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This Time is Different: Facebook's Libra Can Improve Both Financial Inclusion and Global Financial Stability as a Viable Alternative Currency to the U.S. Dollar

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Abstract

Purpose: The aim of this study is to determine the relationship between the propagation of high-magnitude crises since the late 1990s and emergence of cryptocurrencies in the aftermath of the global financial crisis of 2008.

Design and Methodology: The study was based on a literature review of the interaction between financial crises and evolution of money in the digital age. A high-level technical overview of Libra and blockchain is provided. The broad analysis of Libra coin looks at various models and categories of implementation approaches. The study discusses the components of blockchain technology and provides illustrative visuals when possible. We also compare consensus models used in the Libra and Bitcoin blockchain networks. The analysis also touches on the use of blockchain technology in applications such as smart contracts.

Findings: The study shows that cryptocurrencies are not only a natural but an inevitable transformation in the evolution of money. As with any new technology, Facebook's Libra is going to cause a great deal of disruption in the existing ecosystem of cryptocurrencies that has taken a decade to form. On the other hand, Libra's financial inclusion and global stability as a public good promises to revolutionize the cryptocurrency world.

Practical Implications: If Facebook's Libra doesn't sputter out, it will spur central banks to introduce their own cryptocurrency projects. Libra's vast scale will make access to intermediation by banks easier, faster, and cheaper. Unlike Bitcoin, Libra will be backed by a basket of stable currencies as well as low-risk government bonds and central bank reserve assets.

Originality/Value: This study presents a clear picture of both advantages and potential risks of Libra which is considered to be a new invention eventhough Bitcoin has been around more than a decade. The study warns regulators and law makers along with central banks who are running headlong into backlash to Libra can harm consumers more than protect them. Punishing Facebook with a troubled past for violation of privacy and exploitation of users' data could adversely affect innovation and discourage developments of cryptocurrencies.

1.0 Introduction

Trade, to facilitate exchange between people, has existed since the ancient times. Before the invention of money (i.e. coin or paper), people used bartering as a primitive form of exchange (e.g. Smith, 1776) without the use of a monetary medium which, according to Karl Marx (1867), Krugman et al (2012) eliminates difficulties as well as costs of barter. Nevertheless, Chapman (1980) still considers barter as a universal mode of exchange[1]. Later in the evolution[2] of money, people began to use commodities (e.g. Hermele, 2014) and materials to facilitate exchange; leather, parchment, cloth, wood, clay tablet, peppercorns, tea, large stones, barley (Egyptians), salt (Chinese) were used (Davies, 2002). Native Americans used animal skins, wampum, and white shell beads (Dalton, 1967; Rolnick & Weber, 1997). Before minting coins, gold[3] has fascinated humankind for millennia (Pedley, 1972; Roosevelt, 2009); but only after 600 BC, gold was the basis of the bimetallic standard which the U.S. adopted in the late 18th century after declaring independence from Britain on July4, 1776 (Friedman, 1967; Friedman & Schwartz, 1963). The Chinese Tang Dynasty printed the first known paper money in 618 AD, but banknotes across Europe and North America[4] appeared 200 years after the Chinese eliminated paper money in 1455 due to high inflation (Cipolla, 1976; Cook, 1958; Mockford, 2014; Tullock, 1957).

Despite existing cryptocurrencies, Facebook's permissioned Libra digital coin[5] is a recent invention, which is planned to be introduced in 2020. Throughout history, the evolution of money points to an alternated shift between commodity money and credit money (e.g. King, 1999; Goodhart, 2000). The earliest written history shows that a credit system[6] was used in Babylon (current Iraq) in 1800-1750 BC. The Charga-Plate, predecessor of department store charge cards and credit cards, was developed in 1928[7] and had been used until 1950 (Mandell, 1990; Manning, 2001). Ralph Schneider and Frank McNamara founded Diners Club in 1950 as the first general purpose charge card, but only after 1958

[1] The U.S. sanctions and the use of dollar as an economic weapon of mass destruction have become at the center of foreign policy and caused political tensions between the U.S. and a number of countries (Taskinsoy, 2012a, b, c; 2019a, b, c).
[2] Developments in technology and financial sectors have played an important role in the evolution of money. In the 1990s, the homegrown Asian crisis of 1997-98 prompted the introduction of the Financial Sector Assessment Program (FSAP) jointly developed by the IMF and World Bank in 1999 and stress testing became a mainstay in banking regulation and supervision. The savings glut, financial innovation (i.e. mortgage-backed instruments), and the Federal Reserve's (Fed's) expansive (i.e. cheap dollar) policy created a lax credit environment which ushered predatory lending practices, resulting in the 2006 mortgage debacle and the inevitable GFC of 2008, which in turn marked the birth of Basel III, macro stress testing, and cryptocurrencies (for a longer discussion, see Taskinsoy, 2013a, b; 2018a, b, c, d; 2019d, e, f, g, h, I, j, k, l).
[3] Besides predictable reasons for gold to facilitate exchange (i.e. medium of exchange, unit of account, and store of value), gold as a metal has unique characteristics (i.e. best conductor, more malleable and ductile than any metal) and attributes (i.e. gold is used to make tools and accessories). These characteristics and attributes make gold valuable.
[4] In 1661 in Sweden. Bank of England, established in 1694, began issuing promissory notes in 1695 and banknotes in the 1790s. Without a central bank (two earlier attempts failed, first Bank of the United States in 1791 and the second Bank of the United States in 1816), the U.S. government printed banknotes in 1862 to finance its Civil War (1861-65)
[5] Also referred to as electronic money, digital money, cryptocurrency, digital cash, virtual money, and digital currency.
[6] The ruler Hammurabi of the Babylon gave farmers seeds on credit and farmers paid what they owed after the harvest.
[7] American Airlines introduced the Air Travel Card in 1928; by the onset of the 1940s, the U.S. major airlines used it.

a worldwide credit card network was finally established by American Express and Bank of America (BankAmericard). A group of banks (i.e. Citibank's Everything Card) created Master Charge (ancestor of MasterCard) in 1966 to compete with BankAmericard which was reorganized in 1976 as Visa (for a fuller discussion, see Mandell, 1990; Klein, 1999; Lee & Kyoung-Nan, 2002; Scott, 2007).

Mainframe computers by the 1970s coupled with advancements in internet enabled technologies[8] in the 1990s helped track electronic transactions, paving the road for the inevitable birth[9] of electronic money. Therefore, the 1990s proved to be the decade for groundbreaking events that took a leap of faith that internet would make the dream of digital cash a reality (Woodford, 2000), but not without some mishaps along the way. David Chaum's DigiCash (1990) filed for bankruptcy in 1998 and e-gold (1996) had reached several million users before it was shut down by the U.S. government in 2008. In 1998, two attempts at creating a decentralized digital currency emerged; B-money[10] by Wei Dai and Bit gold by blockchain pioneer Nick Szabo. For a longer discussion, see Andolfatto, 2018; Chiu & Wong, 2014; Duffie, 2019; Fung et al., 2014; Kahn & Roberds, 2009; Kocherlakota, 1998).

Since the 2008 global financial crisis (GFC), well over two thousand cryptocurrencies have sprouted. At the time of writing this research article, 2,426 digital coins[11] were trading with a combined market capitalization of $311 billion; Bitcoin's market cap alone is $211 billion (or 68% market share). While the GFC of 2008 was in full swing, a mysterious creator under the alias Satoshi Nakamoto registered the domain name bitcoin.org in August 2008 and published a white paper on October 31 titled *Bitcoin: A peer-to-peer Electronic Cash System* (Nakamoto, 2008). Even a few years after Bitcoin's[12] inception, it was still an arcane topic; for instance, a survey by Bloomberg (2013)[13] revealed that only less than half of those polled knew what Bitcoin was (oddly, 6% thought it was a video game). Although Bitcoin has achieved becoming a household name in less than a decade of its existence (Wallace, 2011), some traditional economists still find it difficult to get a grasp on the Bitcoin phenomenon (Sovbetov, 2018; Taskinsoy, 2018a; 2019c). Bitcoin has no intrinsic value, its value is based on belief and trust.

[8] In the 1960s, IBM and American Airlines created SABRE (Semi-Automatic Business Research Environment); Prestel was launched in UK in 1979 but the equipment was expensive; in 1982, the Minitel service (i.e. electronic cash system) was introduced in France; in 1983, the Bank of Scotland and Nottingham Building Society provided a service called homelink. With the use of personal identification number (PIN) and electronic verification systems via credit card payment terminal or point-of-sale (POS), the trend was toward Radio Frequency Identification (RFID) which is widely used today.

[9] David Chaum, the founder of DigiCash, introduced the idea of digital money in 1983 in his research paper. Since the advent of internet, a long list of cryptographic payment systems have come and gone (the most popular and still currently being used is PayPal. The following earlier examples paved the road for the birth of Bitcoin and so many other cryptocurrencies (2420 as of today). Hashcash by Adam Back (1997), B-money by Wei Dau (1998), Bit gold by Nick Szabo, Liberty Dollar (1998-2009), E-gold (1996-2007), and Reusable P-o-W by Hal Finney.

[10] http://www.weidai.com/bmoney.txt

[11] https://coinmarketcap.com/currencies/bitcoin/historical-data/?start=20130428&end=20181113 (August 6, 2019).

[12] Bitcoin with a capital "B" refers to the electronic cash system; bitcoin with a lowercase "b" is the digital currency.

[13] https://www.edelmanfinancialengines.com/education-center/articles/will-bitcoin-replace-the-dollar

The first symbolic bitcoin transaction took place on January 12, 2009 when Nakamoto Satoshi sent 10 BTC to a computer programmer by the name of Hal Finley (Nakamoto, 2008). Without an official exchange at the time of Bitcoin's launch in January 2009, its arduous existence literally began with a price of $0.00. However, after the establishment of a Japanese-based Bitcoin exchange Mt. Gox in July 2010, 20 bitcoins changed hands at a price of $0.05 cents each on the first day of trading. Less than a year later (December 27, 2010), Bitcoin had achieved a historic milestone when bitcoin price hit $0.29 BTCUSD, and spurred the introduction of many cryptocurrencies. The sale of a good involving bitcoins occurred at the end of 2009, where a bitcoin user swapped 10,000 BTC for an order of two pizzas from Papa Jones in the U.S.[14] (Kristoufek, 2015; Phillips & Gorse, 2017; Taskinsoy, 2018a, 2019c). The image of digital coins has been blemished by their extreme volatility (see Table 1 and 2), nevertheless investors globally have kept pouring billions into this asset class making the price of bitcoin peak at intraday high of $20,089 in December 2017, but few months later 80% of bitcoin value vanished.

Table 1: Bitcoin Price History

Period	Dollar Change ($)	Percentage Change (%)	Direction
Today (August 6, 2019)	+833.31	+7.59	↑
Last 7 days	+2,311.60	+24.33	↑
Last 30 days	+560.17	+4.98	↑
Last 6 months	+8,361.51	+242.28	↑
Last 1 year	+4,785.64	+68.10	↑
Last 2 years	+8,510.87	+257.77	↑
Last 3 years	+11,237.67	+1,954.53	↑
Last 5 years	+11,229.59	+1,929.06	↑
Last 7 years	11,801.77	+108,719.98	↑

Source: Buy Bitcoin Worldwide; https://www.buybitcoinworldwide.com/price/

Table 2: Top 10 Cryptocurrencies by Market Capitalization (August 6, 2019)

Rank	Cryptocurrency	Symbol	Price ($)	Market Cap ($)	Market Share (%)
1	Bitcoin	BTC	11,802.25	210,787,663,777	67.99
2	Ethereum	ETH	233.56	25,037,379,095	8.07
3	XRP	XRP	0.324940	13,931,047,244	4.49
4	Bitcoin Cash	BCH	347.93	6,238,932,197	2.01
5	Litecoin	LTC	98.06	6,175,663,429	1.99
6	Binance Coin	BNB	27.91	4,341,501,330	1.40
7	EOS	EOS	4.52	4,186,025,579	1.35
8	Tether	USDT	1.01	4,075,942,095	1.31
9	Bitcoin SV	BSV	154.38	2,756,391,635	0.89
10	Stellar	XLM	0.082883	1,625,976,610	0.52
		Total market cap & market share		279,156,522,991	90.05

Source: CoinMarketCap; https://coinmarketcap.com/

Notes: The market cap of 2,426 is $311 billion; $279.2 billion belongs to the top ten digital coins.

[14] Available online: http://www.bitcoin2040.com/bitcoin-price-history (accessed 10 July 2019).

Facebook's Libra[15] can be metaphorically referred to as "big bang" in the cryptocurrency market, also backed by 28 heavyweight firms (Figure 1); even the announcement to roll out Libra has created more hype than when Bitcoin emerged in January 2019. Like any new idea or technology, Libra will disrupt the existing electronic cash markets by polarizing cryptocurrency investors and enthusiasts. With a user base of close to 3 billion (i.e. Messenger, WhatsApp, Instagram, and Facebook), Facebook's Libra is forecast to dominate daily transactions for goods/services and money transfers online (LA, 2019). Facebook aims to tap on approximately 1.7 billion unbanked adults worldwide as of 2017 (Demirgüç-Kunt et al., 2018); according to the 2018 FDIC[16] survey, 8.4 million households (i.e. 48.9 million adults and 15.4 million children) in the United States were unbanked in 2017 (FDIC, 2018).

Source: The Libra Association (White Paper); https://libra.org/en-US/white-paper/
Figure 1: Member-Firms of the Libra Association

Unlike Bitcoin's decentralized (permissionless) purely peer-to-peer electronic cash system supported by blockchain without a trusted third party (Nakamoto, 2008), Facebook's Libra blockchain is claimed to be decentralized but starts as a permissioned (centralized) network that relies on the governance of a trusted third-party (i.e. the Libra Association as the central authority). Another confusion is that

[15] In May 2019, Facebook registered Libra Networks LLC in Geneva, Switzerland. Now the question is why did Facebook choose Libra as the name for its cryptocurrency project? Libra was first used as a unit of weight in Ancient Rome; and Libra is only one letter different than the French word libre which means "free". Libra's symbol of waves indicates a flow of funds without borders, with minimal or no restrictions and much reduced or in some cases eliminated costs.
[16] The US Federal Deposit Insurance Corporation conducts this survey biennially since 2009.

Libra coin runs on blockchain without block, this is far different from Bitcoin blockchain where every new transaction through mining starts with a block, and then the ledger consisting of timestamped transactions in chronological order is distributed to all miners (nodes) who check and verify before added to the end of each coin in its block (see LA, 2019; Nakamoto, 2008; Berentsen & Schär, 2018; DeVries, 2016; Dai, 1998; Merkle, 1987; Tamassia, 2003; Taskinsoy, 2018a, 2019c; Wood, 2016).

2.0 Literature Review

Libra, if overcomes all potential regulatory hurdle[17], will be the future of cryptocurrencies. However, Libra is far more different than Bitcoin. Even though Libra is claimed to be decentralized, transactions and monetary policy will be governed by a central authority namely the Libra Association (LA, 2018), whereas Bitcoin at inception is a decentralized (permissionless) purely peer-to-peer electronic cash network without the need of a trusted third party (Nakamoto, 2008). Another major difference is that while Bitcoin is unstable (Chiu & Wong, 2014) and not backed by any asset (its value is based on trust), Libra on the other hand will be backed by a basket of stable currencies (i.e. dollar, euro, pound, and yen) and low-risk reserve assets (Adrian, 2019). Libra definitely has an advantage, its potential of vast scale (i.e. close to a three billion user base) sets it apart from Bitcoin which was arcane even several years after its launch a decade ago (Franco, 2014); a survey by Bloomberg[18] (2013) revealed that less than half of those polled knew Bitcoin (oddly, 6% thought Bitcoin was a video game).

Libra is the new cryptocurrency on the block (but without block), governed by the Libra Association comprising 28 heavyweight firms as founding members; when the member count reaches 100, each governing firm including Facebook Calibra (digital wallet) will have only one voting right. As Bitcoin has faced massive criticism and skepticism along with never-ending questions whether Bitcoin is a digital money, crypto-currency or an investment asset class (Baek & Elbeck, 2015), Libra will also be the centerpiece of similar debates (Adrian & Mancini-Griffoli, 2019). We have absolutely no objection to why people tend to show resistance or are reluctant to accept Bitcoin and Libra or others (DeVries, 2016) because the prevalence of fiat money we are so inseparable now had taken 300 years (Cuthell, 2019); during which, fiat currencies had faced countless rejections and failures (i.e. inflation effect) as people throughout history had a skeptic approach to the notion of literally worthless piece of paper being used in trade as a medium of exchange for goods and services (Davies, 2002; Hermele, 2014). Numerous cryptocurrencies have sprouted as the price of Bitcoin had skyrocketed in December 2017 (i.e. peaked at intraday high of $20,089), this resulted in an intense rivalry among them (Phillips &

[17] The US Federal Reserve (the Fed), European Central Bank (ECB), Bank of Japan (BOJ), Bank of England (BOE), and others.
[18] https://www.edelmanfinancialengines.com/education-center/articles/will-bitcoin-replace-the-dollar

Gorse, 2017; Kristoufek, 2015). Bitcoin's rise to the stardom gave realism to the question of Bitcoin's potential to replace the U.S. dollar as a reserve currency (Bouoiyour & Selmi, 2016; Cermak, 2017).

Though it may sound insanely inconceivable, Facebook's Libra may potentially replace dollar as the reserve currency and the Libra Association may take the place of the US Federal Reserve[19] (the Fed). After all, the Fed is a private corporation (not a government branch) with shareholders (chartered banks) who earn dividends of 6% annually; similarly, the Libra Association (although non-profit) is a private entity with stakeholders who will have a number of responsibilities including governance and policy decisions to control the value of the Libra coin. The current Fed was created at the third attempt after two antecedent efforts failed[20] (Bordo, 2007; Bordo et al., 2017), which were modeled after the Bank of England (Britain's central bank).[21] Until the onset of the 20th century, foreign coins were legal tender in North America such as British pound sterling and Spanish silver dollars, and the excessive quantities of paper money printed by Britain's original 13 North American colonies during 1723-60 were banned[22] in 1764 (see Bernanke, 2004; Eichengreen, 2009; Friedman & Schwartz, 1963).

Notwithstanding a number of distinct technical differences (e.g. Badev & Chen, 2014), both Libra and Bitcoin run on blockchain as the infrastructure technology which is considered to be highly secure, scalable, efficient and reliable (Nakamoto, 2008; LA, 2019). If Facebook's Libra does not sputter out, it promises to spur central banks to introduce their own unique cryptocurrency projects (Taskinsoy, 2019c); in line, Christine Lagarde – Managing Director of the International Monetary Fund – urged central banks not to ignore "winds of change" and consider looking into the case of central bank digital currency – CBDC (Lagarde, 2018; also see, Bech & Garatt. 2017; Coeuré, 2018; Mancini-Griffoli, 2018; McLeay et al., 2014). Since the GFC of 2008, a growing number of central banks define digital money (or commonly referred to as cryptocurrency) as a new variant of central bank money (CPMI-MC, 2018; Barontini & Holden, 2019), which was previously categorized as physical cash (retail – general purpose) and central bank reserves (wholesale only, and in the electronic form); see Figure 2.

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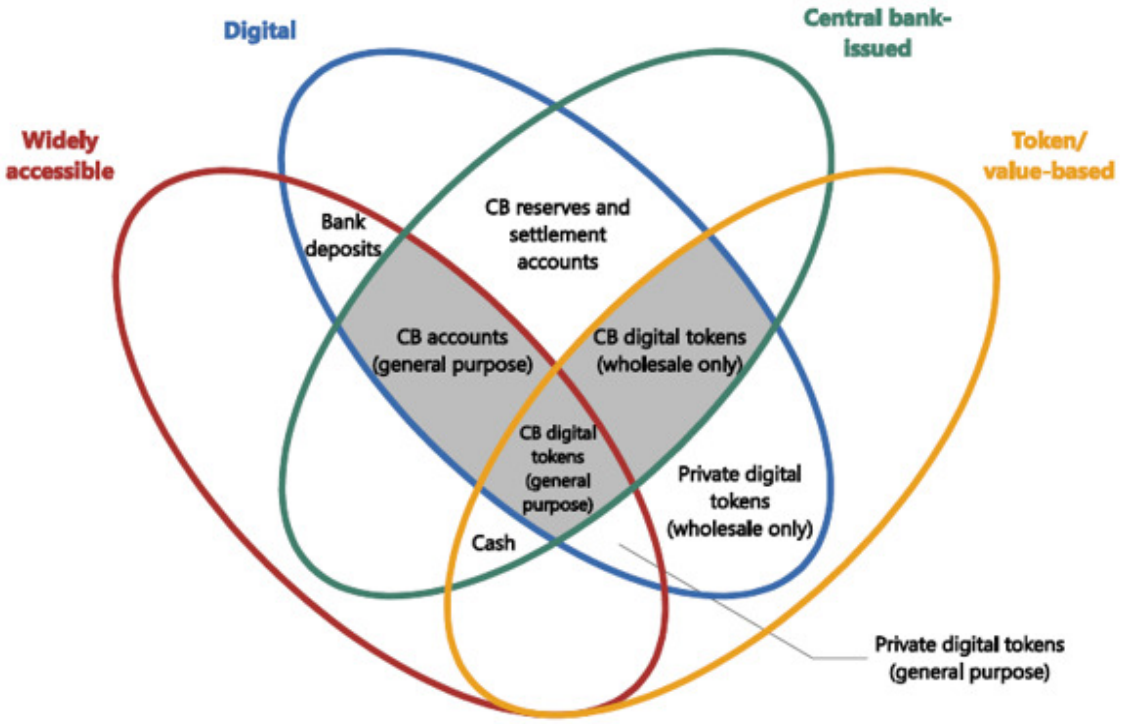
[19] The Federal Reserve System was created in 1913 through the Federal Reserve Act of 1913, which includes three key entities: the Board of Governors, the Federal Reserve Banks (there are 12 Fed banks), and the Federal Open Market Committee (FOMC). The FOMC has 12 members, 7 Board of Governors are appointed by the President of the U.S. and serve a 14-year term. Except the New York Fed president (Vice-Chairman), four Reserve Bank presidents serve one-year terms on a rotating basis); https://www.federalreserve.gov/ (accessed August 7, 2019).

[20] Each of two attempts for creating a central bank only lasted two decades. The first Bank of the United States (1791-1811) was chartered by the newly independent federal government to monitor the new issue of bank notes by other banks, however the bank's charter was not extended due to heavy political opposition. The second Bank of the United States (1816-1836) interestingly lasted only two decades as well and faced a similar opposition as the first bank.

[21] The Swedish Riksbank, established in 1668 as a joint stock, is considered to be the first central bank. The Bank of England (1694), also established as a joint stock, was the most important central bank of the era (see Bordo, 2007).

[22] The dispute by the British government over paper money was argued to be one of the primary causes of the American Revolution War (1775-83). While the Revolutionary war was in full swing, the Continental Congress authorized the issuance of Continental paper notes in 1775 (more like I Owe You "IOUs") to finance the Revolutionary war, a year later declared its independence from the Great Britain on July 4, 1776 (Taskinsoy, 2018a; 2019a, b, c).

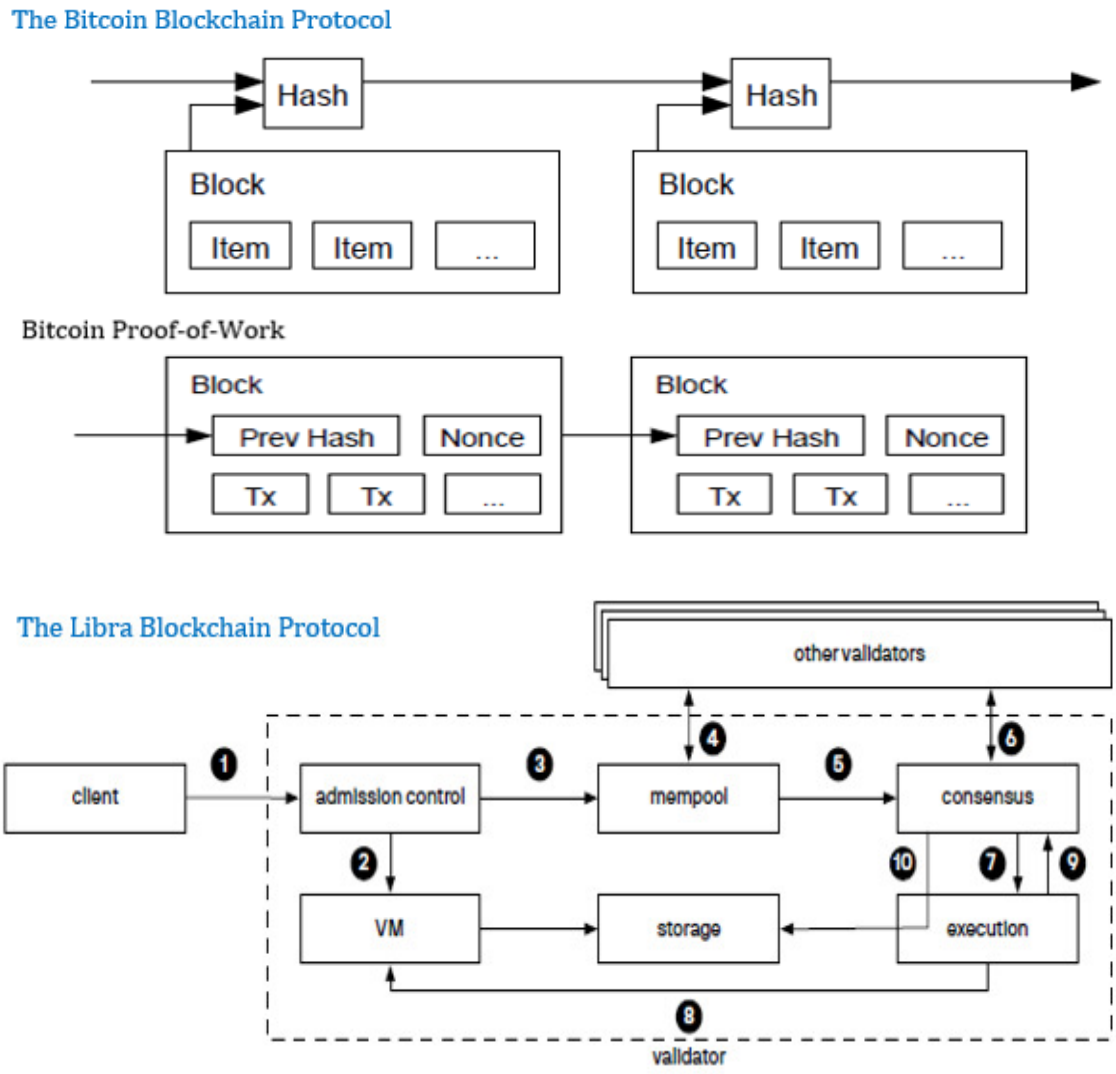


Source: CPMI-MC (2018); Bech and Garratt (2017).
Figure 2: The Money Flower: A Taxonomy of Money

Libra can learn valuable lessons from Bitcoin experience as Satoshi Nakamoto learned from earlier works related to ecash and appreciated their relevance in the design of Bitcoin. As illustrated in Figure 3, every transaction on Bitcoin blockchain is based on cryptographic proof (Chaum et al., 1998; Back, 2002) where a timestamp server timestamps a hash of a block of items and widely publishes the hash, which proves the data (i.e. transaction) existed (see Bayer et al., 1993; Haber & Stornetta, 1991, 1997; Massias et al., 1999). This proof-of-work system used by Bitcoin's blockchain is a lot similar to Adam Back's Hashcash (Back, 2002). Libra, on the other hand, uses a new programming language (Pierce, 2002) called "Move" to execute transactions which are then made visible to validators and clients by the Logical Data Model based on Merkle trees (e.g. Merkle, 1980; 1987). For safety and liveness, Libra uses HotStuff as the basis for Libra's Byzantine Fault Tolerant – LibraBFT (LA, 2019; Bernstein et al., 1987; Castro & Liskov, 1999; Pfitzmann & Köhntopp, 2001; Reed, 1978; Wood, 2016; Yin et al., 2018).

The transaction structures of Bitcoin (also other mineable cryptocurrencies) and Libra follow similar steps executing a transaction (Auer, 2019). Under Bitcoin blockchain protocol, to transfer and receive coins or pay for products and services, a set of private and public keys are used; an owner (sender) digitally signs a hash of the previous transaction and the public key of the next owner the receiver (Nakamoto, 2008; Merkle, 1980). Under Libra blockchain protocol, executing a transaction follows

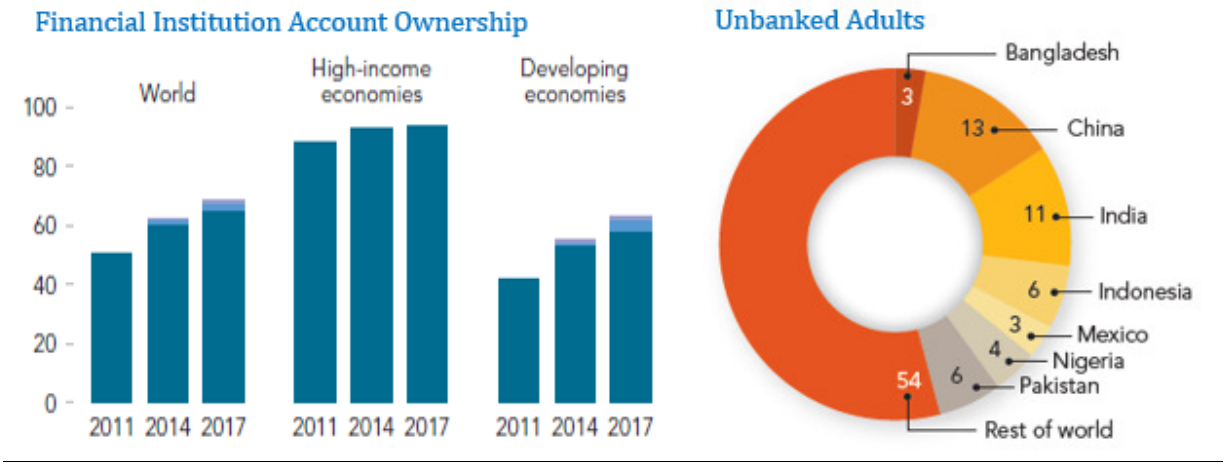
six specific steps; (1) the signature on the transaction is verified to match the sender's public key; (2) the sender gets authenticated (verified) and his/her LibraAccount is checked for sufficient Libra coins (funds); (3) running prologue ensures that the account has enough Libra coins, the Move bytecode verifies the transaction script and modules that no duplication, double spending, or violation of safety (i.e. type, reference, and resource); (4) modules are published under the sender's account (no module with the same name, meaning duplication is not permitted); (5) successfully completed transaction scripts are committed to the global state, but not the failed ones; and (6) Move virtual machine (VM) runs the epilogue to finalize the transaction (see LA, 2019; Bernstein et al., 1987; Catalini et al., 2019; Crosby & Wallach, 2009; Castro & Liskov, 1999; Girard, 1998; Reed, 1978; Schneider, 1990).



Source: Nakamoto (2008); The Libra Association (LA, 2019)

Figure 3: The Overview of Bitcoin and Libra Blockchain Protocols

During the full swing of a global financial meltdown (i.e. GFC of 2008), Bitcoin no doubt was a historic milestone in the evolution of money giving hopes to wishful folks that the dollar's hegemonic days were numbered, but fell short of the hype and expectations due to its extreme volatility (Chiu & Wong, 2014); Facebook's Libra as a stable cryptocurrency promises to revolutionize the future of digital money by keeping the relevant disruptions (Fung et al., 2014; Gandal & Halaburda, 2014) to minimum while paving the road for a maximum long-term gain (e.g. Ingves & Donaldson, 2018; Robleh et al., 2014). Libra aims to transform how people transfer money using mobile payment systems (Calibra) and purchase goods and services online without the hassle at minimum or no transactional cost (see Weber, 2015. With Libra, Facebook aims to tap on circa 1.7 billion unbanked adults as of 2017 (almost 50% live in seven countries (Demirgüç-Kunt et al., 2018; Schabel & Shin, 2018; Goodhart, 2000).



Source: Global Findex database; Demirgüç-Kunt et al (2018)
Figure 4: Financial Institution Account Ownership and Unbanked Adults

Table 3 shows the results of the survey conducted biennially by the FDIC - Federal Deposit Insurance Corporation; based on this report, 8.4 million households were unbanked in 2017 (14.1 million adults and 6.4 million children). Underbanked households were 18.7% or 24.2 million, comprising 48.9 million adults and 15.4 million children. More than half (52.7%) of the unbanked households in the U.S. cited "Do not have enough money to keep in an account" (for more details, see FDIC, 2018).

Table 3: The US Household Banking Status by Year

Year	Number of Households (1000s)	Unbanked (Percent)	Underbanked (Percent)	Fully banked (Percent)	Banked, underbanked status unknown (Percent)
2013	123,750	7.7	20.0	67.0	5.3
2015	127,538	7.0	19.9	68.0	5.0
2017	129,276	6.5	18.7	68.4	6.3

Source: FDIC National Survey (2018)

3.0 Methodology

This article of Libra is based on both the academic and online literature. We provide a high-level technical overview of Libra and blockchain technology. Our broad analysis of Libra cryptocurrency looks at various models and categories of implementation approaches. We discuss the components of blockchain technology and provide illustrative visuals when possible. We also compare consensus models used in Libra and Bitcoin blockchain networks. We touch on the use of blockchain technology in other applications such as smart contracts. The article discusses limitations and misconceptions surrounding Libra and its permissioned decentralized blockchain. Finally, this article presents some recommendations and directions for future research.

4.0 Concluding Remarks

Cryptocurrencies are not only a natural but an inevitable transformation in the evolution of money. As with any new technology, Facebook's Libra is going to cause disruption in the short-term but also, through financial inclusion and global stability as a public good, promises to revolutionize the future of the cryptocurrency world. Libra clearly has an advantage over all cryptocurrencies sprouted since the first successful cryptocurrency (Bitcoin) in January 2009; Libra's vast scale (close to a three billion user base) sets it apart from even the most dominant Bitcoin that enjoys 68% of the market share. Bitcoin's arduous journey to the stardom in the digital cash world has been constantly subject to immense criticism and the question whether it is a digital coin or an investment asset class has never been put to rest. At least Libra is not going to have the same predicament as Bitcoin since Libra will be backed by a basket of stable currencies (dollar, euro, pound, and yen) and low-risk reserve assets; of course, this alone does not shield Libra from market fluctuations and exchange rate risks.

Blockchain and distributed ledgers are a revolutionary innovation; as antecedents, they could lead to foreseeable and unforeseeable impacts on the definition of central bank money and online payment systems. Thus, Libra is argued to disrupt the existing cryptocurrency models and the ecosystem they have created for a decade. Facebook promotes Libra as a very stable digital coin contrary to peers (i.e. Bitcoin), but Libra or its 28-member governing body the Libra Association will not eliminate all of cyberattacks or the default risk of securities and member-firms all which are for-profit companies. Unlike Bitcoin and over 2,400 altcoins, not only Libra will be a liability of individuals and entities but also backed by a central bank like authority (the Libra Association) responsible for Libra's stability in an ongoing basis; this will give Libra intrinsic value which will not be derived from belief or trust.

There is still time until Libra's launch in 2020, but time is running fast and Facebook must resolve criticism from cryptocurrency investors and enthusiasts, opposition from major central authorities, and concerns from governments including the United States, France, England, Germany, and Japan. In the face of Facebook's troubled past regarding privacy and the exploitation of users' data, Facebook assures that Libra will be operated by its subsidiary Calibra and the sensitive financial data including the Libra account holders' transaction history will not be shared with Facebook unless authorized by account owners. Although Facebook plans Libra to become permissionless in the near future, it must initially start as a permissioned network to support billions of potential transactions generated by a user base of close to three billion account holders across the globe. In this vast scale, Libra's closest competition Bitcoin and Ethereum are no comparison with less than 50 million combined users. Time will show whether Libra will sputter out or become a reality.

References

Adrian, T. (2019). Stablecoins, Central Bank Digital Currencies, and Cross-Border Payments: A New Look at the International Monetary System. Speech given at the IMF-Swiss National Bank Conference, Zurich, May. https:// www .imf .org/ en/ News/ Articles/ 2019/ 05/ 13/ sp051419-stablecoins -central -bank -digital -currencies -and -cross-border –payments.

Adrian, T. & Mancini-Griffoli, T. (2019). The Rise of Digital Money. Fintech Notes, Washington, D.C.: International Monetary Fund.

Andolfatto, D. (2018). Assessing the Impact of Central Bank Digital Currency on Private Banks. Federal Reserve Bank of St. Louis Working Paper 2018–026C.

Auer, R. (2019). The Mechanics of Decentralized Trust in Bitcoin and The Block Chain. BIS Working Papers, forthcoming

Back, A. (2002). Hashcash - A Denial of Service Counter-Measure. http://www.hashcash.org/papers/hashcash.pdf.

Badev, A. & Chen, M. (2014). Bitcoin: Technical Background and Data Analysis. Finance and Economics Discussion Series, 2014–104, Board of Governors of the Federal Reserve System, December.

Baek, C., & Elbeck, M. (2015). Bitcoins as an Investment or Speculative Vehicle? A First Look. Applied Economics Letters, vol. 22, no. 1, pp. 30–34.

Barontini, C. & Holden, H. (2019). Proceeding with Caution – A Survey on Central Bank Digital Currency. BIS Papers No 101, Monetary and Economic Department, January.

Bayer, D., Haber, S. & Stornetta, W. S. (1993). Improving the Efficiency and Reliability of Digital Time-Stamping. In Sequences II: Methods in Communication, Security and Computer Science, pages 329-334, 1993.

Bech, M. L. & Garatt. R. (2017). Central Bank Cryptocurrencies", BIS Quarterly Review.

Bernstein, P. A., Hadzilacos, V. & Goodman, N. (1987). Concurrency Control and Recovery In Database Systems." Addison-Wesley.

Berentsen, A. & Schär, F. (2018). A Short Introduction to the World of Cryptocurrencies. Federal Reserve Bank of St. Louis REVIEW, First Quarter, 100(1), pp. 1-16.

Bordo, M.D. (2007). A Brief History of Central Banks. Federal Reserve Bank of Cleveland, December (ISSN 0428-1276).

Bordo, M.D., Monnet, E., & Naef, A. (2017). The Gold Pool (1961-1968) and the Fall of Bretton Woods: Lessons for Central Bank Cooperation." Banque de France (mimeo).

Bouoiyour, J. & Selmi, R. (2016). Bitcoin: A Beginning of a New Phase? Economics Bulletin, 36, 1430–40.

Castro, M. & Liskov, B. (1999). Practical Byzantine Fault Tolerance. In USENIX Symposium on Operating Systems Design and Implementation (OSDI), 1999, pp. 173–186.

Catalini, C., Jagadeesan, R. & Kominers, S. D. (2019). Market Design for A Blockchain-Based Financial System. SSRN Working Paper No. 3396834.

Cermak, V. (2017). Can Bitcoin Become a Viable Alternative to Fiat Currencies? An Empirical Analysis of Bitcoin's Volatility Based on a GARCH Model. SSRN Electronic Journal.

Chaum, D., Fiat, A. & Naor, M. (1998). Untraceable Electronic Cash. CRYPTO 1998.

Chapman, A. (1980). Barter as a Universal Mode of Exchange. L'Homme, 20(3), 33-83. Retrieved from http://www.jstor.org/stable/25131676.

Chiu, J. & Wong, T-N. (2014). E-money: Efficiency, Stability and Optimal Policy. Bank of Canada, Working Paper, 2014–16, April.

Cipolla, C. (1976). Before the Industrial Revolution: European Society and Economy, 1000-1700. New York, NY: W.W. Norton & Company, Inc.

Cook, R. M. (1958). Speculation on the Origins of Coinage. Historia 7: 257–62.

Coeuré, B. (2018). Future of Central Bank Money. Speech by a member of the Executive Board of the ECB at the International Center for Monetary and Banking Studies, Geneva, 14 May.

CPMI-MC (Committee on Payments and Market Infrastructures and the Market Committee) (2018). Cross-Border Retail Payments. February.

Crosby, S. A. & Wallach, D. S. (2009). Efficient Data Structures for Tamper-Evident Logging. In 18th USENIX Security Symposium, Montreal, Canada, August 10-14, 2009, Proceedings, pp. 317–334.

Cuthell, K. (2019). Many Consumers Trust Technology Companies More than Banks. Bain and Company, January. https:// www .bain .com/ insights/ many -consumers –trust -technology -companies -more -than -banks -snap -chart/

Dalton, G. (1967). Primitive Money. In George Dalton, ed. Tribal and Peasant Economies. Austin, TX and London, UK: University of Texas Press: 254–81.

Davies, G. (2002). A History of Money from Ancient Times to the Present Day. 3rd ed. Cardiff: University of Wales Press, 720 pages. Paperback: ISBN 0 7083 1717 0.

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S. & Hess, J. (2018). The Global Findex database 2017: Measuring Financial Inclusion and the Fintech Revolution. World Bank Group.

DeVries, P.D. (2016). An Analysis of Cryptocurrency, Bitcoin, and the Future. International Journal of Business Management and Commerce, Vol. 1 (2), September.

Duffie, D. (2019). Digital Currencies and Fast Payment Systems. Mimeo, Stanford University.

FDIC (Federal Deposit Insurance Corporation) (2018). FDIC National Survey of Unbanked and Underbanked Households. Division of Depositor and Consumer Protection, October.

Franco, P. (2014). Understanding Bitcoin: Cryptography, Engineering and Economics. John Wiley & Sons.

Friedman, M. (1967). The Monetary Theory and Policy of Henry Simons. Journal of Law and Economics, 10, 1–13. Reprinted in The Optimum Quantity of Money and Other Essays, edited by Milton Friedman, pp. 82–93. Chicago: Adeline, 1969.

Friedman, M. & Schwartz, A. (1963). A Monetary History of the United States 1867-1960, Princeton: Princeton University Press, 1963.

Fung, B., Molico, M. & Stuber, G. (2014). Electronic Money and Payments: Recent Developments and Issues. Bank of Canada, Discussion Paper, 2014–2, April.

Gandal, N. & Halaburda, H. (2014). Competition in the Cryptocurrency Market. Bank of Canada, Working Paper, 2014–33, August.

Girard, J. (1998). Light Linear Logic. Inf. Comput., vol. 143, no. 2, pp. 175–204.

Goodhart, C. (2000). Can Central Banking Survive the IT Revolution? International Finance 3 (2): 189–209.

Haber, S. & Stornetta, W. S. (1991). How to Time-Stamp a Digital Document. In Journal of Cryptology, Vol 3(2), pp. 99-111, 1991.

Haber, S. & Stornetta, W. S. (1997). Secure Names for Bit-Strings. In Proceedings of the 4th ACM Conference on Computer and Communications Security, pages 28-35, April.

Hermele, K. (2014). Commodity Currencies vs Fiat Money - Automaticity vs Embedment. Fessud Working Paper Series; Vol. 44. Fessud, University of Leeds.

Ingves, S. & Donaldson, D. (2018). Money, Transformed: The future of currency in a digital world. Finance & Development. A Quarterly Publication of the International Monetary Fund, Vol. 55(2), June.

Kahn, C. & Roberds, W. (2009). Why Pay? An Introduction to Payments Economics. Journal of Financial Intermediation 18 (1): 1–23.

King, M. (1999). Challenges for Monetary Policy: New and Old. Speech delivered at a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, WY, August 27.

Klein, L. (1999). It's in the Cards: Consumer Credit and the American Experience. Greenwood Publishing Group.

Kocherlakota, N. R. (1998). Money Is Memory. Journal of Economic Theory 81(2): 232–51, August.

Kristoufek, L. (2015). What Are the Main Drivers of the Bitcoin Price? Evidence from Wavelet Coherence Analysis. PLOS ONE, 10(4).

Krugman, P.R. Obstfeld, M. & Melitz, M. J. (2012). International Economics. Theory & Policy. Harlow: Pearson.

LA (The Libra Association) (2019). An Introduction to Libra. https://libra.org/en-us/whitepaper.

Lagarde, C. (2018). Winds of Change: The Case for New Digital Currency. Prepared for delivery by IMF Managing Director, Singapore Fintech Festival, 14 November.

Lee, J. & Kyoung-Nan, K. (2002). Consumers' Use of Credit Cards: Store Credit Card Usage as an Alternative Payment and Financing Medium. Journal of Consumer Affairs, 36(2), 239-262.

Mancini-Griffoli, T., Peria, M. S. M., Agur, I., Ari, A., Kiff, J., Popescu, A. & Rochon. C. (2018). Casting Light on Central Bank Digital Currency", IMF Staff Discussion Note SDN/18/08, November 2018.

Mandell, L. (1990). The Credit Card Industry: A History. Twayne Publishers.

Manning, R. D. (2001). Credit Card Nation: The Consequences of America's Addiction to Credit. Basic Books.

Marx, K. (1867). Capital, Volume 1. https://www.marxists.org/archive/marx/works/1867-c1/ch03.htm.

Massias, H., Avila, X. S. & Quisquater, J-J. (1999). Design of a Secure Timestamping Service with Minimal Trust Requirements. In 20th Symposium on Information Theory in the Benelux, May 1999.

McLeay, M., Radia, A. & Thomas. R. (2014). Money Creation in the Modern Economy. Bank of England Quarterly Bulletin 2014, Q1, pp. 14–27.

Merkle, R. C. (1980). Protocols for Public Key Cryptosystems. In Proc. 1980 Symposium on Security and Privacy, IEEE Computer Society, pages 122-133, April.

Merkle, R. C. (1987). A Digital Signature Based on a Conventional Encryption Function. In Advances in Cryptology - CRYPTO '87, A Conference on the Theory and Applications of Cryptographic Techniques, Santa Barbara, California, USA, August 16-20, 1987, Proceedings, pp. 369–378.

Mockford, J. (2014). They are Exactly as Banknotes are: Perceptions and Technologies of Bank Note Forgery During the Bank Restriction Period, 1797-1821 (PDF) (PhD). University of Hertfordshire.

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. Unpublished paper, available at https://bitcoin.org/bitcoin.pdf.

Pedley, J. G. (1972). Ancient Literary Sources on Sardis, Cambridge, MA: Harvard University Press, No. 292-293, 295.

Pfitzmann, A. & Köhntopp, M. (2001). Anonymity, Unobservability, and Pseudonymity—A Proposal for Terminology. In Designing privacy enhancing technologies, pp. 1–9.

Phillips, R.C, & Gorse, D. (2017). Predicting Cryptocurrency Price Bubbles Using Social Media Data and Epidemic Modelling. IEEE Symposium Series on Computational Intelligence.

Reed, D. P. (1978). Naming and Synchronization in a Decentralized Computer System. Ph.D. Dissertation, Massachusetts Institute of Technology, Cambridge, MA, USA.

Robleh, A., Barrdear, J., Clews, R. & Southgate, J. (2014). The Economics of Digital Currencies. Bank of England, Quarterly Bulletin, vol 54, no 3, September, pp 276–86.

Rolnick, A. J. & Weber, W. E. (1997). Money, Inflation, and Output under Fiat and Commodity Standards. Journal of Political Economy 105, 1308–1321, December.

Roosevelt, C. (2009). The Archaeology of Lydia, from Gyges to Alexander. Cambridge University Press. ISBN 978-0-521-51987-8.

Schabel, I. & Shin, H. S. (2018). Money and Trust: Lessons from the 1620s for Money in the Digital Age. BIS Working Paper 698, Bank for International Settlements, Basel.

Schneider, F. B. (1990). Implementing Fault-Tolerant Services Using the State Machine Approach: A Tutorial. ACM Computing Surveys (CSUR), pp. 299–319.

Scott, R. H. (2007). Credit Card Use and Abuse: A Veblenian Analysis. Journal of Economic Issues, 567-574.

Smith, A. (1976). An Inquiry into the Nature and Causes of the Wealth of Nations. Chicago: The University of Chicago Press.

Sovbetov, Y. (2018). Factors Influencing Cryptocurrency Prices: Evidence from Bitcoin, Ethereum, Dash, LiteCoin, and Monero. Journal of Economics and Financial Analysis, Vol. 2 (2), pp. 1-27, Tripal Publishing House.

Tamassia, R. (2003). Authenticated Data Structures. In Algorithms - ESA 2003, 11th Annual European Symposium, Budapest, Hungary, September 16-19, 2003, Proceedings, pp. 2–5.

Taskinsoy, J. (2012a). Relevancy of Corporate Financial Policies and the Profit Maximization View of Islamic Banks. Journal of Social and Development Sciences, Vol. 3(6), pp. 184-193, June, ISSN 2221-1152.

Taskinsoy, J. (2012b). The Investment Rate of Return (IRR) to Tertiary Education in Turkey. Journal of Education and Vocational Research, Vol. 3(5), pp. 154-164, May, ISSN 2221-2590.

Taskinsoy, J. (2012c). The Return of Investment on Tertiary Education in Malaysia. Journal of Education and Vocational Research, Vol. 3(6), pp. 183-192, ISSN 2221-2590.

Taskinsoy, J. (2013a). Rigorous Capital Requirements under Basel III: Possible impact on Turkey's financial sector. Journal of WEI Business and Economics, Vol. 2(1), pp. 1-30, April.

Taskinsoy, J. (2013b). Basel III: Road to Resilient Banking, Impact on Turkey's Financial Sector. LAP LAMBERT Academic Publishing, 237 pages, ISBN 13: 978-3-659-30696-9.

Taskinsoy, J. (2018a). Bitcoin Mania: An End to the US Dollar's Hegemony or another Cryptocurrency Experiment Destined to Fail? (December 1, 2018). Available at SSRN: https://ssrn.com/abstract=3311989 or http://dx.doi.org/10.2139/ssrn.3311989.

Taskinsoy, J. (2018b). Effects of Basel III Higher Capital and Liquidity Requirements on Banking Sectors across the Main South East Asian Nations. International Journal of Scientific & Engineering Research (IJSER), Vol. 9(4), pp. 214-37, April, ISSN 2229-5518.

Taskinsoy, J. (2018c). The Cost Impact of Basel III across ASEAN-5: Macro Stress Testing of Malaysia's Banking Sector. LAP LAMBERT Academic Publishing, 369 pages, ISBN-13 978-613-9-90012-1.

Taskinsoy, J. (2018d). A Macro Stress Testing Framework for Assessing Financial Stability: Evidence from Malaysia. Journal of Accounting, Finance and Auditing Studies (JAFAS), Vol. 4(3), July, ISSN 2149-0996.

Taskinsoy, J. (2019a). The Transition from Barter Trade to Impediments of the Dollar System: One Nation, One Currency, One Monopoly (March 6, 2019). Available at SSRN: https://ssrn.com/abstract=3348119 or http://dx.doi.org/10.2139/ssrn.3348119

Taskinsoy, J. (2019b). Pure Gold for Economic Freedom: A Supranational Medium of Exchange to End American Monetary Hegemony as the World's Main Reserve Currency (April 25, 2019). Available at SSRN: https://ssrn.com/abstract=3377904 or http://dx.doi.org/10.2139/ssrn.3377904.

Taskinsoy, J. (2019c). Facebook's Project Libra: Will Libra Sputter Out or Spur Central Banks to Introduce Their Own Unique Cryptocurrency Projects? (July 20, 2019). Available at SSRN: https://ssrn.com/abstract=3423453 or http://dx.doi.org/10.2139/ssrn.3423453

Taskinsoy, J. (2019d). Stress Testing Made Easy: No More US Banks Stumbling and Facing Public Embarrassment Due to the Federal Reserve's Qualitative Objection (March 17, 2019). Available at SSRN: https://ssrn.com/abstract=3354018 or http://dx.doi.org/10.2139/ssrn.3354018.

Taskinsoy, J. (2019e). Typology of Stress Testing: Microprudential vs. Macroprudential Stress Testing of Risk Exposures (March 28, 2019). Available at SSRN: https://ssrn.com/abstract=3361528 or http://dx.doi.org/10.2139/ssrn.3361528.

Taskinsoy, J. (2019f). Higher Capital and Liquidity Regulations of Basel Standards Have Made Banks and Banking Systems Become More Prone to Financial and Economic Crises (June 9, 2019). Available at SSRN: https://ssrn.com/abstract=3401378 or http://dx.doi.org/10.2139/ssrn.3401378.

Taskinsoy, J. (2019g). Ever More Financial Instability notwithstanding the Basel Standards and the IMF's Financial Sector Assessment Program (February 4, 2019). Available at SSRN: https://ssrn.com/abstract=3328473 or http://dx.doi.org/10.2139/ssrn.3328473.

Taskinsoy, J. (2019h). A Delicate Moment in Turkey's Economic Transition: Can Turkey Survive Mounting Economic Problems without the IMF's Bailout Package? (June 22, 2019). Available at SSRN: https://ssrn.com/abstract=3408520 or http://dx.doi.org/10.2139/ssrn.3408520.

Taskinsoy, J. (2019i). Turkish Lira – A Fiat Currency that Resembles the Volatility of Cryptocurrencies: The Effects of Exchange Rate Volatility on Turkish Economy (February 15, 2019). Available at SSRN: https://ssrn.com/abstract=3335545 or http://dx.doi.org/10.2139/ssrn.3335545.

Taskinsoy, J. (2019j). We Need No Dime from the IMF: Is This a Temporary Illusion or Can the Turkish Economy Recover from the Current Recession without the IMF Loans? (July 9, 2019). Available at SSRN: https://ssrn.com/abstract=3417431 or http://dx.doi.org/10.2139/ssrn.3417431.

Taskinsoy, J. (2019k). Asian Miracle, Asian Tiger, or Asian Myth? Financial Sector and Risk Assessment through FSAP Experience: Enhancing Bank Supervision in Thailand (May 9, 2019). Available at SSRN: https://ssrn.com/abstract=3385337 or http://dx.doi.org/10.2139/ssrn.3385337.

Taskinsoy, J. (2019l). A Hiccup in Turkey's Prolonged Credit Fueled Economic Transition: A Comparative Analysis of Before and After the August Rout (August 2, 2019). Available at SSRN: https://ssrn.com/abstract=3431079.

Tullock, G. (1957). Paper Money—A Cycle in Cathay. The Economic History Review, Second Series, 1957, 9(3), pp. 393—407.

Wallace, B. (2011). The Rise and Fall of Bitcoin. Wired, November 23.

Weber, W. (2015). The Efficiency of Private E-Money-Like Systems: The US Experience with National Bank Notes. Bank of Canada, Working Paper, 2015–3, January.

Wood, G. (2016). Ethereum: A Secure Decentralized Generalized Transaction Ledger. http://gavwood.com/paper.pdf.

Woodford, M. (2000). Monetary Policy in a World without Money. International Finance 3 (2): 229–60.

Yellen, J. L. (2014). Monetary Policy and Financial Stability. Text of the 2014 Michel Camdessus Central Banking Lecture by Ms. Janet L Yellen, Chair of the Board of Governors of the Federal Reserve System, International Monetary Fund, Washington DC, July.

Yin et al (2018). Hotstuff: BFT Consensus in the Lens of Blockchain. arXiv preprint arXiv:1803.05069.