemable for gold with all other currencies pegged to the USD and as such indirectly linked to gold. Consequently, the intrinsic value of the USD was tied to the contractual obligation to redeem USD for gold at a fixed rate. Any devaluation of the USD against gold under Bretton Woods invariably would diminish faith in the USD as money. It was such a devolution that resulted in the collapse of the Bretton Woods system.

production.²⁴ As a consequence, all nations around the world have had to maintain reserve balances of U.S. dollars and as such there is consistent and active trading in USD that prevents runs on the U.S. dollar and ensures the stability of fiat currencies globally. It can therefore be speculated, as seen from the market instability that occurred under the 1971 Nixon Shock, that a significant loss of trust in the petrodollar system or an attack on said system, from for example the Brazil, Russia, India, China, South Africa (BRICS) economic trade block, could result in substantial volatility in fiat currencies of countries with heavy trade exposures to the U.S. dollar.

Figure 9: Some Uses of Crude Oil in Everyday Life

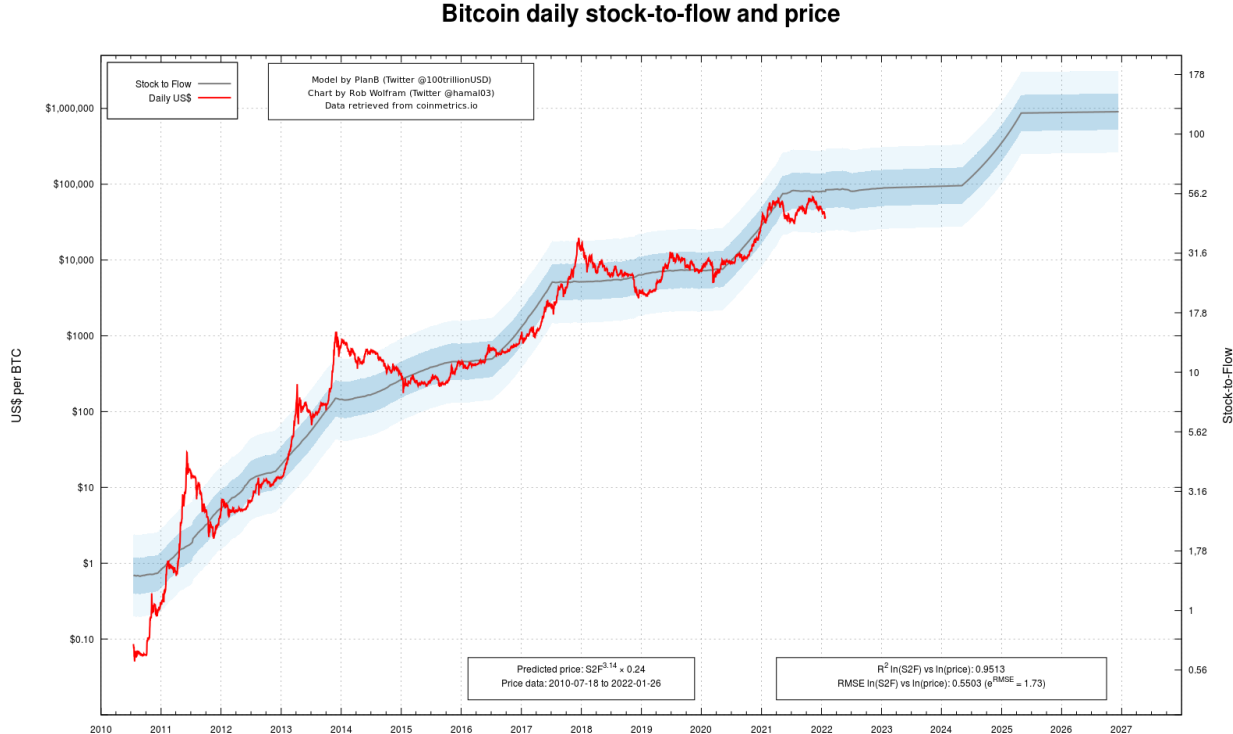


Source: [The International Association of Oil & Gas Producers \(IOGP\)](https://www.iofp.org/)

²⁴ This point of all agriculture and manufacturing is further proof that the arguments made against cryptocurrency mining as well as policies on climate change and carbon neutrality are predicated on an uneducated perception of the fundamental economics of crude oil and fossil fuel consumption.

In this light I would argue that the price volatility in cryptocurrencies is a process of price discovery as a globally exchangeable asset that have their own unique idiosyncrasies such as the boom and bust cycles associated with the halving of bitcoin’s algorithmic issuance rate of new coins. To this end and as illustrated in **Figure 10**, the price of bitcoin (which for all intents and purposes drives general cryptocurrency prices) appears to be highly correlated with its stock-to-flow ratio. The stock-to-flow ratio is the ratio of bitcoin in circulation to bitcoin production through its mining. What **Figure 10** shows is that Bitcoin production halving and the associated stock-to-flow ratio increases tend to be accompanied by level increases in bitcoin prices.

Figure 10: Bitcoin Daily Stock-to-Flow vs Price



Source: [Daily updated charts of Bitcoin's stock-to-flow vs price](#)

4.1. “Money as we know it is an accident of history and therefore not set in stone”

If you are still with me at this point and not completely lost, I hope to have illustrated that, (1) money as consideration exchanged in contracts is dependent on the network of contracts the

entity whose seal is on that money is able to amass; (2) the value of this seal has nothing to do with the numbering system of accounting it is used for in the negotiation of value exchanged in contracts; (3) money therefore has a market value that is equally as irrational and subjective as the goods and services we exchange it for in contractual interactions; (4) because the valuation of money is market determined, it is subject to “Minsky moments” or valuation bubbles and therefore systemically volatile at the macroscopic level since it creates both credit and debt.

Money as we are accustomed to is therefore nothing more than an accident of history and as such not set in stone, but rather has persisted over time and space for lack of a viable competitive alternative. Moreover, just as money as we know it is not an epistemic constant that must exist in the form we have become accustomed to over the centuries, the systems supporting the storage and transfer of money are also not epistemic absolutes. In other words, there are a multitude of Gödelian off-diagonal states of nature or multiverses in which payment systems operators do not and need not exist; or at the very least are exposed to significant competition from systems supporting competing forms of “money” and would need to innovate aggressively to maintain a competitive advantage or relevance.

4.2. “It is not all doom and gloom for payment systems operators or central banks, however, thinking must necessarily evolve beyond building railroads when the broader ecosystem is imagining interstellar flight.”

This forced innovation is how one must view the emergence of CBDC, given the view of money I have laid out above. Indeed, based on the contractual network argument, the ability of tech companies such as Facebook to amass a user base accounting for at least a third of the global population, including major corporations and financial institutions, makes these companies an existential threat to nation-states and by extension central banks. If Diem was to gain mass adoption on Facebook and other Diem Association partner organisations’ network of users there

might be little over the longer term preventing the Association from choosing to unpeg the digital currency from the US dollar.²⁵ Furthermore, the Linux Foundation's [Hyperledger](#) makes a blockchain economy on a global scale that is untethered to the state a distinct possibility. This is in part because Hyperledger comes with the lofty ambitions of becoming the blockchain of blockchains through which multitudes of corporations and individuals can interoperate upstream and downstream across various business models using REST APIs.²⁶

Realpolitik more than economics will dictate the need for CBDC and CBDCs facilitating cross-border payments. In essence, political expediency is the driving factor behind domestic CBDC and any speculation of Special Drawing Rights (SDR) based CBDC.²⁷ However, unless such CBDC is underpinned by a meaningful business model or use case (i.e. something more than just replacing physical cash), it will simply offer no value add to counteract the continued decline of physical cash. Indeed, cash offers end user benefits such as anonymity which in an age of excessive data collection and increasing concerns of privacy and potential for government overreach, a CBDC may lead to competing innovations in privacy focused alternatives. For example, nothing stops someone receiving payments in CBDC converting that CBDC into commercial bank money and using that money to purchase a zero knowledge cryptocurrency such as Monero or zcash which could then be used to transact. In this instance, CBDC would simply accumulate on the balance sheet of commercial banks but not be used by privacy motivated consumers. Moreover in countries like Canada, there is enough end user confidence in the commercial banking system and value added services it provides, that it is unclear how a cash replacing CBDC will offer any value over existing non-cash payment

²⁵ In fact, Diem like other stablecoins pegged to fiat for this reason suffer from the very same devaluation or store of value risk that fiat currencies do.

²⁶ See [Hyperledger Architecture, Volume 1: Introduction to Hyperledger Business Blockchain Design Philosophy and Consensus](#)

²⁷ Note that the idea of a CBDC based on SDRs or the international reserve asset based on a basket of major currencies (in order of weights US Dollar 41.73%, Euro 30.93%, Chinese Yuan 10.92%, Japanese Yen 8.33%, and Pound Sterling 8.09%), created by the IMF in 1969 to supplement its member countries' official reserves is merely speculation based on observations around geopolitics.

mechanisms. The requirement of end-user value add of a cash replacing CBDC is especially important in an environment where cash usage is already on the decline as the public prefer the ease of card or digital options such as peer-to-peer (P2P) payment rails like Interac e-Transfer, Paypal and Venmo when making payments. Therefore, even if there is a chance that the institutions behind the Diem association, for example, could collapse into bankruptcy unlike a central bank, Diem may still have a stronger use case for its adoption than CBDC.

Added to this, as the Citigroup March 2021 report "[Bitcoin At the Tipping Point](#)" argued, Bitcoin's decentralised and borderless design, its lack of foreign exchange exposure, and neutrality could make it a better international trade currency than fiat based CBDC. More specifically, the report notes that a "[decentralised] cryptocurrency might be preferred as no government or outside entity can take steps that might affect the supply of the trade currency, helping to decouple trade from political considerations". Moreover as billionaire investor [Carl Icahn, CEO of Icahn Capital](#), [told Bloomberg Markets' Taylor Riggs](#) as he signalled the potential of acquiring crypto, "what's the value of a dollar? The only value of the dollar is because you can use it to pay taxes....I'm looking at the whole business, and how I might get involved in [cryptocurrency]."

Likewise, with Hyperledger and other technologies underpinning cryptocurrencies ever evolving and democratising financial services through decentralised finance (DeFi)²⁸ away from a centralised core, payment centric financial market infrastructures (FMs) and service providers also need to innovate. While there is often the comparison of cryptocurrencies to gold, unlike gold, cryptocurrencies are easily transmitted in contracts at faster speeds, less friction, and

²⁸ DeFi is an umbrella term for financial services on public blockchains, primarily Ethereum. DeFi enables users to carry out most operational functions banks support such as earning interest, borrowing, lending, purchasing insurance, trading derivatives and other assets, and much more. DeFi is nevertheless faster than traditional banking and does not require as much paperwork or a third party. As with crypto generally, DeFi is global, peer-to-peer (meaning directly between two contracting parties and not routed through a centralised system), pseudonymous, and open to all.

lower cost than gold.²⁹ They also are capable of embedding contractual terms and remittance information in the same transmission as the value being transmitted. This brings them into the realms of payment instruments facilitated by payment systems operators and also explains the confusion in defining cryptocurrencies for oversight purposes that securities, commodities, and other conventional regulatory bodies have experienced. Indeed the advent of non-fungible tokens (NFTs) in 2021 saw the [Ethereum network process US\\$11.6 trillion](#) in payments volume compared to VISA's US10.4 trillion.

Moreover, the emergence of custodians such as Coinbase, Netcoin, and Kraken combine aspects of the traditional roles of commercial banks and FMIs into one entity across various blockchains. Furthermore, the rise of decentralised exchanges (DEX), atomic swaps, [decentralised autonomous organisations \(DAOs\)](#)³⁰, and institutions such as NYDIG³¹ link these private digital currency networks with the traditional fiat currency deposits we are accustomed to. Thus it is becoming easier to interchange between fiat and private digital currencies and transacting over private blockchains. Furthermore, the proposed Taproot improvement to bitcoin's blockchain will also permit more complex transactions such as those with embedded escrows, time limits and multiple signatures to be processed as standard end-to-end transactions. By introducing smart contracts to Bitcoin, Taproot would enable fast interchange between various cryptocurrencies without the need for exchanges (either centralised or decentralised) as the atomic swaps are built into the blockchain itself. Wrapped Bitcoin, a

²⁹ It is worth noting that institutions such as UK-based physical gold brokerage and vault Glint have started offering services like Glintpay (<https://glintpay.com/>) to reduce the transactional inefficiencies associated with gold.

³⁰ A DOA is an open-source blockchain protocol governed by a set of rules, created by its elected members, that automatically execute certain actions without the need for intermediaries.

³¹ [NYDIG](#) is a bitcoin company that provides technology and financial services to businesses in a broad range of industries. The company's vision is building an inclusive financial system that makes Bitcoin, which it views as a resource for human progress, a universal payment and wealth holding option for billions of people worldwide.

tokenized version of Bitcoin that runs on the Ethereum blockchain, is already spurring this interchangeability across networks and reduces transaction costs.

In addition, the often stated criticisms of cryptocurrencies, specifically in reference to Bitcoin, is the scalability and speed of transactions. However, even this is becoming less of a problem. The evolution of innovations such as the Lightning Network on the bitcoin blockchain also serves to raise the number of transactions processed to a limit of 60,000 transactions per second. With the Ethereum (ETH) blockchain, similar developments under the Raiden Network are looking to push this transaction limit to 1million transactions per second.

Moreover, while there have been ongoing accusations of poor efficiency thrown at proof-of-work mining and pool mining, these forms of mining decentralise the distribution of transaction fees. This may be beneficial because it provides anyone with the appropriate computing hardware a source of passive income and thus facilitates financial inclusion and would be a potentially useful tool in the toolbox for providing a universal basic income without unsustainable tax increases and debt spending. In addition to this, staking (i.e. proof-of-stake) and other alternative proof models may also make mining more accessible to the general public.³² That is, cryptocurrencies offer the average individual with access to a desktop computer with compute orientated central processing unit (CPU) graphics processing unit (GPU) or application-specific integrated circuits (ASICs) the ability to acquire portions of transaction fees that would, under current fiat systems, be locked within and dictated by a central core of institutions such as credit card companies.

³² Note that while staking is often considered to be superior to proof-of-work from an environmental, profitability, and compute efficiency standpoint, it may also substantially increase the entry cost to the average miner. The environmental benefits of staking and cryptocurrency decentralisation may also be eroded because proof-of-stake mining will likely shift to utilising wasted compute space at data centres globally. This shift to data centres from the general public with home mining operations may also create centralization of mining on devices owned and controlled by Big Tech companies and other large corporations. Both proof-of-work and staking could nevertheless be a revenue generating opportunity for payment systems operators.

Put into a Canadian dollar value perspective, at \$3,085 per ETH, these transaction fees amount to a potential \$260 per month in mining revenue at a cost of \$30 in hydroelectricity per month at \$0.11/Kwh on a single desktop computer running a single AMD Radeon RX 5700XT GPU or Nvidia RTX 2080ti. Both AMD and Nvidia flagship compute GPUs the Radeon VII and RTX 3090 net anywhere up to \$500 per month mining ETH. For an institution this might not be a lot, but for the average end user an extra \$230-\$500 per month on a single GPU is something. Indeed, even the less profitable alternative of cloud mining through companies such as Genesis Mining and HashShiny among others still offer a modest monthly revenue stream. This provides incentives for both consumers and businesses utilising cryptocurrencies to become microscale miners within a pool in order to recoup some of their transaction fees across all payments made globally. Indeed, a growing number of PC gamers are mining ETH overnight. Thus, widespread adoption may challenge existing interchange fee models of credit card companies.

5. Conclusion

It is not all doom and gloom for payment systems operators and traditional financial institutions as existing fiat based payment channels are not going anywhere, however, thinking must necessarily evolve beyond building railroads when the broader ecosystem is rapidly imagining interstellar flight. Indeed, I envision a world in which people maintain a portfolio of multiple digital assets (CBDC, cryptocurrencies, gold backed digital currencies, e-wallets, bank deposits, credit cards, non-fungible tokens, etc) they use as consideration in their contractual arrangements on a cheapest to deliver or application specific basis. Nevertheless, understanding the nature of the technological innovations occurring in the digital currency space and the philosophies and business models underpinning the various private digital currencies will help payment systems operators better strategically position themselves. Having said this, the nature of money as a technology evolving from networks of legally binding contractual interactions raises questions as

to the political risk associated with issuers of that money seeking to maintain the hegemonic control over those networks of contracts. Consequently any individual or organisation seeking to employ non-fiat based currencies must necessarily be cognisant of the use of laws, regulations, and legal challenges by government agencies and other vested interests in maintaining the monopoly of fiat monetary systems.

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