Cryptocurrencies and the Economy: A Review of Literature

University Honors Capstone

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April 19, 2018
Abstract

In October 2008, pseudonymous developer Satoshi Nakamoto published a report on cryptography describing the digital currency Bitcoin. It was the first currency capable of working without a central bank or administrator. Research on cryptocurrencies is important to our society because they are global currencies that affect us in many ways: taxes, stock market, retirement portfolios, business transactions, etc. If the currencies are “a bubble” as some skeptics say, the repercussions of the cryptocurrency market failing would be detrimental: Billions of dollars would be lost. However, if cryptocurrencies remain successful, in several years the currencies will fuel business transactions and micropayments. This capstone will review research on how the traditional financial systems operate and the implications cryptocurrencies have within this environment. Through literature reviews, I will research the factors driving cryptocurrency usage and also the potential drawbacks the monetary system has to offer. I will discuss the benefits, consequences, and potential implications cryptocurrencies have on society, technology, and the environment.
Cryptocurrencies and the Economy: A Review of Literature

**Introduction to Cryptocurrencies**

Prior to the United States financial crisis of 2008, decentralized cryptocurrencies did not exist. In October 2008, pseudonymous developer or developers Satoshi Nakamoto published a report on cryptography describing the digital currency *bitcoin*. It was the first currency that eliminated the use of a central bank or administrator. The currency is sent straight from the owner to the receiver. The new currency could only exist digitally through the network. Since the introduction of bitcoin, countless cryptocurrencies have been introduced: Litecoin, Ethereum, Ripple, Zcash, Dash, and Monero to name a few.

Transactions using cryptocurrency are verified through the network through the use of cryptography. There are several types of cryptography technologies that make-up bitcoin: public-key, symmetric-key, and hash functions. Cryptography is used to secure communications in many telecommunication networks such as ATMS, computer networks, the Internet, radio systems, etc.

**Introduction to Blockchain**

Blockchain is a digital database containing information (such as records of financial transactions) that can be simultaneously used and shared within a large decentralized, publicly accessible network (Merriam Webster, 2018). Cryptocurrencies are maintained, verified, and secured by network users via the *blockchain*. Like the name indicates, blockchain is a chain of information connected via “blocks.” The blocks are records of information kept in a ledger, distributed across thousands of computer nodes, accessible to anyone on the network.
The software forms the “block,” assigns it a header and time stamp, and then “hashes” it. The “hash” is an encrypted reference to the underlying data message, which remains part of the block, while the data itself is moved outside of the block. This provides a high level of security, as any hack of the hash within the block will not reveal the underlying data. (Pike, 2017)

Due to this security, any attempt to hack or alter a specific block within the chain would not be successful because it would not correspond to the rest of the chain; The peer-to-peer network rejects blocks because it is not similar to the rest of the system. This is a secure way ensuring that there is no doubling spending or counterfeiting money.

The transparent nature of blockchain reveals a continuously updated record of who holds what currency. Because of the blockchain’s distributed application architecture shared among user, it is essentially hack-proof. “Encryption, distribution, and the hash structure that keeps the core data outside of the block are all factors in blockchain technology's reputation for being highly secure,” (Pike, 2017).

Cryptocurrencies like bitcoin, Ethereum, LiteCoin, are run on the blockchain. The new software is a network that helps decentralized trade. It can be used to exchange any kind of information. It helps by reducing intermediaries like companies, banks, or other third-parties.

Environmental Impacts

Bitcoin and Ether (from Ethereum) are generated through a process called mining. Mining is a process where computers solve complex algorithms using processing power. After bitcoins are mined, they can be kept as an investment or sold on exchanges.
Massive data centers are being built to mine bitcoins, consuming vast amounts of energy. Miners have relocated to countries like China and South Korea where electricity costs are cheaper than the Midwest (Rapier, 2018). Since bitcoin has been the most relevant and pronounced cryptocurrency the past decade, there are studies recognizing the amount of energy bitcoin mining has consumed. Below are charts representing energy consumption of bitcoin mining as of April 1st, 2018.

Table 1: Bitcoin’s percentage of energy use in based on country (Digiconomist, 2018).
Table 2: Bitcoin energy compared to other country’s total energy consumption (Digiconomist, 2018).

As shown in the graphs above, mining has created an ever-increasing carbon footprint because of the intensive Proof-of-Work technology. In cryptocurrency, Proof-of-Work is a system that uses computational power by calculating algorithms to verify functions and limit misuse. Globally, mining consumes more energy than several countries alone each year. Within the economy, this increase in energy consumption could create a new market for utility companies within the economy. Currently, the general population purchases application-specific integrated circuit (ASIC) which is an integrated circuit customized for individual mining use. Data centers that mine from cryptocurrency produce vast amounts of heat. Not only does mining need the computational power for solving complex algorithms, but data centers need energy to
cool off their servers. In early 2017, Venezuelan authorities shut down a mining operation that had 11,000 computers allegedly running on power siphoned illegally. The power usage caused severe repercussions for the country, including electricity shortages (Fairley, 2017). Companies across the globe are investing in additional sustainable solutions to decrease the negative impact that energy-intensive bitcoin mining brings. This brings us to the concept of Proof-of-State.

**Proof of Work vs. Proof-of-State.**

To decrease the amount of energy consumption and environmental impact that certain cryptocurrencies consume, the Proof-of-Stake (PoS) algorithm is being adopted into cryptocurrency blockchains. Proof-of-Stake (PoS) system requires the end-user to display ownership of a specific number of cryptocurrency units. While PoW completes work by solving computationally difficult math problems and awards the currency to whoever solves the algorithm, Proof-of Stake involves users who already have stake. The creator of a new block is selected in a random way, determined by the user’s economic “stake” or wealth within the system. Essentially, in the PoS system, the more coins that a single person forges, the better the chance he or she has to find additional blocks on the blockchain. In PoS, blocks are forged, not mined. Users are then referred to as forgers rather than miners. Furthermore, since users put their stake into each transaction, once a user validates a fraudulent transaction, they will lose their holdings (Bergman, 2018).

Ethereum currently runs off the proof-of-work technology. Vitalik Buterin, Ethereum creator, wants to implement a hybrid system that alternates between the two technologies: some will run on PoS, while the majority will still run on PoW. With their
final update called Serenity, they plan to take out the ‘mining’ concept and run it off a more sustainable technology called PoS (Rosic, 2017).

**Tax implications**

Taxing is a vital function of our economy. It provides finances for our government, healthcare programs, social security, transportation routes, education programs, and more.

Table 3: Top 15 Cryptocurrency Market Capitalizations as of April 14th, 2018 (CoinMarketCap).

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Market Cap</th>
<th>Price</th>
<th>Volume (24h)</th>
<th>Circulating Supply</th>
<th>Change (24h)</th>
<th>Price Graph (7d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bitcoin</td>
<td>$136,535,671,337</td>
<td>$6,042.03</td>
<td>$5,647,600,000</td>
<td>16,977,762 BTC</td>
<td>0.92%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>2</td>
<td>Ethereum</td>
<td>$49,986,062,663</td>
<td>$505.85</td>
<td>$1,650,630,000</td>
<td>98,620,518 ETH</td>
<td>1.39%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>3</td>
<td>Ripple</td>
<td>$25,101,185,252</td>
<td>$0.641600</td>
<td>$747,178,000</td>
<td>39,122,794,968 XRP</td>
<td>-2.48%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>4</td>
<td>Bitcoin Cash</td>
<td>$12,659,457,313</td>
<td>$741.47</td>
<td>$281,305,000</td>
<td>17,073,413 BCH</td>
<td>-1.64%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>5</td>
<td>Litecoin</td>
<td>$7,147,464,510</td>
<td>$127.45</td>
<td>$285,324,000</td>
<td>56,082,738 LTC</td>
<td>-0.49%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>6</td>
<td>EOS</td>
<td>$6,670,605,661</td>
<td>$8.41</td>
<td>$720,579,000</td>
<td>792,777,660 EOS</td>
<td>-5.45%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>7</td>
<td>Cardano</td>
<td>$5,248,702,087</td>
<td>$0.202441</td>
<td>$134,540,000</td>
<td>25,927,070,538 ADA</td>
<td>-1.57%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>8</td>
<td>Stellar</td>
<td>$4,677,912,684</td>
<td>$0.252047</td>
<td>$52,214,600</td>
<td>18,559,684,043 XLM</td>
<td>-0.52%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>9</td>
<td>NEO</td>
<td>$4,228,172,000</td>
<td>$65.05</td>
<td>$110,939,000</td>
<td>65,000,000 NEO</td>
<td>1.19%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>10</td>
<td>IOTA</td>
<td>$3,903,850,282</td>
<td>$1.40</td>
<td>$52,944,200</td>
<td>2,779,530,283 MIOTA</td>
<td>2.50%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>11</td>
<td>Monero</td>
<td>$3,072,366,886</td>
<td>$192.87</td>
<td>$43,900,300</td>
<td>15,929,565 XMR</td>
<td>0.24%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>12</td>
<td>Dash</td>
<td>$2,874,151,826</td>
<td>$358.82</td>
<td>$79,126,800</td>
<td>8,009,905 DASH</td>
<td>-2.02%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>13</td>
<td>NEM</td>
<td>$2,669,292,000</td>
<td>$0.295588</td>
<td>$31,895,300</td>
<td>8,999,999,999 XEM</td>
<td>0.54%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>14</td>
<td>TRON</td>
<td>$2,647,893,425</td>
<td>$0.04273</td>
<td>$326,566,000</td>
<td>65,748,111,645 TRX</td>
<td>1.09%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
<tr>
<td>15</td>
<td>Tether</td>
<td>$2,288,147,155</td>
<td>$1.00</td>
<td>$2,272,290,000</td>
<td>2,287,140,814 USDT</td>
<td>0.00%</td>
<td><img src="#" alt="Graph" /></td>
</tr>
</tbody>
</table>

*Cryptocurrencies not mineable
Above are the top ten cryptocurrency markets and their worth in dollars. The cryptocurrency market is huge and there is an immense amount of money to be made by taxing cryptocurrency revenue.

Digital currencies are taxable by United States law. The Internal Revenue Service issued Notice 2014-21 on cryptocurrencies:

For U.S. tax purposes, transactions using virtual currency must be reported in U.S. dollars. Therefore, taxpayers will be required to determine the fair market value of virtual currency in U.S. dollars as of the date of payment or receipt. A taxpayer has to recognize a capital gain or loss if exchanged for digital currency. If the fair market value of property received in exchange for virtual currency exceeds the taxpayer’s adjusted basis of the virtual currency, the taxpayer has taxable gain. (United States Treasury, 2014)

Digital currencies should essentially be treated as securities, stocks, houses, and bonds for taxing purposes. Regular brokerage firms provide 1099-Bs to investors that list their gains and losses for their transactions throughout the year. Coinbase, a digital currency exchange, only sends 1099-Ks to investors if they have a realized gain of $20,000 off of virtual currency or completed 200 transaction within the current year (Coinbase, 2018). This is a standard for all companies that issue 1099-Ks. Investors under the 1099-K threshold are responsible for keeping track of their basis for each cryptocurrency transaction they might have and the resulting gain or loss. Moreover, many investors still do not report earnings and losses on Schedule D when completing taxes. The Internal Revenue Service successfully sued Coinbase for access to customer
records when only 802 citizens reported gains or losses on cryptocurrencies. Over 14,000 investors had cryptocurrency transactions that impacted IRS standards through Coinbase. This resulted in a huge tax liability towards the United States government (Wieczner, 2018).

Here are following virtual currency transactions and their tax implications (Villamena, 2018):

- **Trading cryptocurrencies** - Produces capital gains or losses. Losses can either offset gain or be carried forward to future periods.

- **Receiving payments in cryptocurrency** - in exchange for goods or services should be added to ordinary income. The currency will be worth fair market value at time of receipt.

- **Spending cryptocurrency** - Subject to short-term or long-term capital gain or loss, depending on holding period. Different tax rates apply to the periods.

- **Converting cryptocurrency** - Treated as cryptocurrency being sold. Subject to short-term or long-term capital gain or loss, depending on holding period. Different tax rates apply to the periods.

- **Mining or “forging” coins** - Considered as ordinary income equal to the fair market value of the coin the day it was mined.

- **Initial coin offerings** - Result in ordinary income for individuals invested. The currency will be worth fair market value at time of receipt.
As of March 2018, there are eight states (Alabama, Connecticut, Georgia, New Hampshire, North Carolina, Pennsylvania, Vermont, and Washington) that have amended their legislation to recognize virtual currencies. Currently in Vermont, lawmakers are considering a bill that would tax companies’ transactions that operate on digital currency. For example, the law would require a company to pay “a transaction tax per transaction for 1) each unit of currency mined or created; and 2) on each sale or transfer of one or more units of that currency.” (Morton and Frazzini, 2018).

**Proof-of-Stake Taxation** There have been debates on how to tax when coins are initially earned and dividends earned later using PoS systems. The cryptocurrency DASH (#12 on Table 3) is a cryptocurrency that allows investors to earn dividends. The cryptocurrency NEO (#9 of Table 3) generates tokens called GAS, which initially come into society as dividends. The IRS does not provide direct guidance on whether to treat transaction fees and dividends as ordinary income under the PoS system. Adam Bergman, writer for *Forbes* magazine, states that:

> The consensus seems to consider the “forging” activities of the PoS system to have the same core validation role as miners in the PoW system, although, the PoS system does not have a block reward. Accordingly, it appears that many PoS forgers are treating the transaction fees and tokens received by way of forging as ordinary income, like mining activities under the PoW system. (Bergman, 2018)

**Potential Downfalls**

There are several downfalls to cryptocurrencies. Volatility, transaction speed, lack of regulation, and environmental impact.
**Volatility.** Cryptocurrency volatility is driven by trust, supply, and demand. Consumers and investors give each currency value. The greater the value of a currency, the more it is worth. Users should proceed with caution and only invest amounts they are willing to lose. As with the stock market, there is uncertainty in the future of cryptocurrencies. In December of 2017, the bitcoin cryptocurrency experienced a significant crash. One bitcoin was valued at almost $20,000 last year, only to lose 40 percent of its value by January (Tashea, 2018).

**Transaction Speed.** Transaction speed can looked at as a positive and a negative. While bitcoin can only do 10 transactions per second, Visa and Mastercard can do eighty thousand (ColdFusion). However, as stated above, digital currencies reduce the need for intermediaries, reducing total transaction time between customers. Cryptocurrencies can also be accepted globally.

**Lack of Regulation.** There are many perceptions on the future of cryptocurrencies. Many believe it is “a bubble” and others believe it will power the future of monetary systems. One thing is certain, cryptocurrencies lack regulation. While the IRS has tax implications surrounding digital currencies, there are few laws regulating cryptocurrencies. Peter Van Valkenburgh, research director compares cryptocurrencies to the time when the Internet was adopted. Since the Internet was never classified as one thing, hence, Internet of Things (IoT), the use of it could trigger different laws and agencies. The legal questions surrounding cryptocurrencies, ICOs, and blockchain are growing. For example, is it legal to create a cryptocurrency in order to fundraise for a company (ICO)? China and South Korea have banned ICOs. Moreover, IoT caused
many lawsuits because it was not regulated as it gained popularity. Many are worried history may repeat itself concerning cryptocurrencies.

On an individual level, there is lack of regulation surrounding personal ownership of digital currency. While the blockchain is hack-proof, it does not prevent hackers from stealing access to cryptocurrencies or losing access to virtual or physical ‘wallets.’ If an investor stores currencies in these wallets, a hacker could gain access to the user’s password. Nellie S. Huang, Senior Editor for Wall Street Journal offers an example:

When you own bitcoin, you have two “keys,” similar to the login ID and password you use to access traditional online financial accounts. One is called a private key; the other, a public key. The public key is analogous to your account number. The private key is akin to your personalized digital signature and is your proof of ownership. Lose your private key and you lose your claim to the bitcoin. (Huang, 2018)

Furthermore, if digital currencies are stored on old hard drives and the harddrive loses function or cannot be recovered, those currencies are lost. There has been talk of insurance plans to regulate stolen or lost digital currencies.

**Environmental Impact.** As stated above, one of the downfalls of several cryptocurrencies is the massive computational power the PoW system consumes. Many economists and environmentalists have said bitcoin’s PoW design will not be sustainable in future decades due to electricity usage. Because of this, the PoS system is starting to be adopted into more cryptocurrency technology.
Benefits of Cryptocurrency

Cryptocurrency offers many benefits to the economy: it is convenient and efficient, there are no intermediary regulations, it reduces the time of exchange within a global market, has high security through its proof-of-work system, and ICOs raise capital for companies.

Convenient and Efficiency. As explained in the beginning of the report, cryptocurrencies reduce the need for intermediaries and increase the efficiency of transactions. For example, when purchasing a house, it typically involves a time consuming process of assessing credit, transferring finances, and signing paperwork between third parties and consumer. While there is an initial delay to transfer one’s fiat currency into cryptocurrency on different platforms, exchanging cryptocurrencies is efficient. Within the economy, this decreases the need for third-parties. According to the current Chairman of BitPay, the largest bitcoin checkout processor globally:

Bitcoin’s blockchain is like a large property rights database. Bitcoin contracts can be designed and enforced to eliminate or add third party approvals, reference external facts, or be completed at a future date or time at a fraction of the expense and time required in the traditional system. (Rosic, 2016)

Definite Supply. One of the advantages of the cryptocurrency bitcoin is that there is a definite supply. In certain countries, there are inflation issues with fiat currency because the government prints more money to keep up with its own debt. When writing the code for Bitcoin, creator Satoshi Nakamota only allowed 21 million coins to be mined.
Secure and Safe. As emphasized before, the blockchain is essentially hack-proof. The blockchain technology of encryption, distribution, and the hash structure keeps the core data outside of the block so all factors in blockchain are highly secure (Pike, 2017). The more nodes and blocks within a chain, the harder it is to take hold of a majority of the chain. Cryptocurrencies with secure blockchains reduce fraud and protect it from being counterfeited.

This being said, the benefits digital currencies offer are easily taken advantage of. Many illegal activities are financed through the blockchain. Without government regulation, payments with cryptocurrency can flow through the system efficiently and without being taxed. While the government does have some regulations in place regarding digital currencies, the framework is still being developed.

Initial Coin Offerings. Initial Coin Offerings or ICOs are like initial public offerings but are for cryptocurrencies being released into the market. They are seen as fundraising opportunities for companies that want to attract investors. This is done by companies releasing their own new cryptocurrency into the market in exchange for funds. Eleven months before December 2017, more than 200 ICOs raised $3.9 billion in funds. For a specific example, an application valued at $1 billion, Kik, raised almost $100 million during its 2017 ICO after it initially failed to raise revenue through company operations like advertising, marketing, and partnerships (Tashea, 2018). ICOs have been banned by the People’s Bank of China, thus prohibiting creating and selling digital currencies to investors to finance startups (Bloomberg, 2017). The Bank was speculative of the currency the therefore outlawed it. While there were initial repercussions like the value of digital currencies dropping, the markets have re-surged since the event.
What are Economists Saying

There are hundreds of different forms of digital currencies just like each country has their own designated fiat currency. So what forms of digital currency are legitimate? What digital currencies have the most secure blockchain? What currencies will have sustainable value? Cryptocurrencies have been compared to pyramid schemes and “bubbles” that are about to burst. Let us take a look at what major economists are saying.

In *The Age of Cryptocurrency* (2015), authors Vigna and Casey interviewed Dr. Larry Summers, American Economist, former U.S. Treasurer Secretary, former Vice President of Development Economics and Chief Economist of the World Bank. He supports cryptocurrencies on the value of trust:

If you think about what a modern economy is all about, it basically involves ever more exchange. Exchange, unless it can be literally simultaneous, always has real issues of trust. So, what the breakthrough in communications and computer science represented in bitcoin does is to support a deeper exchange at lower price. And that matters both within countries for traditionally excluded and it also matters across international borders. (p. 8)

Bill Gates, found of Microsoft, expands on the negative effects on the anonymity of cryptocurrency:

The main feature of crypto currencies is their anonymity. I don’t think this is a good thing. The Government’s ability to find money laundering and tax evasion
and terrorist funding is a good thing. Right now crypto currencies are used for buying fentanyl and other drugs so it is a rare technology that has caused deaths in a fairly direct way. I think the speculative wave around ICOs and crypto currencies is super risky for those who go long. (Torpey, 2018)

Joseph Stiglitz, American Economist and Nobel Prize winner for Economics had similar views as Gates, saying, “cryptocurrencies’ popularity is from lack of regulation and potential for circumvention” (Bach, 2017).

**Conclusion**

Cryptocurrency is a very disruptive industry. It involves the introduction of new technologies that risk many jobs that rely on the current monetary system involving intermediaries. There are tradeoffs for adopting technology. Automated processes put people’s’ careers at risk that rely on the traditional system. I believe that is why there is such controversy surrounding cryptocurrency; it changes the global monetary system. People are afraid to trust digital currencies because they believe there is no value in it. Just like fiat currency, dollars, yuan, pesos, and the pound, society gives value to the currency, whether digital or not.

If digital currency’s popularity continues to rise, there will be many changes in the future: rise of regulations regarding digital currencies, new job markets, and change in technologies. While cryptocurrencies will automate many jobs, there will also be new jobs needed to regulate the new financial system: Attorneys and lawyers specializing in
regulation of cryptocurrencies and blockchains, specific sectors in the Securities and Exchange Committee (SEC) working to regulate cryptocurrencies, and cryptocurrency taxation experts.

Whether cryptocurrencies survive and surpass their initial boundaries, on thing is for sure: the technology surrounding bitcoin and ethereum cryptocurrency are here to stay. The advanced technology that blockchain offers is efficient and effective. The blockchain design has inspired other applications and technologies.

Currently, Microsoft, Nasdaq Stock Exchange, and Facebook are using blockchain technology to develop software and other applications. Walmart is also exploring ways to enhance their business operations with blockchain to improve food tracking and safety. Vanguard is testing whether it can smooth trades and simplify management of its U.S. stock index funds. (ColdFusion)

Blockchain technology should be applied in places where the environment is susceptible to fraud, a need for an intermediary, high number of daily business transactions, or stable data flow (ColdFusion). Blockchain is able to reduce the amount of fraud due to the inability to tamper with the data. Blockchain also reduces the need for intermediaries that do no provide value to the business or users. By eliminating middle-men and third-parties, the efficiency of operations improves significantly.

Within the past decade, society has been treating cryptocurrencies like speculative investments or commodities rather than legitimate currencies. The debate between the regulation and security of digital currencies will not be settled as there are a variety of strong opinions on the sustainable value of the currencies. Stay tuned.
References


