

Ignorance, debt and cryptocurrencies:

The old and the new in the law and economics of concurrent currencies[†]

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Abstract

Cryptocurrencies are expected to have a significant impact on banking, finance, and monetary systems. Due to uncertainty as to the possible future trajectories of the evolving cryptocurrency ecosystem, governments have taken a relatively hands-off approach to regulating such currencies. This approach may be justified within the theoretical information-economics framework of this paper, which draws parallels between the information economics of money and quasi-money creation within the current central banking, commercial banking and shadow banking systems with that of the cryptocurrency ecosystem. In particular, drawing lessons from the literature on the role of information in creating 'safe assets', this paper finds that by building on symmetric (common) knowledge as to the inner workings of the Bitcoin Blockchain - though in a different way - bitcoin possesses a degree of endogenous information insensitivity typical of safe assets. This endogenous information insensitivity could support bitcoin's promise of maturing into a viable store of value and a niche medium of exchange. This finding should not be overlooked in the policy discussions for potential future regulatory interventions in the cryptocurrency ecosystem.

Keywords: Cryptocurrency, Bitcoin, Blockchain, Information asymmetry, Safe asset, Money, Debt

JEL classification: E42, E51, E58, G01, G23, G28, K22, K23, K24

[†] The title of this paper is inspired by an article by Dang, Gorton and Holmström. See: Tri Vi Dang, Gary Gorton, and Bengt Holmström, "Ignorance, Debt and Financial Crises," *Yale University and Massachusetts Institute of Technology, working paper* (2012).

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Introduction

Decentralized, permissionless and blockchain-based cryptocurrencies¹ and their underlying technology are said to have as transformative an impact on *value* as the invention of the internet had on *information*.² The Bitcoin Blockchain or its so-called distributed ‘trust machine’³ has eventually solved the age-old double-spending problem, which for decades hampered the advent of digital money for the internet. Prior to bitcoin (BTC), even outside the virtual space, addressing double-spending problem was delegated to trusted third parties with centralized ledgers, who used to verify and confirm financial transactions. Bitcoin solved this problem in a secure, *decentralized*, consensus-based and censorship-resistant manner, without relying on third parties. The proof of work (PoW)⁴ used in the Bitcoin Blockchain, despite being energy intensive, appears to be a secure technique which provides a decentralized and incentive-compatible mechanism for verifying and confirming transactions, as well as securing the Bitcoin Blockchain.⁵ Although solving the double-spending problem has been a significant step forward in introducing bitcoin as a potential medium of exchange, the more challenging problem proved to be its universal acceptance.⁶ As Minsky puts: “everyone can create money; the problem is to get it accepted”.⁷ As of this writing, the problem of price volatility has been a barrier discouraging universal adoption and has prevented bitcoin from becoming a reliable store of value or a potential unit of account.⁸

¹ The origins of the idea of creating bitcoin-like currencies can be traced back to an article by David Chaum entitled “Security without Identification: Transaction Systems to make Big Brother Obsolete.”, but the idea culminated in the Nakamoto’s “Bitcoin: A Peer-to-Peer Electronic Cash System”.

See: David Chaum, “Security without Identification: Transaction Systems to Make Big Brother Obsolete,” *Communications of the ACM* 28, no. 10 (1985). See also: Satoshi Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System,” (2008).

² For potential applications of blockchain technology in general, see: UK Government Office for Science, “Distributed Ledger Technology: Beyond Block Chain,” (London: UK Government Office for Science, 2016). See also: Don Tapscott and Alex Tapscott, *Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World* (New York: Penguin Random House LLC, 2016).

³ The Economist, “The Promise of the Blockchain: The Trust Machine,” *The Economist*, Oct 31st 2015 2015.;

⁴ The price volatility of bitcoin, as part of a premature asset class, should not come as a surprise. Perhaps the most difficult case to be made for bitcoin as a currency is the unit-of-account aspect of money. As a commodity with a fixed supply schedule, the bitcoin would remain volatile for the foreseeable future in response to the demand shocks. Nonetheless, as will be shown in this paper, bitcoin price volatility has had a decreasing trend.

⁵ The proof of work in principle discourages 51% attack on the network, because to hack the network, the hacker should accumulate substantial amounts of the coins. Having accumulated the coins and invested in the mining infrastructure, the hacker would not have the economic incentive to hack the system anymore. See: Josh Stark, “Making Sense of Cryptoeconomics,” in *CoinDesk* (August 19, 2017). See also: Katherine Heires, “The Risks and Rewards of Blockchain Technology,” *Risk Management* March 1, 2016.

⁶ William Luther and Lawrence White, “Can Bitcoin Become a Major Currency?,” *JMU Working Paper in Economics No. 14-17* (2014).

⁷ Hyman P. Minsky, *Stabilizing an Unstable Economy* (New York: McGraw-Hill, 1986; repr., 2008), 255.

⁸ For the unit-of-account purposes, the authors do not believe that the current decimal numbers can be a real bottleneck for bitcoin as it can be solved redefining the default standard for measuring bitcoin. Currently, there is one promising Bitcoin Improvement Proposal (BIP) for bits submitted by Jimmy Song in December 2017. It is a proposal to record BTC in ‘bits’, every bit having a corresponding value of one thousandth of a bitcoin (i.e., 1 bit = 100 satoshis). This proposal is known as Bits Denomination BIP. See: Jimmy Song, “Bits Denomination BIP,” GitHub, <https://github.com/bitcoin/bips/blob/master/bip-0176.mediawiki>.

Despite skepticism about the economic function of bitcoin as money or currency,⁹ and its earlier tarnished image as a useful currency for criminals (e.g., the role of bitcoin as a means of payment in Ross Ulbricht's Silk Road,¹⁰ and AlphaBay),¹¹ security threats involving bitcoin exchanges, (e.g., the failure of Mt. Gox),¹² and vulnerabilities in some of the blockchain-based organizations (the hacking of the DAO),¹³ as of this writing, the Bitcoin Blockchain has proved its resilience and likely long-term viability.¹⁴ If cryptocurrencies, satisfy the critical mass constraint,¹⁵ some of them, in particular bitcoin, could potentially wield a significant influence on the financial and monetary systems in the long run.¹⁶

This is not to say that bitcoin and the Bitcoin Blockchain is immune to threats. In fact, at its current form, bitcoin is not fully decentralized and censorship resistant, because the mining pools of bitcoin as well as other cryptocurrencies tend to exhibit a high level of concentration.¹⁷ Not only is this concentration harmful for the competitiveness of the market, but also it can compromise the overall security of the Bitcoin Blockchain. For example, at certain point, GHash.io mined six blocks in a row on the Bitcoin Blockchain, which raised significant security concerns.¹⁸ In June 2014, for a short period of time, GHash alone even became a 55% miner for Bitcoin.¹⁹ More recently, there has been a few successful 51% attacks to perform double-spend attacks on some cryptocurrencies such as Verge, Bitcoin Gold, and MonaCoin.²⁰

⁹ David Yermack, "Is Bitcoin a Real Currency? An Economic Appraisal," *National Bureau of Economic Research Working paper* no. 19747 (2013). For the legal nature and treatment of virtual currencies, see: Noah Vardi, "Bit by Bit: Assessing the Legal Nature of Virtual Currencies," in *Bitcoin and Mobile Payments: Constructing a European Union Framework*, ed. Gabriella Gimigliano (London: Palgrave Macmillan UK, 2016)..

¹⁰ Andy Greenberg, "Silk Road Mastermind Ross Ulbricht Convicted of All 7 Charges," *Wired* April 02, 2015.. For a vivid account of the story of the Silk Road, see: Nick Bilton, *American Kingpin: The Epic Hunt for the Criminal Mastermind Behind the Silk Road* (New York: Portfolio/Penguin, 2017).

¹¹ When Europol shut down AlphaBay, it seized large quantities of bitcoin, Zcash, Ether and some Monero. See: Europol, "Massive Blow to Criminal Dark Web Activities after Globally Coordinated Operation," news release, 20 July 2017, <https://www.europol.europa.eu/newsroom/news/massive-blow-to-criminal-dark-web-activities-after-globally-coordinated-operation>.

¹² See Lawrence Trautman, "Virtual Currencies: Bitcoin & What Now after Liberty Reserve, Silk Road, and Mt. Gox," *Richmond Journal of Law & Technology* 20, no. 4 (2013).

¹³ Securities and Exchange Commission, "Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The Dao," (Washington, DC July 25, 2017).

¹⁴ As of this writing, as listed on the coinmarketcap.com there are 1564 cryptocurrencies. The market cap of all cryptocurrencies on this website stands at \$275,986,942,828 with BTC Dominance of 42.7%. (Accessed: 12.04.2018). See: Bitcoin obituaries: <https://99bitcoins.com/bitcoinobituaries/>

¹⁵ Ernie G.S. Teo, "Emergence, Growth, and Sustainability of Bitcoin: The Network Economics Perspective," in *Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data*, ed. David Lee Kuo Chuen (San Diego, CA: Academic Press, 2015).

¹⁶ See for example, Jeffrey Tucker, "Op Ed: Is There a Future for Banking in a Cryptocurrency-Dominated World?," *Bitcoin Magazine* Oct. 11, 2017.

¹⁷ For the state of affairs on decentralization see <https://arewedecentralizedyet.com/>

¹⁸ See: https://www.reddit.com/r/Bitcoin/comments/1uk690/ghashio_just_mined_6_in_a_row_again_no_big_deal/; See also: <https://bitcoinmagazine.com/articles/mining-pool-centralization-crisis-levels-1389302892/>. See also: handbook of digital currency; chapter on bitcoin mining technology

¹⁹ (See: Ittay Eyal and Emin Gün Sirer, "How to Disincentivize Large Bitcoin Mining Pools," *Hacking, Distributed* (June 18, 2014).

²⁰ Cali Haan, "Verge, Bitcoin Gold and Monacoin Hacked," *Crowdfund Insider* May 25, 2018.

At the time of this writing, the Bitcoin Blockchain is the most decentralized network in terms of its mining pools. Other cryptocurrencies display higher concentration levels. As the concentration increases, the likelihood of collusion and 51% attack among major participants increase, posing security threats to the underlying blockchain. The increased concentration also increases the probability of being taken under central control (of governments or non-governmental entities), eventually leading to the loss of censorship-resistance feature and even being shut down. Although game-theoretic and economic incentives embedded in the bitcoin network harshly punish misbehaving, such incentive mechanisms do not entirely eliminate such a probability.²¹ There has been proposals to make bitcoin mining pools more decentralized, however, as of this writing, none has been implemented.²²

In this paper, after a discussion on the nature of money and cryptocurrencies, we will focus on the concept of money and building upon the literature on information-economics of debt contracts and safe assets, we will argue that bitcoin can potentially be viewed as a 'safe assets' from this information-economics perspective. Although bitcoin aims at offering the functions of base money or central bank high-powered money²³ and as such cannot be directly compared to the commercial bank money (i.e., bank-issued IOUs) or shadow bank money, money creation in banking and shadow banking is discussed as it is necessary for understanding the creation of information-insensitivity in the process of (private or public-private) money creation. Our main contribution lies in the insights gained from the information economics in the context of 'safe assets' and money and quasi-money creation within the shadow banking sector and their application to the cryptocurrency context. In particular, drawing lessons from the literature on 'safe assets' and building on Holmstrom's seminal work (2015),²⁴ this paper highlights certain differences in the basic information economics of cryptocurrencies as opposed to that of fiat currencies (including the monetary aggregates) that can inform policy discussions about the future regulation of cryptocurrencies.

It is noteworthy at this very outset that informational advantage is not the only parameter that can play a role in transforming an asset into a money-like asset or a means of payment and settlement. There are other, and more important considerations in transforming an asset into money or quasi-money, such as price stability, lower intermediation costs, universal acceptance, technical neutrality (i.e., neutrality towards the type or value of the underlying transaction), instant and immediate settlement of the underlying fiduciary obligations and, last but not least, legal tender status and legal protections offered to the means of payments

²¹ See: Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System."; Stark, "Making Sense of Cryptoeconomics."

²² See: Eyal and Sirer, "How to Disincentivize Large Bitcoin Mining Pools."

²³ Base money or high-powered money is the money issued by central banks and in most economies consists of coins and (central bank) notes.

²⁴ Bengt Holmstrom, "Understanding the Role of Debt in the Financial System," *BIS Working Paper No 479* (2015).

and settlements such as ensuring settlement finality, protection from fraud, counterfeiting, and misuse.²⁵ For example, in addition to the information insensitivity, moneyness requires scarcity. There are many information insensitive objects that can become money merely because of their simple informational structure (e.g., a grain of sand), however, since their supply is practically infinite, they are not accepted as money. On the contrary, gold is a simple product in the sense that it carries no counterparty risk and has no underlying obligation or collateral, but it is scarce, hence it is closer to moneyness. In this example, what differentiates gold from a grain of sand is not its informational structure, but its scarcity.

Money, bitcoin and a crisis of identity

“Men of business in England do not...like the currency question. They are perplexed to define accurately what money is: *how* to count they know, but *what* to count they do not know.”²⁶

On August 21, 2017, a proposal was laid out by the Managing Director at e-Residency of Estonia for issuing crypto tokens - called ‘estcoins’ - to its e-residents through an Initial Coin Offering (ICO).²⁷ The idea could be further extended to build a sovereign wealth fund on top of such a currency.²⁸ On September 07, 2017, however, the European Central Bank’s (ECB) Mario Draghi rejected Estonia’s idea of issuing virtual currencies stating that “... no member state can introduce its own currency... The currency of the euro zone is the euro.”²⁹ Developments of this kind, along with the keen interest of central bankers in studying and potentially issuing their own cryptocurrencies,³⁰ have shown that cryptocurrencies can at least tangentially compete with fiat currencies.

²⁵ Phoebus Athanassiou, "Impact of Digital Innovation on the Processing of Electronic Payments and Contracting: An Overview of Legal Risks," *ECB Legal Working Paper Series No 16* (October 2017): 10-11.

²⁶ Walter Bagehot, "The General Aspect of the Banking Question," in *The Collected Works of Walter Bagehot*, ed. Norman St John Stevas (London: The Economist, 1857).

²⁷ Kaspar Korjus to E-Residency Blog, August 22, 2017, 2017, <https://medium.com/e-residency-blog/estonia-could-offer-estcoins-to-e-residents-a3a5a5d3c894>.

²⁸ Lionel Laurent, "The Bitcoin Sovereign Wealth Fund; Estonia Wants in on the Crypto-Currency Bubble," *Bloomberg* August 25, 2017.

²⁹ Reuters Staff, "Ecb’s Draghi Rejects Estonia’s Virtual Currency Idea," *Reuters* September 7, 2017.

³⁰ Morten Bech and Rodney Garratt, "Central Bank Cryptocurrencies," *BIS Quarterly Review* (2017). Other central banks, such as Sweden’s Riksbank, are considering issuing digital currencies (e-krona in the case of Riksbank), though as of this writing, there is no final decision as to the issue or technical specification of e-krona. To follow this project, see: <https://www.riksbank.se/en-gb/financial-stability/the-financial-system/payments/does-sweden-need-an-e-krona/>. For the pros and cons of central bank digital currencies, see; Max Raskin and David Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking," (National Bureau of Economic Research, 2016).

Although there is no single agreed-upon definition of a currency or money,³¹ a classic textbook definition comprises anything exhibiting three key features of being a store of value, a medium of exchange, and a unit of account.³² Based on the above definition, bitcoin, as of this writing, cannot be considered as a currency.³³ However, scholars of monetary history, economics and law may disagree with the classic textbook definition on the notion of money. In general, there are two prevailing schools of thought on money. On the one hand, the credit theory of money advocates a credit or debt-based monetary system,³⁴ by mainly emphasizing the role of money as a unit of account, or a ledger on which assets and liabilities are recorded. On the other hand, the commodity theory of money mainly focuses on a commodity-based monetary system by emphasizing the role of money as a medium of exchange or a store of value. Bitcoin appears to be more in line with the commodity theory of money.

However, there is another important aspect to money relating to the role of the state, law and legal institutions in the definition of money, which appears to be more contentious in the contemporary thought on the theory of money. More specifically, as regards the role of the state in monetary systems, two prevailing views exist. The state theory of money, championed by Georg Knapp and Abbe Lerner, views legal tender status as central to money.³⁵ In contrast, the spontaneous or emergent theory of money,³⁶ which finds its roots in the works of Carl Menger on the origins of money,³⁷ views universal acceptance as a medium of exchange as the most important criterion of money.³⁸ Friedrich Hayek, George Selgin, Richard Timberlake, Roland Vaubel, Lawrence White, and Leland Yeager are the most vocal theorists of this approach many of whom hold a free banking view and are supporters of the view that in a ‘concurrent’

³¹ Milton Friedman, "The Island of Stone Money," *The Hoover Institution Working Papers in Economics E-91-3* (1991).; See also: Michael F. Bryan, "Island Money," *Federal Reserve Bank of Cleveland, Economic Commentary* (2004). There are apparently some differences between money and currency according to some scholars. For examples and detailed discussion of different meanings of money in a legal context, see: Charles Proctor, *Mann on the Legal Aspect of Money*, 7 ed. (Oxford: Oxford University Press, 2012)., Chapter 1.

³² Proctor, *Mann on the Legal Aspect of Money*. Chapter 1. Proctor/Mann add(s) "a measure of value" or "a standard for contractual obligations" in the functional definition of money, however, he also views the medium of exchange function as the key feature of money. See also: Jack Weatherford, *The History of Money: From Sandstone to Cyberspace* (New York: Crown Publishers, Inc., 1997), 20.; David Graeber, *Debt: The First 5,000 Years* (Brooklyn, New York: Melville House Publishing, 2011). (Viewing money as a unit of account for debt.)

³³ David Yermack, "Is Bitcoin a Real Currency? An Economic Appraisal," *NBER Working Paper Series 19747* (2013).

³⁴ A Mitchell Innes, "The Credit Theory of Money," in *Credit and State Theories of Money: The Contributions of A. Mitchell Innes*, ed. L. Randall Wray (Cheltenham, UK: Edward Elgar Publishing Limited, 2004). David Graeber (an anthropologist who provides significant evidence that money has emerged as a unit of account for debt. See Graeber, *Debt: The First 5,000 Years*.

³⁵ Georg Friedrich Knapp, "The State Theory of Money," *History of Economic Thought Books* (1924).; see also; Abba P. Lerner, "Money as a Creature of the State," *The American Economic Review* 37, no. 2 (1947).

³⁶ Some texts refer to this theory as 'Societary Theory of Money'. See: Proctor, *Mann on the Legal Aspect of Money*.

³⁷ Karl Menger, "On the Origin of Money," *The Economic Journal* 2, no. 6 (1892).; See also: Mikael Stenkula, "Carl Menger and the Network Theory of Money," *The European Journal of the History of Economic Thought* 10, no. 4 (2003).

³⁸ Lawrence H. White, *Competition and Currency: Essays on Free Banking and Money* (New York: New York University Press, 1989), 7.

currency setting, good money would drive bad money out of circulation.³⁹ Historical evidence for the claim that anything that is generally accepted as a medium of exchange can be considered as money abounds.⁴⁰ Lacking legal tender status, bitcoin and cryptocurrencies in general cannot be considered as money from the state theory of money perspective.⁴¹ It is therefore only from the point of view of the spontaneous or emergent theory of money that we can explore the moneyness of bitcoin.

For bitcoin, a first hurdle to becoming money or quasi-money is its total lack of any intrinsic value. As the native token of the Bitcoin Blockchain, bitcoin's value is tied to the security of its Blockchain and is partly a result of the trust that its users assign to that security and the fixed number of bitcoins that, by design of its Blockchain, can be issued. Therefore, as of today, bitcoin is being mainly held for speculative purposes. Yet since bitcoin is an evolving phenomenon, it is likely that through time and with emergent upgrades to the bitcoin protocol, such as scaling solutions (e.g., segregated witness or Segwit), second-layer solutions such as Lightning Network,⁴² and proposals for redefining the default standard for measuring bitcoin, such as Bits denomination BIP,⁴³ it could evolve into a reliable store of value and possibly a medium of exchange.⁴⁴

However, the most difficult hurdle for bitcoin to pass will remain becoming a generally accepted unit of account. There is a hierarchy among the functions of money. For an asset to become a medium of exchange, it needs to be a store of value. And to become a unit of account, such an asset should be used as a medium of exchange across a variety of transactions in a given society so that it could become a means of social coordination.⁴⁵ Indeed, for some economists, money's function as the unit of account is the most important criterion in the definition of money.⁴⁶ In this perspective, it is far easier for bitcoin to become a store of value or a medium of exchange, however, bitcoin may never become a unit of account due to its inflexible supply schedule that begets price volatility. In theory, the community of users could expand to a size where

³⁹ Friedrich A Von Hayek, *Choice in Currency: A Way to Stop Inflation* (London: The Institute of Economic Affairs, 1976).; George Selgin, "Salvaging Gresham's Law: The Good, the Bad, and the Illegal," *Journal of Money, Credit and Banking* 28, no. 4 (1996).

⁴⁰ See for example: Weatherford, *The History of Money: From Sandstone to Cyberspace*, 20.

Perhaps the best illustration of the spontaneous theory of money can be found in Radford's work in which he illustrates how cigarettes became the standard of value and currency in the Prisoner of War Camp. See: R. A. Radford, "The Economic Organisation of a P.O.W. Camp," *Economica* 12, no. 48 (1945).

⁴¹ Although legal tender status plays an important role in giving an asset the status of money, it is not the only criterion of moneyness. Scottish and Northern Ireland banknotes are examples of notes that are widely used as money, but there is no legislation that confers legal tender status on them. See: Proctor, *Mann on the Legal Aspect of Money*, chapter 2; Parags 2.31, 2.32.

⁴² Joseph Poon and Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments," (2016).

⁴³ Song, "Bits Denomination Bip."

⁴⁴ There are improvements on Bitcoin protocol and also second layer solutions that promise to make bitcoin good for all the above-mentioned purposes. For an overview of two such business improvements called "market exchange pricing", and "instantaneous exchange facilities", see: Luther and White, "Can Bitcoin Become a Major Currency?." See also: Song, "Bits Denomination Bip."

⁴⁵ Robleh Ali et al., "The Economics of Digital Currencies," *Bank of England Quarterly Bulletin 2014 Q3* (2014): 278-79.

⁴⁶ Michael Woodford, *Interest and Prices: Foundations of a Theory of Monetary Policy* (Princeton: Princeton University Press, 2003).

bitcoin could meet the criterion of sufficient public acceptance to serve within a given community as a means of exchange. However, as of this writing, the number of businesses and individuals accepting bitcoin as a medium of exchange is limited.⁴⁷

Similar to the elephant-in-the-dark-room metaphor, public authorities have also taken different stances on the nature of cryptocurrencies. Tax authorities have designated cryptocurrencies as property.⁴⁸ Commodity markets authorities have viewed them as commodity.⁴⁹ Securities regulators have seen them as security,⁵⁰ and regulators and supervisors in charge of money or financial crime have designated them as currency. By the same token, legislators and regulators around the globe have attempted to define cryptocurrencies. In many legal and statutory texts, as well as central banking nomenclature, cryptocurrencies are often dubbed as virtual or digital currencies. For example, a virtual currency is defined in the § 102(23) of the U.S. Uniform Regulation of Virtual-Currency Business Act (URVCBA) as a “(A) digital representation of value that: (1) is used as a medium of exchange, unit of account, or store of value; and (2) is not legal tender, whether or not denominated in legal tender”.⁵¹ The New York Bitlicense defines virtual currencies as “any type of digital unit that is used as a medium of exchange or a form of digitally stored value.”⁵² According to the Bitlicense, “Virtual Currency shall be broadly construed to include digital units of exchange that (i) have a centralized repository or administrator; (ii) are decentralized and have no centralized repository or administrator; or (iii) may be created or obtained by computing or manufacturing effort.”⁵³ The ECB defines virtual currencies as “a digital representation of value, not issued by a central bank, credit institution or e-money institution, which in some circumstances can be used as an alternative to money”.⁵⁴ In ECB’s view, virtual currencies are not money nor currency from a legal standpoint.⁵⁵ It seems that these definitions have been intentionally broadly constructed to include the majority of the cryptocurrencies, even if they may not be a store of value or a medium of exchange.

⁴⁷ As of this writing, the number of businesses and individuals accepting bitcoin as a medium of exchange is limited. For a map of bitcoin accepting venues, see: <http://coinmap.org/#/map/45.54995577/10.50400257/15>

The universal acceptance in the definition of money may be understood to refer to acceptance by a given community. See: Benjamin Geva, "Disintermediating Electronic Payments: Digital Cash and Virtual Currencies," *Journal of International Banking Law and Regulation* 13, no. 8 (2017).

⁴⁸ See: Athanassiou, "Impact of Digital Innovation on the Processing of Electronic Payments and Contracting: An Overview of Legal Risks," 22-24.

⁴⁹ Commodity Futures Trading Commission, "In the Matter Of: Coinflip, Inc., D/B/a Derivabit, and Francisco Riordan, Respondents: Order Instituting Proceedings Pursuant to Sections 6(C) and 6(D) of the Commodity Exchange Act, Making Findings and Imposing Remedial Sanctions (Cftc Docket No. 15-29)," (September 17, 2015).

⁵⁰ Commission, "Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The Dao."

⁵¹ § 102(23) of the Uniform Regulation of Virtual-Currency Business Act (URVCBA)

⁵² Section 200.2(p) Bitlicense, New York Department of Financial Services, New York Codes, Rules and Regulations; Title 23, Department of Financial Services, Chapter I. Regulations of the Superintendent of Financial Services, Part 200, Virtual Currencies.

⁵³ Ibid.

⁵⁴ European Central Bank, "Virtual Currency Schemes- a Further Analysis," (2015): 4.

⁵⁵ Ibid.

From a legal perspective, cryptocurrencies should also be differentiated from electronic money (e-money).⁵⁶ E-money is always at par with fiat money. The main difference between e-money and fiat money is that e-money is the digital representation of fiat money stored on an electronic chip.⁵⁷ However, cryptocurrencies are self-anchored and are not pegged to any currency.⁵⁸ In addition, e-money issuers should redeem the monetary value of the e-money at par on demand, whereas such an obligation does not exist for cryptocurrency developers or issuers.⁵⁹

Table 1. Comparison between e-money and Bitcoin

	E-Money	Bitcoin
Format	Digital	Digital
Unit of account	Fiat currencies (USD, EUR, KES)	Bitcoins (BTC)
Customer identification	Financial Action Task Force (FATF) standards apply for customer identification (though such standards permit simplified measures for lower risk financial products)	Anonymous
Means of production	Digitally issued against fiat currency of central authority	Mined/mathematically generated
Issuer	Legally established e-money issuer (which may be a financial institution)	Community of people/miners

Source: Adapted from European Central Bank (2012).

3 The European Commission Electronic Money Directive (2009/110/EC). http://ec.europa.eu/internal_market/payments/emoney/text/index_en.htm

The anonymous attribute in the customer identification section of the above table may not be accurate. As bitcoin transactions are mainly pseudonymous.

In our view, apart from being a commodity money, at least three main properties of bitcoin set it apart from traditional central bank money: decentralization, consensus mechanism, and censorship resistance. Bitcoin has created an incentive-compatible ecosystem for the security and maintenance of the Bitcoin Blockchain

⁵⁶ Sarah Rotman, "Bitcoin Versus Electronic Money," in *CGAP Brief* (Washington, D.C.: The Consultative Group to Assist the Poor Brief, 23 January 2014).

⁵⁷ Article 2(2) for the E-money directive defines e-money as a monetary value represented as a claim on the issuer which is stored on an electronic device and accepted as a means of payment by undertakings other than the issuer. See Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC, *OJ L 267*, 10.10.2009, p. 7–17.

⁵⁸ Though they can be pegged to fiat currencies (e.g., USDT)

⁵⁹ Art. 11 Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC, *OJ L 267*, 10.10.2009, p. 7–17.

leading to the creation of a denationalized and decentralized money. In this view, the idea of central bank cryptocurrency (CBCC),⁶⁰ put forward by, among others,⁶¹ Bech and Garratt of the Bank for International Settlements (BIS),⁶² which retains the issuance of money under the control of the central bank, but decentralizes the settlement method (peer-to-peer settlement) would seem as an oxymoron.⁶³ This paper, also does not view such cryptocurrencies as true cryptocurrencies; they may best be classified as (centralized) digital base money with a peer-to-peer settlement mechanism.

Alongside bitcoin, the cryptocurrency ecosystem includes a whole variety of other so-called cryptoassets. According to one classification, assets created using cryptography could fall under the umbrella term of cryptoassets.⁶⁴ However, cryptoassets suffer from a crisis of identity.⁶⁵ This is mainly because they differ widely from one another,⁶⁶ and many tokens or cryptocurrencies listed in cryptocurrency exchanges may not meet even the minimum required criteria of moneyness. On the contrary, upon a closer scrutiny, a majority of digital tokens issued through ICOs can easily meet the definition of an investment contract (security), such as the tokens issued by the DAO.⁶⁷

Cryptoassets could be classified as digital commodities (cryptocommodities) representing raw digital resources, or digital tokens (cryptotokens) representing finished digital goods and services.⁶⁸ Some of these assets can potentially become a new asset class with potential of maturing into a valuable portfolio

⁶⁰ CBCC are also called digital base money (DBM). For a thorough analysis of the DBM as well as why, as of now, there is no need for introducing it, see: Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective," in *Speech at the Farewell ceremony for Pentti Hakkariainen, Deputy Governor of Suomen Pankki – Finlands Bank, Helsinki* (16 January 2017).; "Virtual or Virtueless? The Evolution of Money in the Digital Age," in *Lecture at the Official Monetary and Financial Institutions Forum, London* (8 February 2018).;

⁶¹ JP Koning to Moneyness: Money is best described as an adjective, not a noun, October 19, 2014, <http://jpkoning.blogspot.lu/2014/10/fedcoin.html>.; to American Institute for Economic Research, April 26, 2018, <https://www.aier.org/article/sound-money-project/anonymous-digital-cash>.; Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy," (National Bureau of Economic Research, 2017).; David Andolfatto to MacroMania, April 25, 2015, <http://andolfatto.blogspot.lu/2015/02/fedcoin-on-desirability-of-government.html>.;

Aleksander Berentsen and Fabian Schar, "The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies," *Federal Reserve Bank of St. Louis Review* (2018); John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," *Bank of England Staff Working Paper No. 605* (2016).

⁶² Bech and Garratt, "Central Bank Cryptocurrencies." In their view a central bank cryptocurrency (CBCC) is "an electronic form of central bank money that can be exchanged in a decentralized manner known as peer-to-peer, meaning that transactions occur directly between the payer and the payee without the need for a central intermediary." "Central Bank Cryptocurrencies," 56. In other words, in central bank cryptocurrency, the money creation leg of currency still remains to be the prerogative of governments (central banks) but the settlement leg is decentralized and organized in a peer-to-peer fashion.

⁶³ For an engaging read on the CBCC, see: JP Koning to Moneyness, October 19, 2014, <http://jpkoning.blogspot.lu/2014/10/fedcoin.html>.

⁶⁴ Chris Burniske and Jack Tatar, *Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond* (New York: McGraw Hill, 2018).

⁶⁵ For regulatory implications of the crisis of identity, see: Hadar Yoana Jabotinsky, "The Regulation of Cryptocurrencies - between a Currency and a Financial Product," *SSRN* (2018).

⁶⁶ Bank, "Virtual Currency Schemes- a Further Analysis," 9-11.

⁶⁷ Commission, "Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The Dao."

⁶⁸ Burniske and Tatar, *Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond*. Chapter 4.

diversification instrument.⁶⁹ This paper focuses on bitcoin, which is the most well-known and the largest cryptocurrency in terms of market cap. Although bitcoin has been designated as a commodity, it has a hybrid nature, displaying the features of both commodities and currencies. Perhaps as of this writing, bitcoin might best be seen as a form of digital commodity money, or in Selgin's words 'synthetic commodity money'.⁷⁰ Despite the focus on bitcoin, the analysis of this paper would apply, with varying degrees, to many other cryptocurrencies such as Litecoin (LTC), Dash (DASH), Ripple (XRP), Monero (XMR), and Zcash (ZEC), which exhibit features that are considerably closer to currencies or commodities than investment contracts (securities).

It is important to note that the remainder of this paper has a very specific focus. It is an attempt to apply the lessons from the information economics within the safe asset debate in the shadow banking sector to the emerging world of cryptocurrencies. It is important to acknowledge that although better informational features are helpful and perhaps necessary for an asset that has no intrinsic value to become money, as previously mentioned, it takes more than transparency in information economics for an asset to become a safe asset, money or currency. Therefore, this paper is not and should not be considered as a full treatment of cryptocurrencies and their potential to become money or currency.

Information economics: how bitcoin differs from fiat currency

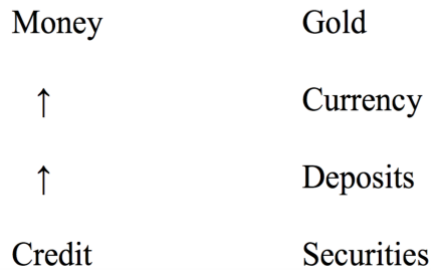
According to Perry Mehrling, under the gold standard covering mainly the 19th century, gold (the ultimate international means of payment), national currencies (promises to pay gold), bank deposits (promises to pay currency on demand), and securities (promises to pay currency or deposits during a certain period of time in the future) used to constitute the hierarchy of money; with gold being at the apex of the hierarchy and securities at the bottom.⁷¹

⁶⁹ Aleksander Berentsen and Fabian Schär, "A Short Introduction to the World of Cryptocurrencies," *Federal Reserve Bank of St. Louis Review* 100, no. 1 (First Quarter 2018).

⁷⁰ Selgin defines synthetic commodity money as "money that lacks nonmonetary value but is nevertheless reproducible only at a positive and rising marginal production cost, if indeed it can be reproduced at any cost at all." George Selgin, "Synthetic Commodity Money," *Journal of Financial Stability* 17 (2015): 95.

⁷¹ Perry Mehrling, "The Inherent Hierarchy of Money," *Social Fairness and Economics: economic essays in the spirit of Duncan Foley* 169 (2012).

A Simple Hierarchy



Source: Mehrling, P. (2012). "The inherent hierarchy of money."

In the fiat money framework, the concept of hierarchy of money can be reconfigured based on the ‘safety’ or ‘information insensitivity’ of a financial instrument. In other words, another way to construct a concept of hierarchy in the fiat currency system is to build this concept based on the information economics of a particular financial instrument or asset. The most information-insensitive (the safest) assets being at the top of the hierarchy of money, the least information-insensitive (the riskiest) assets lying at the bottom.⁷² Therefore, within this framework, the level of safety of an asset as a means of settlement would be the benchmark against which the concept of hierarchy is built; the source of safety being the money claims’ proximity to the government; i.e., the ultimate source of official liquidity and credit puts that make money claims information insensitive.

One essential difference between cryptocurrencies and fiat money is that the latter is invariably the liability of someone, which has to be redeemed by the issuing entity. Although it is hard to establish that the central bank money is a debt instrument,⁷³ the rest of the monetary aggregates (i.e., parts of the M1, M2, and M3)⁷⁴

⁷² For a similar classification see: Katharina Pistor, "Moneys’ Legal Hierarchy," in *Just Financial Markets? Finance in a Just Society*, ed. Lisa Herzog (Oxford: Oxford University Press, 2017).

⁷³ See: Nick Rowe to Worthwhile Canadian Initiative: A mainly Canadian economics blog, April 05, 2015, 2015, http://worthwhile.typepad.com/worthwhile_canadian_initi/2012/04/from-gold-standard-to-cpi-standard.html; to Worthwhile Canadian Initiative: A mainly Canadian economics blog, March 12, 2012, 2012, http://worthwhile.typepad.com/worthwhile_canadian_initi/2012/03/is-modern-central-bank-money-a-liability.html. However, such a promise would not be considered as a binding legal contract as the central bank has theoretically unlimited discretion on inflating the currency.

Some theories, such as the credit theory of money, suggest that there is no need for redeemability or convertibility. For example, Mitchell Innes casts significant doubt on whether redeemability has been a feature of currency even under the metallic standard. See: A Mitchell Innes, "What Is Money?," in *Credit and State Theories of Money: The Contributions of A. Mitchell Innes*, ed. L. Randall Wray (Cheltenham, UK: Edward Elgar Publishing Limited, 2004), 36.

⁷⁴ According to the ECB’s definition monetary aggregates “comprise monetary liabilities of MFIs [monetary financial institutions] and central government (post office, treasury, etc.) vis-à-vis non-MFI euro area residents excluding central government.

- M1 is the sum of currency in circulation and overnight deposits;
- M2 is the sum of M1, deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months; and

is the liability of someone; mainly governments and banks. But bitcoin, similar to a commodity money, is the liability of no one.

Whilst initially government-issued money had to be redeemed in gold or silver,⁷⁵ after decoupling money from the precious metals, the ‘full faith and credit’ of governments replaced the convertibility of the money to gold or silver. Aside from granting legal tender status to fiat money, the power of the state to impose taxes in the future, which itself depends upon the GDP growth, is mainly what backs fiat money. In addition, the fact that fiat money is accepted by the government for tax purposes ensures that such a currency is good for the discharge of debt (and hence a store of value for future debt repayments), which ultimately facilitated the universal adoption of fiat money (medium of exchange).⁷⁶

In analyzing bitcoin and cryptocurrencies, the state theory of money, which presupposes that for an asset to become money, it needs to be given the status of legal tender, has limited application as bitcoin has not been granted such a status in any major jurisdiction. Therefore, for the sole purpose of the argument and following the spontaneous or emergent theory of money, we argue that for an asset to become a store of value and a potential medium of exchange, at a minimum, it needs to possess certain safety features. In other words, for something to become a non-state or denationalized money, it needs to first be, or perceived to be, a ‘safe asset’. The safe-asset property of a currency can pave the way for its universal adoption, especially at its start-up phase. We will explain then how safety enhancing features of assets (money and quasi-money) in financial and monetary systems have been at work for decades and will show why bitcoin cannot rely on the safety features of traditional currencies. Yet, we will also argue that from an information-economics perspective, bitcoin presents certain safety features, which originate from the symmetric knowledge of economic agents or users as to its protocol and the inner workings of its underlying blockchain.

Information asymmetry, adverse selection and money as a medium of exchange

In the context of non-commodity money (e.g. fiat currency), A is willing to accept a piece of paper as a method of payment in anticipation that B will accept it from A, and C will accept it from A and B, ad infinitum. For this to happen, the settlement asset should not give rise to any adverse selection problem

- M3 is the sum of M2, repurchase agreements, money market fund shares/units and debt securities with a maturity of up to two years.” See: ECB, Monetary aggregates, available at:

https://www.ecb.europa.eu/stats/money_credit_banking/monetary_aggregates/html/index.en.html

⁷⁵ Though there is disagreement on this point between the proponents of the credit theory of money and those supporting commodity money.

⁷⁶ William J. Luther, "Getting Off the Ground: The Case of Bitcoin," *AIER Sound Money Project Working Paper Series* (2018).

arising from the information asymmetry as to the value of the settlement asset. In other words, the asset should be perceived as ‘safe’ and its safety should be common knowledge. By definition, a safe asset is an information-insensitive asset,⁷⁷ holding the promise of becoming a high-quality store of value, a medium of exchange and potentially a unit of account. In other words, in order for a financial instrument to become a store of value and a medium of exchange, it should be highly information-insensitive. This attribute of safe assets could contribute to its price stability in the long run.⁷⁸

Finance literature suggests that debt instruments have traditionally been superior to equity instruments in addressing informational problems between borrowers and lenders.⁷⁹ Debt instruments not only economize on the cost of information collection at the contract execution stage, but also on the liquidation cost of collateral.⁸⁰ Debt-on-debt (debt used as collateral for another debt contract) minimizes financial market participants’ incentives to produce private information about the ultimate payoffs.⁸¹ This makes debt the least information-sensitive instrument in the financial markets. In other words, “the argument for the optimality of debt is simply that it’s easiest to trade if you’re sure that neither party knows anything about the payoff on the debt.”⁸² This near-information insensitivity removes adverse selection problem,

⁷⁷ Gary Gorton, Stefan Lewellen, and Andrew Metrick, "The Safe-Asset Share," *The American Economic Review* 102, no. 3 (2012): 102.

⁷⁸ The analogy to bitcoin could be made as to the underlying design of the Bitcoin Blockchain. Unlike fiat money, bitcoin as a commodity money, is self-anchored and its value is not pegged to any other commodity or contract. However, the trust in bitcoin, especially as a store of value, comes from the fact that it is based on the embedded rules or algorithms governing the Bitcoin Blockchain, that it is decentralized and that its monetary policy should be decided by a specific consensus mechanism. In addition, artificial scarcity in this ‘digital’ currency plays an important role in the moneyness of bitcoin. Therefore, the value of bitcoin largely originates from holding a digital unit of a means of a store of value, medium of exchange and unit of account on the Bitcoin Blockchain as a secure, decentralized (and intermediary-free), censorship-resistant network for digital payments. In this sense, the value of bitcoin deriving from the trust in the Bitcoin Blockchain would very much resemble the arguments put forward by the institutional theory of money which states that money is “no more than credit against an obligor, whose acceptance as a store of value and as a means of payment by the public is dependent on a comprehensive legal framework that ensures stable purchasing power, its availability even in time of banking stress and its functional capability to settle monetary obligations. It is no longer a chattel, but a transferable credit within an overall institutional framework.” See: Antonio Sáinz de Vicuña, "An Institutional Theory of Money," in *International Monetary and Financial Law: The Global Crisis*, ed. Mario Giovanoli and Diego Devos (New York: Oxford University Press, 2010), 517. (paragraph 25.01)

Some commentators view bitcoin’s self-anchored property as its principal weakness as it causes inherent instability in its value. See: Geva, "Disintermediating Electronic Payments: Digital Cash and Virtual Currencies."

⁷⁹ These informational advantages originate from the fact that at the contracting stage, debt instruments are an optimal instrument to address private information. See: David C. Nachman and Thomas H. Noe, "Optimal Design of Securities under Asymmetric Information," *The Review of Financial Studies* 7, no. 1 (1994). At this stage, if lenders screen borrowers, debt instruments can optimize information collection. See: Roman Inderst and Holger M. Mueller, "Informed Lending and Security Design," *The Journal of Finance* 61, no. 5 (2006). In addition, debt instruments are better positioned to address the moral hazard behavior of managers. Robert D. Innes, "Limited Liability and Incentive Contracting with Ex-Ante Action Choices," *Journal of Economic Theory* 52, no. 1 (1990). Debt is also the least information-sensitive instruments to ex-post public information. See: Peter M. DeMarzo, Ilan Kremer, and Andrzej Skrzypacz, "Bidding with Securities: Auctions and Security Design," *American Economic Review* 95, no. 4 (2005).

⁸⁰ Robert M. Townsend, "Optimal Contracts and Competitive Markets with Costly State Verification," *Journal of Economic Theory* 21, no. 2 (1979).; See also: Oliver Hart and John Moore, "Default and Renegotiation: A Dynamic Model of Debt*," *The Quarterly Journal of Economics* 113, no. 1 (1998).

⁸¹ Dang, Gorton, and Holmström, "Ignorance, Debt and Financial Crises.". As will be explained, in the section entitled ‘price tag or relying on symmetric ignorance’, this can be problematic in times of crisis.

⁸² Gary Gorton, "Shadow Banking," *The Region* December 2010, 19.

contributes to liquidity of debt instruments, and thereby makes them a viable instrument for both market and funding liquidity.⁸³

The informational advantage of debt instruments, i.e., information insensitivity, makes them a relatively better instrument to be used for issuing money claims.⁸⁴ This is because an information-insensitive financial instrument would be highly liquid and adverse-selection proof. Liquidity and adverse-selection-proof property of information-insensitive instruments would make them suitable for use as a medium of exchange. For example, aside from central bank money (which is currently the most information insensitive financial instrument), bank claims are effectively used as money as the prudential regulation together with government credit and liquidity puts (i.e., deposit insurance and lender of last resort (LOLR), respectively) make them information insensitive⁸⁵ and a viable choice for a medium of exchange and a store of value,⁸⁶ making such claims even suitable as an ultimate settlement asset used in the operations by certain financial market infrastructures.⁸⁷ In the absence of such government measures and protections, bank claims would not have been redeemable at par on demand, and would have long ceased to be money.⁸⁸

To summarize, for an asset to become a medium of exchange, the first and utmost important factor is the safety feature that could enhance its stability in the long run. In transactional terms, the less an asset is prone to adverse selection, the better it is for transactional purposes (i.e., medium of exchange). There are different methods to mitigate adverse selection. Since adverse selection exists because of information asymmetry, signaling and screening have traditionally been two main mechanisms to mitigate information asymmetry.⁸⁹ Another major way of addressing adverse selection problem is to essentially do away with information asymmetry by either shedding sunlight on the settlement asset so that its value would be symmetrically and

⁸³ This difference in economics of information in the equity markets versus debt markets projects itself in the organization and structure of these two markets. Stocks markets are organized to facilitate price discovery, money markets are organized to enhance liquidity. And to do so, they must obviate the need for price discovery. See: Holmstrom, "Understanding the Role of Debt in the Financial System."

For the difference between funding and market liquidity, see: Markus K. Brunnermeier and Lasse Heje Pedersen, "Market Liquidity and Funding Liquidity," *The Review of Financial Studies* 22, no. 6 (2009).

⁸⁴ Dang, Gorton, and Holmström, "Ignorance, Debt and Financial Crises." For bitcoin and other cryptocurrencies to become money, they need to become information insensitive. As soon as a currency becomes information sensitive, it would lose its moneyness.

⁸⁵ The core banking claims (deposits) also enjoy government (limited) credit and liquidity puts. In other words, the trust in banking claims - used as money - comes from the trust in the government backing such claims (trust in the prudential regulation and liquidity and credit puts).

⁸⁶ This is perhaps why banks are considered traditionally opaque. Indeed, the logic behind transparency in equity markets does not apply to money markets. See: Holmstrom, "Understanding the Role of Debt in the Financial System."

⁸⁷ Before the advent of central banking, clearing houses, by undertaking functions similar to central banks, could ensure that checks would trade at par by adding a layer of endogenous opacity. See Gary Gorton, "The Development of Opacity in U.S. Banking," *Yale Journal on Regulation* 31, no. 3 (2013): 839.; See also Gary B. Gorton, *Slapped by the Invisible Hand: The Panic of 2007* (New York: Oxford University Press, 2010).

⁸⁸ Gorton, "The Development of Opacity in U.S. Banking."

⁸⁹ See for example: George A. Akerlof, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *The Quarterly Journal of Economics* 84, no. 3 (1970).

perfectly evaluated by both parties to a transaction (i.e., creating common knowledge), or by obfuscating and hiding all the information so that neither party to a transaction could be able or would have incentive to acquire information (i.e., creating symmetric ignorance). Since an ultimate means of settlement needs to be the most information insensitive and completely free from the adverse selection problem, we argue that for such an asset (money), neither signaling nor screening would provide complete information insensitivity. Instead, for such an asset to best perform its function as an ultimate means of settlement, its value and underlying mechanisms should be either common knowledge or should not be known to any financial market participant at all (symmetric ignorance). In money markets, laddered safety is no safety.

The safety feature of an asset can be enhanced either through public/government guarantees or through private mechanisms.⁹⁰ Since bitcoin is a decentralized asset, this paper does not suggest increasing the safety of bitcoin as a store of value by relying on government credit or liquidity puts (if ever possible!) as that suggestion would defeat the very purpose of bitcoin in the first place. And since bitcoin is the first digital asset, pegging its price to a basket of physical commodities would be counterproductive and would defeat the purpose for which it is created. In what comes next, we draw analogies between safety-enhancing mechanisms in the current (shadow) banking system⁹¹ and in the end, compare them to the design of the Bitcoin Blockchain.

How banks and shadow banks create money?

Historically banks and shadow banks have been in the money creation business. Bills of exchange were used to be a remedy for the scarcity of money and soon became the money for merchants. Besides modern banks, whose history goes back to at least the Middle Ages, shadow banking has existed at least since the late 19th century, when the Bank of England initiated a program to stabilize the private bills markets by bailing out bill brokers.⁹² These brokers were not banks. However, they were accepting to convert the bills into money,⁹³ an activity that would be called shadow banking today. Therefore, contrary to the public perception, money is far more elusive a concept than what initially appears to be, and many entities alongside central banks can create it.

⁹⁰ There would be other safety enhancing mechanism such as pegging the price of a currency to the price of a basket of commodities.

⁹¹ For a discussion of shadow banking definition and its regulation see: Hossein Nabilou and Alessio Paccès, "The Law and Economics of Shadow Banking," in *Research Handbook in Shadow Banking*, ed. Iris H. Chiu (forthcoming 2017).

⁹² Perry Mehrling et al., "Bagehot Was a Shadow Banker: Shadow Banking, Central Banking, and the Future of Global Finance," *Central Banking, and the Future of Global Finance (November 5, 2013)* (2013). Mehrling draws interesting parallels between the bills market of the late 19th century England and the current functioning of the shadow banking system.

⁹³ Walter Bagehot, *Lombard Street: A Description of the Money Market* (London: H.S. King, 1873).

In one classification, Pozsar (2014), arguing for the introduction of a new set of monetary aggregates that is able to track the supply of money and money-like claims for financial economy transactions (rather than real-economy transactions), defines money as something that trades at par on demand.⁹⁴ He further classifies currency, reserves and T-bills as purely public money (public money), insured bank deposits as private-public money (insured money), government repos⁹⁵ and Constant Net Asset Value (CNAV) share of government-only Money Market Funds (MMFs)⁹⁶ as public-private money (public shadow money), and repos collateralized by credit-risky private securities,⁹⁷ CNAV shares of prime funds, and uninsured deposits as purely private money (private shadow money). The latter instruments lack even an indirect access to public liquidity and credit puts.⁹⁸ In this view, four main institutions create money: central banks, banks, dealer banks and money market funds. A common denominator in all of the above classifications is the quest for safety (information-insensitivity) engineered using private mechanisms in the absence of public credit and liquidity puts.

⁹⁴ Zoltan Pozsar, "Shadow Banking: The Money View," *Office of Financial Research Working Paper* (2014): 7.

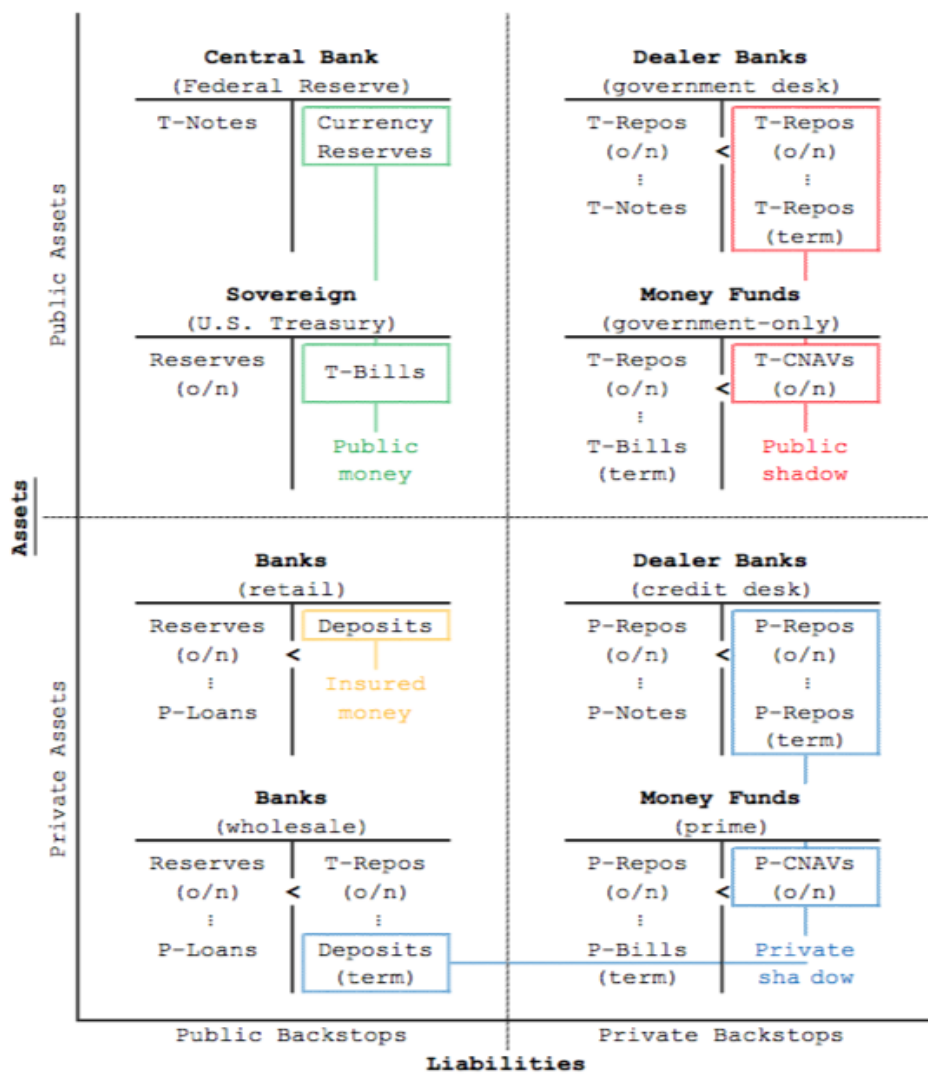
⁹⁵ These repos are collateralized by credit-safe public securities issued by dealers' government bond trading desks.

⁹⁶ These shares are Backed by public assets but not by public liquidity and credit puts explicitly

⁹⁷ These private securities could include instruments such as corporate bonds, issued by dealers' credit trading desks

⁹⁸ Pozsar, "Shadow Banking: The Money View."

Figure 1: The Money Matrix¹⁵



Source: Pozsar (2014)

In what follows, we study four typical mechanisms used to create money or quasi-money in the banking and shadow banking sector, they include:

1. Insurance or explicit and implicit government credit and liquidity puts; for example, deposit insurance, LOLR, and bailouts;
2. Collateralization (in covered bonds);
3. Exemptions from bankruptcy laws in repos;
4. Prudential requirements such as capital and liquidity requirements as well as portfolio restrictions for money-claim issuing entities.

Insurance

There are three theories of banking as related to money creation. The ‘financial intermediation theory’ suggests that banks do not create money,⁹⁹ the ‘fractional reserve theory’ of banking implies that although banks create money collectively through ‘multiple deposit expansion’ (the ‘money multiplier’), they do not individually create money, and the ‘credit creation theory of banking’ argues that each individual bank can create credit and money by granting a loan.¹⁰⁰

In the credit creation theory of banking, what enables (commercial) banks to create money is their monopoly over taking deposit and lending simultaneously without any rule requiring them to segregate clients’ money.¹⁰¹ In this view of banking, “[D]eposits are not endowments that precede loan formation; it is loans that create deposits.”¹⁰² Evidence from the UK suggests that banks create and allocate approximately 97% of the money supply.¹⁰³ In the fractional reserve theory and credit creation theory of banking, commercial banks would also create money through fractional reserve banking model. Fractional reserve banking entails risks. Since banks take *demand* deposits and at the same time commit not to recall loans at their whim, they are exposed to maturity mismatch. In addition, banks often find themselves funding illiquid assets by liquid liabilities and thereby exposed to liquidity mismatch. In short, banks engage in maturity and liquidity transformation carrying significant maturity mismatch risk. A bank that undertakes *levered* liquidity and maturity transformation, which along the way creates money, would need (government) safety nets, such as deposit insurance¹⁰⁴ and liquidity support.¹⁰⁵ In other words, the fragility of *levered* maturity transformation is the reason why banks are protected by a public safety net. Since the introduction of deposit

⁹⁹ Under the financial intermediation theory, banks create money by receiving deposits first and lending them out. In the fractional reserve theory, banks create money by receiving new reserves first and by lending them out. Therefore, to create money under the financial intermediation theory, banks have to have deposits first.

¹⁰⁰ Richard A. Werner, "A Lost Century in Economics: Three Theories of Banking and the Conclusive Evidence," *International Review of Financial Analysis* 46 (2016)..

¹⁰¹ "How Do Banks Create Money, and Why Can Other Firms Not Do the Same? An Explanation for the Coexistence of Lending and Deposit-Taking," *International Review of Financial Analysis* 36 (2014).; Werner, "A Lost Century in Economics: Three Theories of Banking and the Conclusive Evidence."; Richard A. Werner, "Can Banks Individually Create Money out of Nothing? — the Theories and the Empirical Evidence," *International Review of Financial Analysis* 36 (2014).

¹⁰² .

This is also called endogenous money theory. See Basil Moore J., *Horizontalists and Verticalists: The Macroeconomics of Credit Money* (New York: Cambridge University Press, 1988).; Nicholas Kaldor, "The New Monetarism," *Lloyds Bank Review* 97, no. 1 (1970).. The money created in this fashion is sometimes called ‘inside money’. See Markus K Brunnermeier and Yuliy Sannikov, "The I Theory of Money," *National Bureau of Economic Research Working Paper No. 22533* (2016).

¹⁰³ Michael; McLeay, Amar Radia, and Ryland Thomas, "Money in the Modern Economy: An Introduction," *Bank of England Quarterly Bulletin* 2014 Q1 (2014 Q1).; Michael; McLeay, Amar; Radia, and Ryland Thomas, "Money Creation in the Modern Economy," *Bank of England Quarterly Bulletin* 2014 Q1 (2014 Q1).;

¹⁰⁴ Deposit insurance as a means to achieve financial stability is a controversial issue. Many scholars argue that it would not overall protect financial stability. See: Asli Demirgüç-Kunt and Edward J. Kane, "Deposit Insurance around the Globe: Where Does It Work?," *Journal of Economic Perspectives* 16, no. 2 (2002).; Asli Demirgüç-Kunt, Edward Kane, and Luc Laeven, "Deposit Insurance around the World: A Comprehensive Analysis and Database," *Journal of Financial Stability* 20 (2015).

¹⁰⁵ Bagehot, *Lombard Street: A Description of the Money Market*. Some scholars advocate extending the safety net to shadow banking see: Mehrling et al., "Bagehot Was a Shadow Banker: Shadow Banking, Central Banking, and the Future of Global Finance."; Morgan Ricks, *The Money Problem: Rethinking Financial Regulation* (Chicago: University of Chicago Press, 2016).

insurance, there has been almost no serious runs by depositors on the banks of the developed world.¹⁰⁶ Indeed, the only way banks can create money is by relying on the government safety nets. Although deposit insurance rests on risk-based contributions of banks to the deposit insurance funds, in the event of systemic risk, there is an implicit government guarantee for such funds (i.e., bailouts). The government itself relies on its fiscal powers (taxing) in bailouts, and its monopoly over issuing central bank money in its LOLR function.¹⁰⁷

The problem with insurance is that it often begets moral hazard, i.e., excessive money creation. It is to prevent such excessive money creation using public credit and liquidity puts that several restrictions and conditions are in place for the provision of such measures. One such proposal for imposing further restrictions was the structural or functional separation in the banking industry that was proposed after the Great Depression. The most radical of all these proposals was the narrow banking proposal for a 100% currency-reserve banking, the most vocal proponents of which was Henry Simons.¹⁰⁸ This proposal, along with his advocacy for equity financing versus debt financing, would effectively ensure that no non-banking institution would be able to create quasi-money instruments or money substitutes. In short, the proponents of narrow banks¹⁰⁹ call for reforms that require all deposits of customers of a bank be held at central banks in the form of deposits, which is equivalent to a 100% reserve requirement. This means that the amounts that can be redeemed at par on demand should have a 100% reserve requirement. This proposal was part of the proposals that came to be known as the Chicago Plan in the aftermath of the Great Depression.¹¹⁰ At the heart of the narrow banking solutions to the banking crises is the separation of banks into two parts: A narrow bank offering deposits, and a mutual fund or investment company in which all the risks of volatility in the market value of assets pass through to the investors.

It is no surprise that such proposals resurfaced again in the aftermath of the global financial crisis (GFC) of 2007-2009. These proposals included a wide spectrum of recommendations ranging from narrow banking

¹⁰⁶ See Gorton, *Slapped by the Invisible Hand: The Panic of 2007*, 5. However, even in the recent global financial crisis, there were instances of runs on banks such as the run on the Northern Rock.

¹⁰⁷ It should be mentioned that governments do not enjoy a full discretion in providing such credit and liquidity puts, and in major jurisdictions, there are several statutory and legal restrictions on all these measures, such as state aid restrictions and restrictions on monetary financing.

¹⁰⁸ Henry C. Simons, *A Positive Program for Laissez Faire*, Public Policy Pamphlet No. 15 (Chicago: University of Chicago, 1934).; "Rules Versus Authorities in Monetary Policy," *Journal of Political Economy* 44, no. 1 (1936).

¹⁰⁹ A narrow bank is defined as "a financial institution that issues demandable liabilities and invests in assets that have little or no nominal interest rate and credit risk." George Pennacchi, "Narrow Banking," *Annual Review of Financial Economics* 4, no. 1 (2012): 141.

¹¹⁰ For a discussion of the Chicago plan, see: Jaromir Benes and Michael Kumhof, *The Chicago Plan Revisited* (International Monetary Fund Washington, DC, 2012).

initiatives,¹¹¹ ring fencing,¹¹² subsidiarization, prohibitions on proprietary trading by banking institutions coupled with putting limitations on their relationship with private funds.¹¹³ One could view the Volcker Rule and other structural reform measures, as well as Sections 23A and 23B of the U.S. Federal Reserve Act,¹¹⁴ as measures devised to curb excessive (quasi)money creation by the shadow banking sector relying on the government safety nets initially provided to banks.¹¹⁵

Bankruptcy safe harbors

Cash as a bearer instrument is the ultimate means of settlement. The reason for cash having such a status is that it bears virtually no counterparty risk. As soon as cash is tendered, the underlying fiduciary obligation of the buyer to the seller is instantaneously discharged (cleared and settled).¹¹⁶ This means that cash and cash settlement is bankruptcy proof and payment by cash carries no counterparty risks. Bankruptcy-proof nature of cash settlement helps cash become a safe and popular medium of exchange. For any other financial instrument that vies to become an ultimate medium of exchange and settlement, it should be, to the extent possible, free from counterparty risks.

The story of the transformation of repurchase agreements (repos)¹¹⁷ from a traditional old-style funding instrument to an effective shadow-banking-sector money can illustrate how removing counterparty credit risk can help transform a commonplace financial instrument to money. Despite the fact that shadow banks cannot rely on the banks' safety net and are susceptible to runs,¹¹⁸ by creating safe, short-term, and liquid instruments (quasi money) from risky, long-term and illiquid assets, they nevertheless responded to the

¹¹¹ Biagio Bossone, "Should Banks Be Narrowed?," *IMF Working Paper* (2001): 23. Bossone views the Britain's core banking model, or separation of commercial banking from investment banking, even within the same financial holding company as better alternatives to narrow banking.

¹¹² See Matthias Lehmann, "Volcker Rule, Ring-Fencing or Separation of Bank Activities – Comparison of Structural Reform Acts around the World," *Journal of Banking Regulation* 17, no. 3 (2016).; For the concept of ring-fencing, see: Steven L. Schwarcz, "Ring-Fencing," *Southern California Law Review* 87 (2013).

¹¹³ Hossein Nabilou, "Bank Proprietary Trading and Investment in Private Funds: Is the Volcker Rule a Panacea or yet Another Maginot Line?," *Banking and Finance Law Review* 32, no. 2 (2017).

¹¹⁴ 12 U.S.C. § 1851(f).

¹¹⁵ Nabilou, "Bank Proprietary Trading and Investment in Private Funds: Is the Volcker Rule a Panacea or yet Another Maginot Line?."

¹¹⁶ For the advantages and shortcomings of cash as well as conventional media of payments and settlements, see: Athanassiou, "Impact of Digital Innovation on the Processing of Electronic Payments and Contracting: An Overview of Legal Risks," 5-11.

¹¹⁷ A repo or repurchase agreement is the sale of securities coupled with a commitment to repurchase them at a specified price and at a future date or on demand. See Tobias Adrian et al., "Repo and Securities Lending," *NBER Working Paper Series* (2012): 2. In the GFC, the run on repos, which led to forced deleveraging, played a significant role in the crisis. See Gary B. Gorton and Andrew Metrick, "Securitized Banking and the Run on Repo," *Journal of Financial Economics* 104, no. 3 (2012).; Gorton, *Slapped by the Invisible Hand: The Panic of 2007*. For an overview of the differences between U.S. and EU repo markets, see: Songjiwen Wu and Hossein Nabilou, "Repo Markets across the Atlantic: Similar but Unalike," *SSRN Working Paper Series* (2018).

¹¹⁸ In fact, central banks end up intervening as lenders of last resort in practically every systemic crisis. See J Bradford DeLong, "This Time, It Is Not Different: The Persistent Concerns of Financial Macroeconomics," in *Rethinking the Financial Crisis*, ed. Alan S. Blinder, Andrew W. Lo, and Robert W. Solow (New York: Russell Sage Foundation and the Century Foundation, 2012).

excess demand for safe assets.¹¹⁹ A large amount of creation of these assets were conducted using securitization, repos, and extensive use of credit derivatives, replacing government guarantees by implicit or explicit private sector guarantees.¹²⁰ However, repo, which, thanks to over-collateralization (i.e., a haircut on the market value of the collateral) and the short maturity, provides an efficient substitute for demand deposits and a means of short-term market funding, stands out. Unlike bank deposits, the repos' safety does not depend on the amount of the contract, therefore, they are suitable for the cash-management needs of institutional investors.¹²¹

An analogy of cryptocurrencies with money markets dominated by repos can shed some light on the issue, as the prime driver of repos in the money markets has been the quest for safe assets. To increase the safety of an asset and use it as money, banks resorted to repos to provide short-term (overnight) investment opportunities for investment funds and, in the meantime, create an efficient source of funding and liquidity for themselves. Repos essentially replicated the function of demand deposits, with an additional safety due to its secured nature. In a short period of time, the use of repo for interbank and institutional financing arrangement became so popular that it effectively became the "oil in the engine of the global banking network"¹²² and a substitute for bank deposits for institutional investors.¹²³ One important aspect of enhancing safety feature of repos lies in the repo's preferential treatment in bankruptcy.

The U.S. Bankruptcy Code affords special treatment to Qualified Financial Contracts (QFCs) (including derivatives and repos) by exempting them from the 'automatic stay' and allowing counterparties to terminate these contracts (by closing out, netting or setting off their derivatives positions) and to seize the underlying collateral.¹²⁴ The equivalent of such preferential treatment is also adopted in Europe as part of the Financial Collateral Directive.¹²⁵ Such exemptions have substantially reduced the counterparty risks in repo transactions.

Recently, after much debate about the advantages and disadvantages of the bankruptcy safe harbors, there

¹¹⁹ Ben S. Bernanke et al., "International Capital Flows and the Returns to Safe Assets in the United States, 2003-2007," *Board of Governors of the Federal Reserve System; International Finance Discussion Papers number 1014* (2011).; For a critique of savings glut hypothesis, see: Claudio Borio and Piti Disyatat, "Global Imbalances and the Financial Crisis: Link or No Link?," *BiS Working Papers No 346* (2011).

¹²⁰ According to Haldane, the size of the global asset management industry is some \$87 trillion. See Andrew G. Haldane, "The Age of Asset Management?," *Speech at the London Business School* 4 (2014).

¹²¹ Zoltan Pozsar et al., "Shadow Banking," *Federal Reserve Bank of New York Economic Policy Review* 19, no. 2 (2013): 6.

¹²² Robert Guttman, *Finance-Led Capitalism: Shadow Banking, Re-Regulation, and the Future of Global Markets* (New York: Palgrave Macmillan, 2016), 133.

¹²³ Swati Ghosh, Ines Gonzalez del Mazo, and İnci Ötoker-Robe, "Chasing the Shadows: How Significant Is Shadow Banking in Emerging Markets?," *The World Bank- Economic Premise*, no. 88 (2012): 2-3.

¹²⁴ The Safe Harbor Provisions are embedded in the following provisions: 11 U.S.C. §§ 362 (2012). In Europe, such safe harbors are granted in the financial collateral directive (FCD) art. 8.

¹²⁵ Directive 2002/47/EC on financial collateral arrangements [2002] OJ L168/43, as amended by Directive 2009/44/EC [2009] OJ L146/37 and Directive 2014/59/EU [2014] OJ L173/190.

has been regulatory proposals to change the treatment of derivatives and repos in bankruptcy. For example, recommendations to impose a temporary stay on close-out netting for a short period of time (48h or until 5pm of the next business day) were put forward. Such a temporary stay would allow for benefiting from the risk-mitigation advantage of close-out netting while preventing fire sales. However, any modification beyond that has not gained considerable traction.¹²⁶ This proposal has already been implemented in Europe by the Bank Recovery and Resolution Directive (BRRD) amending the Financial Collateral Directive (FCD).¹²⁷

In general, removing the automatic stay exception would act as a curb on repos by reducing the liquidity of the collateral, particularly in tri-party markets.¹²⁸ This can be viewed as a sensible regulatory measure to reduce the reliance on lower-quality collateral, akin to setting minimum haircuts. However, removing this exception would probably be unwarranted for higher-quality collateral, such as most government-guaranteed securities.¹²⁹ As the most important impact of such bankruptcy safe harbors for repo collateral is that they enhanced the safety of repo to be used in (interbank) financial transactions as money, removing such exemptions for lower quality collateral would erode the moneyness of repos and place a curb on (quasi)money creation by shadow banks.

Microprudential regulation: Portfolio restrictions, leverage and liquidity requirements

Money Market Funds (MMFs) are financial intermediaries that connect short-term debt issuers with providers of funds who need daily liquidity.¹³⁰ Currently, CNAV MMFs are effective substitutes for insured deposits, and provide continuous liquidity for those institutional investors that have surplus funds and need daily liquidity. Since claims on MMFs are virtually redeemable at par on demand, they are money (M3). The Securities and Exchange Commission (SEC) and the Office of the Comptroller of the Currency (OCC)

¹²⁶ Philipp Paech, "Shadow Banking: Legal Issues of Collateral Assets and Insolvency Law," (Brussels: European Parliament; Directorate General for Internal Policies; Policy Department A: Economics and Scientific Policy, 2013), 5. See, David A. Skeel and Thomas H. Jackson, "Transaction Consistency and the New Finance in Bankruptcy," *Columbia Law Review* 112, no. 1 (2012). Other commentators believe that the safe harbors should be removed even for such instruments. See Norbert J. Michel, "Fixing the Regulatory Framework for Derivatives," (Washington, D.C.2016).

¹²⁷ See, BRRD, arts. 70-71 and 118 that revises the FCD by inserting a new article 1(6) to that directive.

¹²⁸ Nathan Goralnik, "Bankruptcy-Proof Finance and the Supply of Liquidity," *Yale Law Journal* 122 (2012).

¹²⁹ See Nabilou and Paces, "The Law and Economics of Shadow Banking,"; A rather different proposal comes from Acharya and Öncü who propose creating a special resolution authority called 'Repo Resolution Authority' (RRA) for addressing the potential systemic risks of repo collateral fire sales during a financial crisis. They advocate removing the bankruptcy safe harbor (except for high quality government bonds). And in case of a default by a counterparty on a repo, the RRA would make a liquidity payment to repo lenders and then will try to liquidate the collateral in an orderly manner. In this case, an ex-ante fee should be charged on the repo lenders. They also propose that there should also be certain eligibility criteria on such repo lenders. Viral V. Acharya and T. Sabri Öncü, "A Proposal for the Resolution of Systemically Important Assets and Liabilities: The Case Of the Repo Market," *International Journal of Central Banking* 9, no. S1 (2013).

¹³⁰ In doing so, MMFs can become subject to runs due to their engagement in liquidity - and to a lesser extend maturity - transformation without access to government safety nets.

have adopted measures on the reform of the MMFs and short-term investment funds (STIFs) to address the risk of run on such entities.¹³¹ SEC's reforms have so far focused on reducing risk on the asset side of MMFs' balance sheet. These reforms require a minimum percentage of assets to be held in highly liquid securities (daily and weekly requirements), they further impose restrictions on the purchase of lower quality securities by MMFs.

In addition, the SEC rules treat government MMFs (that invest at least 80% of their assets in U.S. government debt) and prime MMFs (that invest in corporate debt) differently. These rules require that government MMFs can maintain stable price per share (CNAV), but the prime MMFs should adopt the Variable Net Asset Value (VNAV) pricing model. To be more precise, according to the SEC's 2014 revisions to the regime governing MMFs, there will be three distinct categories of MMFs: retail (prime/municipal) MMFs, institutional (prime/municipal) MMFs, and government MMFs. Retail (prime/municipal) MMFs will be priced daily, at CNAV of \$1.00, and will be available to natural persons only. Institutions, businesses, and other organizations are not eligible to invest in these types of funds. They are required to impose liquidity fees and or redemption gates. Institutional prime/municipal MMFs will be priced daily at VNAV. All categories of investors are eligible to invest in these types of funds. They are required to impose liquidity fees or redemption gates. And government MMFs, which will be priced daily at CNAV, will face no restrictions on eligible investors. These MMFs can impose redemption or liquidity fees and/or they can suspend all fund redemptions (aka redemption gates).¹³²

Similar measures were put in place in 2017 in Europe.¹³³ The EU MMF Regulation recognizes three types of MMFs. VNAV MMFs, public debt CNAV MMFs and Low volatility NAV MMFs (LVNAV MMFs).¹³⁴ This regulation imposes certain levels of daily/weekly liquidity (portfolio rules) on both short-term MMFs¹³⁵ and standard MMFs.¹³⁶ The LNAV and public debt CNAV funds are required to hold at least 10% of their assets in instruments that mature on a daily basis¹³⁷ and an additional 30% of their assets maturing in a week.¹³⁸ These liquidity requirements are imposed to ensure that investor redemption could be satisfied in a timely fashion. As it is clear, the main reason behind these new regulatory developments has been to limit 'private' quasi-money creation by MMFs, while allowing such quasi-money creation for funds

¹³¹ Financial Stability Oversight Council, "Financial Stability Oversight Council (Fsoc) 2016 Annual Report," (Washington, D.C.: Financial Stability Oversight Council, 2016), 111-12.

¹³² Retail funds will be available only to natural persons (individuals, certain trusts and retirement accounts).

¹³³ Regulation (EU) 2017/1131 of the European Parliament and of the Council of 14 June 2017 on money market funds *OJ L 169*, 30.6.2017, p. 8–45, hereinafter EU MMFs Regulation

¹³⁴ Art. 3 of the EU MMFs Regulation

¹³⁵ Art. 24 of the EU MMFs Regulation.

¹³⁶ Art. 25 of the EU MMFs Regulation.

¹³⁷ Art. 24 (c) of the EU MMFs Regulation.

¹³⁸ Art. 24 (e) of the EU MMFs Regulation.

investing in government bonds. In effect, this suggests that the ultimate source of safety of such privately-created quasi money is the government.

Collateralization

An additional private innovation, which has played a major role in enhancing the safety of assets, is collateralization, which has reached its zenith in the production of covered bonds. Covered bonds are bonds (debt securities) secured by high-quality collateral. In addition to the over-collateralized cover pool, investors in covered bonds have an unsecured recourse against the issuer in the event of collateral deficiency (dual recourse). Cover-pool assets, which are ring-fenced to protect investors in the event of the bankruptcy of the issuer (bankruptcy remoteness of the cover pool), remain on the balance sheet of the issuer. Furthermore, the weak assets in the cover pool are constantly replaced by high-quality assets throughout the life of the bond (dynamic cover-pool).¹³⁹ In addition to all of the above features, bankruptcy laws and regulations such as the BRRD and the Single Resolution Mechanism (SRM) Regulation exempt covered bonds from its bail-in provisions, which essentially constitutes a regulatory subsidy for covered bonds.¹⁴⁰ All these features make covered bonds a high-yielding and attractive alternative to government securities.¹⁴¹ Covered bonds are not different from securitization in essence, in the sense that they are trying to create safe assets using private sources of safety. Such funds, if sufficiently information insensitive, can play the role of money in the financial markets by becoming a safe collateral against which borrowing would be made possible.

All in all, shares or bonds in money market funds, repos and to a lesser degree covered bonds can be viewed as quasi-money. All of the above mechanisms for money creation rely on a set of complex instruments enhancing information insensitivity of money created by banks and shadow banks. However, all of the above sources of safety and money and quasi-money creation mechanisms share a common feature in that they are directly or indirectly linked to governments as the ultimate credit and liquidity put providers.

To summarize, the shadow banking sector engages in money creation by turning information-sensitive assets into information-insensitive ones by deploying insurance, collateralization, prudential regulation, and

¹³⁹ Steven L. Schwarcz, "The Conundrum of Covered Bonds," *The Business Lawyer* (2011): 566-67.

¹⁴⁰ Art. 44(2)(b) of the Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms and amending Council Directive 82/891/EEC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council OJ L 173, 12.6.2014, (BRRD) & Art. 27(3)(b) of the SRM Regulation. Regulation (EU) No 806/2014 of the European Parliament and of the Council of 15 July 2014 establishing uniform rules and a uniform procedure for the resolution of credit institutions and certain investment firms in the framework of a Single Resolution Mechanism and a Single Resolution Fund and amending Regulation (EU) No 1093/2010, OJ L 225, 30.7.2014, p. 1–90,

¹⁴¹ Frank Packer, Ryan Stever, and Christian Upper, "The Covered Bond Market," *BIS Quarterly Review* (September 2007): 45.

preferential regulatory treatment in bankruptcy. As it is clear by now, money creation in shadow banking has mainly been a public-private endeavor. As we sketched the main mechanisms of the public-private money creation in the banking and shadow banking sector, now it is time to ask what creates safety or information insensitivity for central bank money, which is considered to be the safest asset in the financial system and the ultimate means of settlement in payment and settlement systems.

Information asymmetry and central bank money

Ideally, to become a ‘safe asset’ and to play a role as a medium of exchange, a debt instrument should be above suspicion and beyond doubt as to the value of the underlying collateral. However, no debt instrument is risk-free. Any financial claim, including central bank money, carries a certain degree of counterparty risk. Governments have managed to get around such a credit risk in an unorthodox fashion. The residual information insensitivity of fiat currencies has been eliminated by making all financial market participants ‘symmetrically ignorant’ of the value of the collateral (a promise to pay). As Homlstrom puts:

“Money itself is very opaque about the underlying collateral. No one knows what exactly backs up government issued money. “The full faith and credit of the government” is a very vague promise. But the beauty of money is that even if I do not know the exact value of the collateral backing my government’s promise, neither does anyone else. So we are “symmetrically ignorant” – a blissful state in money markets.”¹⁴²

Further studies also confirm that at least at its inception, obviating the incentive for information acquisition through creating symmetric ignorance played a key role in shaping central bank money. Schnabel and Shin (2018) discuss the evolution of trust in central banking in the context of the Kipper- und Wipperzeit (the clipping and culling times) crisis in the early 1600s in Germany, where due to clipping and debasement of coins, which resulted in the uncertainty about the true value of coins, trade was brought into a standstill. They show how the evolution of public deposit banks (precursors to modern central banks) helped subdue the crisis by the standardization of the wholesale payments through replacing cash settlement by settlement through bank deposits (cashless payment system). They concede that “[e]ven if the coins backing the deposits were of uncertain quality, such uncertainty affects all account holders equally and symmetrically. The fundamentals would be uncertain, but the uncertainty is common knowledge.”¹⁴³ Instead of using the term ‘symmetric ignorance’, the authors dub the knowledge of uncertainty ‘common knowledge’, as is

¹⁴² Holmstrom, "Understanding the Role of Debt in the Financial System," 14.

¹⁴³ Isabel Schnabel and Hyun Song Shin, "Money and Trust: Lessons from the 1620s for Money in the Digital Age," *BIS Working Paper No 698* (2018): 5.

often used in economics and finance literature. However, the better terminology for this common knowledge of ignorance or uncertainty would be ‘symmetric ignorance’ as used throughout this paper.

Therefore, in contrast to the view that holds that the common knowledge in transactions has been provided by central banks or their predecessors (reducing or removing adverse selection problem),¹⁴⁴ in fact, early banking institutions and governments have chosen a certain degree of obscurity and obfuscation to remove the incentives for people to acquire information about the true value of money and its underlying collateral. Indeed, a level of symmetric ignorance is necessary in order for the people to accept a debt instrument as a medium of exchange or a store of value. This symmetric ignorance removes all the incentives to acquire information about the underlying collateral.

Despite its accounting treatment, i.e., banknotes and coins being recorded on the liability side of central banks’ balance sheets, central banks do not view central bank money as a liability.¹⁴⁵ Therefore, central bank money is not considered as a debt instrument that would need an underlying collateral. However, it seems that even in its current form central bank money could be thought of as a ‘liability’ or promise in the sense that the central bank commits to certain inflation targets (price stability mandate; say below 2% annual inflation). Such a commitment would mean that the central bank promises to pay the holder of notes and coins a certain amount of the number of goods included in the basket of goods that comprises the Consumer Price Index (CPI) or Harmonised Index of Consumer Prices (HICP). In other words, the holder of the note can redeem the central bank money in terms of the commodities included in the CPI.¹⁴⁶ It seems that central bankers are very much aware of this implicit promise embedded in fiat money. According to the ECB, fiat money “has no intrinsic value ... yet is still accepted in exchange for goods and services because people trust the central bank to keep the value of money stable over time. If central banks were to fail in this endeavor, fiat money would lose its general acceptability as a medium of exchange and its attractiveness as a store of value.”¹⁴⁷ Therefore, although viewing central bank money as an explicit promise would not be an accurate description, it could be viewed as an implicit promise or ‘liability’. In spite of the fact that such a promise would not be considered as a binding legal contract as the central bank has theoretically unlimited discretion on inflating the currency, it would be helpful in understanding the underlying trust in the central bank money and comparing such trust to the trust the bitcoin users place in bitcoin.

¹⁴⁴ See: Ibid.

¹⁴⁵ European Central Bank, "What Is Money?," European Central Bank, https://www.ecb.europa.eu/explainers/tell-me-more/html/what_is_money.en.html.

¹⁴⁶ See: Rowe.; .

¹⁴⁷ Bank, "What Is Money?."

The price tag of relying on symmetric ignorance

The safety feature arising from a secured debt contract comes with a price tag. A shock to the value of the underlying collateral that would cause an information-insensitive debt to become information sensitive can have a disruptive impact and unleash a full-fledged financial crisis.¹⁴⁸ Such a shock would either provoke information acquisition, leading to adverse selection, and resulting in the likely collapse of the market for debt, or it would provoke no incentive for information acquisition. In the latter case, instead of information acquisition, market participant would only be willing to trade at a price lower than the fundamental value of the debt instruments, which again would lead to write-downs and fire sales. Both scenarios are likely to result in financial crises.¹⁴⁹

Compared to equity markets, money claimants respond differently from equity claimants to new information. Unlike equity markets where equity prices respond to new information in an incremental fashion, money markets often respond to new information non-linearly and in a precipitous manner.¹⁵⁰ In other words, new information can lead to a collapse of trade in debt funding markets and can be a discontinuous event,¹⁵¹ creating a cliff-effect. This is perhaps why financial crises often involved debt markets. This has been documented in the GFC in the run on repos backed by structured securities (private money à la Pozsar).¹⁵² In the repo markets, due to lower appetite for liquidity and credit risks, triparty repo investors (mainly MMFs) often pre-emptively withdraw funding at an early stage.¹⁵³ This feature of non-central bank money - also called - institutional money, gives it a special attribute: Debt-based money becomes a binary, either-or phenomenon.

However, it is hard to extend this argument to central bank money, and especially to those central banks with credible track record, such as the ECB, the Federal Reserve or the Swiss National Bank (SNB). The information insensitivity of money issued by such central banks relies on a longstanding trust in the institutions and the political context within which they were born and evolved. The information-economics perspective of non-central bank fiat money and debt contracts offers therefore only a limited insight on the

¹⁴⁸ Dang, Gorton, and Holmström, "Ignorance, Debt and Financial Crises."

¹⁴⁹ Ibid.

¹⁵⁰ See: Adam M Copeland, Antoine Martin, and Michael Walker, "The Tri-Party Repo Market before the 2010 Reforms," *FRB of New York Staff Report*, no. 477 (2010): 3.; Kathryn Judge, "Information Gaps and Shadow Banking," *Virginia Law Review* (forthcoming) 103 (2016): 31.

¹⁵¹ Dang, Gorton, and Holmström, "Ignorance, Debt and Financial Crises."

¹⁵² Gorton and Metrick, "Securitized Banking and the Run on Repo." See also: Gorton, *Slapped by the Invisible Hand: The Panic of 2007*.

¹⁵³ In this sense, the repos as debt instruments, reflect the features of money (information insensitivity), see: Judge, "Information Gaps and Shadow Banking."; See also: Dang, Gorton, and Holmström, "Ignorance, Debt and Financial Crises."; Gorton, "The Development of Opacity in U.S. Banking." In other words, holders of money claims, either have faith in it completely, or will lose it completely and switch to something else for a medium of exchange, store of value or unit of account. This has been seen in many countries in which there has been periods of high inflation. Dollarization in Zimbabwe was a prominent example of such a phenomenon.

safety features of such central bank money. This holds less true however for such currencies that continue to be subject to wild fluctuations, such as Venezuelan Bolívar, Russian Ruble, Turkish Lira, Iranian Rial, and Argentinian Peso, as well as the extreme cases of Zimbabwean Dollar and Ecuadorian Sucre, which led to dollarization in the latter two countries. The binary nature of fiat money from the information economics approach could well be applicable to such currencies.

Bitcoin as an evolving digital commodity money

Most cryptocurrencies, especially bitcoin, are more akin to commodity money. Compared to debt instruments, a commodity has even a bumpier road to becoming money. Unlike fiat money, whose value depends on the full faith and credit of governments, to be viable, a commodity money, as a self-anchored money, needs to build consensus among its users that it is, or is perceived to be, a viable store of value or a medium of exchange in a coordination game.¹⁵⁴ And arriving at such a consensus can take centuries or more, as was the case with gold or silver.

In the absence of a credible obligor (i.e., a central authority, underwriter, or debtor), building consensus around a commodity money would require it to display certain properties to assure the users that the commodity money possesses certain intrinsic value or safety features in terms of information insensitivity so that it could get off the ground. In the absence of intrinsic value or any other stabilizing mechanism, such as pegging the value of the money to the price of a basket of commodities, the value (if any) of commodity money is prone to wild fluctuations.¹⁵⁵ In case of bitcoin, this may be due to the increased information sensitivity coming from the user sentiment and fluctuations in the network value of the coin or even potential security vulnerabilities. Such levels of information sensitivity would be a major obstacle in the path to becoming an effective store of value, a viable medium of exchange, or a potential unit of account. Without a mechanism to ensure stability, a run would easily occur upon a discovery of additional information as of the value of a commodity money. In case of bitcoin, its transparency, digital nature and its global reach have helped it gain momentum and become a consensus-based store of value and medium of exchange within the bitcoin community in a relatively short time span. However, to become a long-term store of value or a widely accepted medium of exchange, bitcoin needs to be information insensitive.

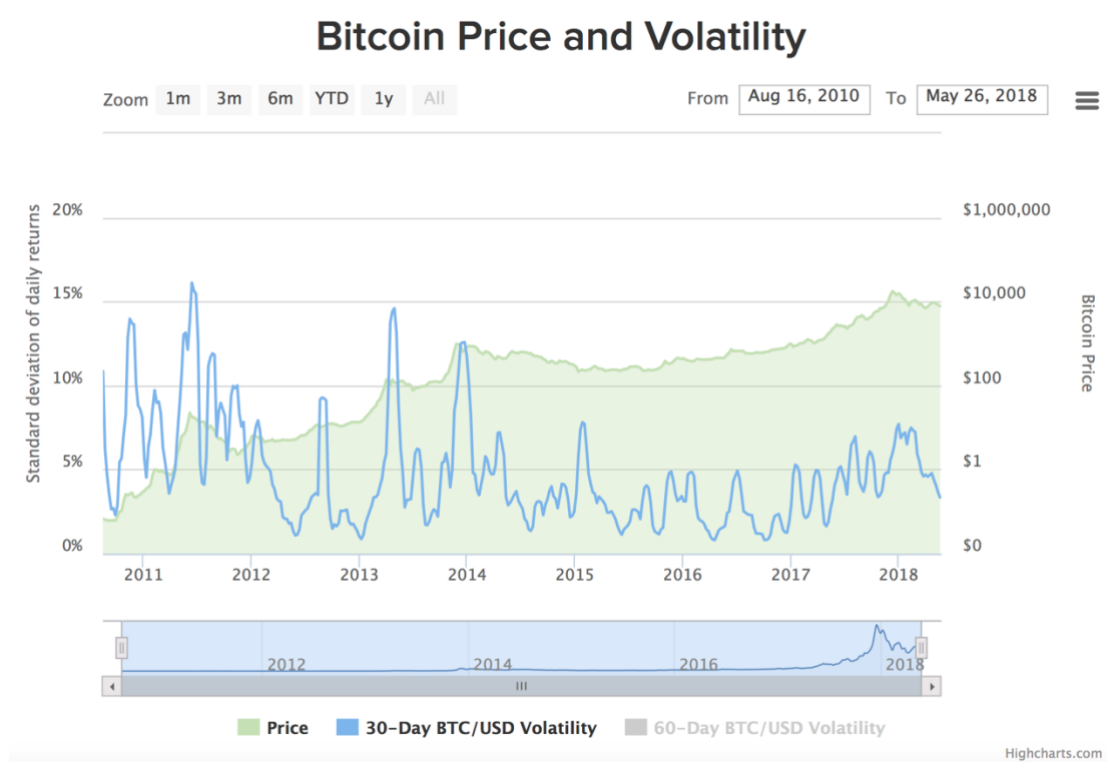
Nonetheless, there is a difference between information insensitivity stemming from exogenous shocks/information and that originating from endogenous shocks. As of this writing, bitcoin has been extremely sensitive to exogenous information or shocks. Even trivial positive information, such as listing in an exchange, has doubled or tripled its price in a relatively short time span. On the other hand, negative

¹⁵⁴ Luther, "Getting Off the Ground: The Case of Bitcoin."

¹⁵⁵ Even in the presence of intrinsic value, such volatility would persist due to the fixed supply schedule of bitcoin which makes its price volatile in the presence of demand shocks.

information (such as a hack of an exchange) has also had a disproportionate negative impact on its price and increased its volatility by orders of magnitude unheard of in the traditional assets markets. However, seldom could these wild fluctuations be attributable to the endogenous shocks or information about the Bitcoin Blockchain itself; with a few exceptions such as the scalability debate, which occurred in November 2017, that had a rather benign impact on its price.¹⁵⁶

The extreme price volatility stemming from exogenous shocks can also be a sign of the youth and immaturity of an asset. And it is not to say that in the future, volatility and information sensitivity of bitcoin cannot be mitigated by market forces. As data suggest, volatility of bitcoin has been decreasing significantly over time.



Source: <https://www.buybitcoinworldwide.com/volatility-index/>

In what follows, we argue that bitcoin possesses certain informational attributes that cannot be directly found in fiat money. This informational distinction of bitcoin could likely reduce bitcoin price volatility with orders of magnitude far smaller than what we witness today. However, this is not to say that the

¹⁵⁶ For a concise illustration of the debate, see: Laura Shin, "Will This Battle for the Soul of Bitcoin Destroy It?," *Forbes* Oct. 23, 2017.

volatility of bitcoin can easily be tamed, as it will remain relatively volatile for the foreseeable future in the face of demand shocks due to its inflexible supply schedule.

Fiat money vs. bitcoin: Symmetric ignorance vs. common knowledge

Does the information economics of debt-based money apply to a digital or synthetic commodity money (i.e., bitcoin)? If history is of any guidance, it suggests that commodity money is also not immune to perils of information economics. As for gold, its price is dependent on its scarcity. News related to the mining and discovery of gold would have a positive or negative impact on the price of gold. This has happened several times in history (e.g., California gold rush). At its extreme, a discovery of a large swath of gold would diminish its value as a store of value and put its moneyness at risk. However, gold itself is a self-anchored simple product and as such its value is not dependent on many endogenous shocks.

It appears that bitcoin has also taken a different path from that of fiat money with regard to its information economics. This path is very similar to that of gold. Although, unlike gold, bitcoin is a complex product, its high level of transparency, originating from its open-source nature, makes *all endogenous information* available to *all* users. Such technical transparency is at the heart of bitcoin. The issuing (how, what and how many), peer-to-peer nature, mining process, miners, verification and confirmation of transactions are all *common* knowledge. The functioning of bitcoin and the Bitcoin Blockchain is completely transparent and is laid out in Satoshi's whitepaper.¹⁵⁷ There is a predefined supply schedule,¹⁵⁸ and the open ledger of bitcoin is out in the public eye and everyone with an internet connection has access to all the data and transactions being processed on the Bitcoin Blockchain. Hence, there seems to be no endogenous information with regard to bitcoin the revelation of which could cause a dramatic increase or a collapse in the value of bitcoin. Therefore, bitcoin makes no attempt to hide any information by creating endogenous vagueness. On the contrary, technical transparency is endogenous to bitcoin.¹⁵⁹ By design, the transparency level of bitcoin is so high that it discourages any attempt by agents to acquire private information about the value of bitcoin, making it an adverse-selection proof instrument and a viable instrument to become a medium of exchange.

Since ignorance can be turned into knowledge, but knowledge cannot be reversed back into ignorance, an instrument, which is built on common knowledge, has an advantage against an instrument that is built on

¹⁵⁷ Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System."

¹⁵⁸ This supply schedule could theoretically be changed if the required consensus would be achieved, however, given the history of consensus building to amend the bitcoin protocol, achieving such a consensus on such a controversial issue would be close to impossible.

¹⁵⁹ However, bitcoin can be and still is vulnerable to external or exogenous information or shocks. For example, any news about 51% attack, advances in quantum computing – which may or may not affect the bitcoin security, can cause mayhem in bitcoin valuation markets.

symmetric ignorance. Hence, bitcoin enjoys a high level of endogenous information insensitivity. This in turn means that bitcoin does not have to pay the price of symmetric-ignorance-based information insensitivity, i.e., a precipitous run. This gives bitcoin a certain edge compared to fiat money and can potentially transform it into a safe store of value.

It appears that this high level of technical transparency in the Bitcoin Blockchain has been the most significant factor contributing to building trust among the early adopters and has paved the way to its incredibly fast adoption. Creating a consensus that something without a physical form has value and can be used as a currency without relying on trusted third parties is by far a success in itself.¹⁶⁰ The digital nature, high level of security based on PoW, properties such as resistance to double spending, forge-proof, tamper-proof and immutability, censorship resistance, pseudonymity (and anonymity), cheaper transaction cost,¹⁶¹ and decentralized, distributed trust feature of bitcoin all contribute in turn to this consensus.

As bitcoin cannot rely on the safety features of fiat money, especially not the trust and institutional backing of central banking, it needs to overcome this inherent weakness by building information insensitivity through fully sharing the information about the technical processes - protocol, blockchain, network and all underlying operational features of the Bitcoin Blockchain - on which it is built. The common knowledge of these technical features stands in contrast to the symmetric ignorance of the inner workings and backing of fiat money. From a pure information-economics perspective, transparency entails a higher level of information insensitivity than symmetric ignorance. This is not to say such technical transparency can make up for the absence of intrinsic value of bitcoin. Yet, it is the strongest feature on which bitcoin can rely on its journey to be recognized as a 'safe asset' or its claim to moneyiness.

Despite its informational attributes, it is highly unlikely that bitcoin would be accepted as a single base money within a single currency area due to its inelastic or fixed supply schedule, which removes monetary policy flexibility needed both in times of calm and crises and makes it volatile in the face of demand shocks. It is also unlikely that bitcoin would be a substitute for commercial bank money, as the latter has its own advantages serving various needs of a given economy. However, bitcoin could become a niche currency even if it will most probably never become a major parallel or concurrent currency exerting substantial competitive pressure on the central bank money.¹⁶² As the development of banking and shadow banking

¹⁶⁰ Burniske and Tatar, *Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond*. Chapter 4.

¹⁶¹ Although at some point, transaction cost of bitcoin transactions soared, it came down eventually. It seems that new developments such as transaction batching and second layer solutions are substantially reducing transaction costs.

¹⁶² Daniel Heller, "Do Digital Currencies Pose a Threat to Sovereign Currencies and Central Banks?," *Peterson Institute for International Economics Policy Brief*, no. BP 17-13 (April 2017); Raskin and Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking."

around bitcoin cannot be ruled out,¹⁶³ bitcoin may in the future directly compete against commercial bank, as well as shadow banking money.

Summary and conclusion

Although regulators on both sides of the Atlantic have taken a passive approach to regulating cryptocurrencies, with the increasing popularity and potential success of cryptocurrency experiments, it is likely that governments would involve in regulating cryptocurrencies in the foreseeable future. This paper highlights certain aspects of information economics in cryptocurrency as well as fiat-money ecosystems that could inform future regulatory intervention in the cryptocurrency ecosystem.

The main contribution of this paper lies in the lessons drawn from the literature on shadow banking, safe assets and information economics. Cryptocurrencies are not the first example of non-governmental or private money creation. Even within the current financial system, a large portion of monetary aggregates (including parts of M1, M2, and M3) consists of private or quasi-private money (e.g., bank deposits, claims on government and prime CNAV MMFs, etc.,).

Shadow banking has long been in the business of quasi-money issuance, and safe-asset debate lies at the heart of money creation within the shadow banking system. For an asset to be safe, it needs to be information insensitive. The main techniques used to create information insensitive assets in the banking and shadow banking system have been insurance, (over)collateralization, imposing prudential requirements on the issuing entities, and preferential regulatory treatment of quasi-money instruments (bankruptcy safe harbors for repos). In all these cases, the value of an external element (e.g., collateral in repos, government credit and liquidity puts in deposits) removes the depositors' or investors' incentives to acquire information about the underlying debt contract, making it information insensitive.

Although the safest asset in the financial system (i.e., central bank money) is not a debt contract in its current form, it can be thought of as an implicit or abstract promise. It is the full faith and credit of the relevant government and the credibility of the central bank that remove any incentive for participants to acquire information about the underlying collateral. Obviating the need for information acquisition in this way eventually leads to a state of blissful symmetric ignorance, in the words of Holmstrom.

The information economics and potential information insensitivity of bitcoin relies, on the contrary, on the symmetric (common) knowledge of the underlying inner workings of the Bitcoin Blockchain. The proposition that knowledge can be attained, and ignorance can be turned into knowledge, but knowledge

¹⁶³ Hal Finney, "Re: Bitcoin Bank," (December 30, 2010).

cannot be unlearned and reversed back into ignorance is central to the information insensitivity of bitcoin. Full technical transparency in the Bitcoin Blockchain eliminates incentives to acquire new information, thereby eliminating the adverse-selection problem arising from information asymmetry as to the theoretical value of bitcoin as a medium of exchange. This informational attribute of bitcoin can potentially help transform it into a potential 'safe asset', a store of value, and perhaps a medium of exchange.

As previously mentioned, this paper has a narrow focus and studies bitcoin from a very specific microeconomic (information-economics) perspective with a special focus on the lessons drawn from the safe asset literature within the broader shadow banking literature. Therefore, this study should not, in and of itself, be viewed as a full and comprehensive treatment of safety and potential moneyiness of bitcoin. Further future research needs to be conducted on the potential for bitcoin or similar cryptocurrencies to become a full-fledged safe asset. In addition to a huge future research opportunity on technical specificities such as miner concentration and validation and confirmation processes, special focus should be given to bitcoin's price stability, supply schedule, robust legal framework for payments in cryptocurrencies, concerns about fungibility and immutability and the impact of the rise of cryptocurrencies on central and commercial banking.

Yet, given the potential promises of bitcoin and its properties in terms of its information economics, public policy should allow for the organic and market-driven growth of bitcoin, which is by far one of the most promising experiments in the modern digital-era monetary history. Since the cryptocurrency ecosystem is in its infancy, a hard-touch regulatory approach can hinder the potential welfare-enhancing innovations coming from this ecosystem. However, this suggestion should not be mistaken for an advocacy of regulatory fainéance, as the development of the ecosystem suffers from legal uncertainty. To the contrary, this approach is a defense of regulatory sobriety, data dependency, and a deference to the virtues of experimentation, permissionless innovation, spontaneous discovery process¹⁶⁴ and evolutionary dynamics in the financial system.¹⁶⁵

¹⁶⁴ Israel M. Kirzner, "The Perils of Regulation: A Market-Process Approach , 119–49.," in *Discovery and the Capitalist Process*, ed. Israel M. Kirzner (Chicago: University of Chicago Press, 1985).

¹⁶⁵ Simon A. Levin and Andrew W. Lo, "Opinion: A New Approach to Financial Regulation," *Proceedings of the National Academy of Sciences* 112, no. 41 (2015).

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