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The Adoption of Cryptocurrency Technology into the US Banking Infrastructure

Trevor Melito
University of South Carolina - Columbia

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By

Trevor Melito

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Approved:

Ozgur S. Ince

Dr. Ozgur Ince
Director of Thesis

Barbara Lee Bolt

Dr. Barbara Bolt
Second Reader

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Thesis Summary

This thesis examines the possibility of using Blockchain technology to permanently change the payment structure of the US banking system. First, I examine the current technology that dominates the banking sector. I introduce the most frequently used payments methods including Automatic Clearing House transfers and wire transfers, both domestically and internationally. In addition, I highlight the major players controlling these transactions. Under the current system, frictions between senders and receivers cause billions of dollars in losses each year.

Next, I examine Blockchain's roots along with some similar cryptocurrency technology, namely Distributed Ledger Technology and Smart Contracts. The transparency, security, and efficiency offered by the technology behind many cryptocurrencies demonstrates the possibility for rethinking decades-old payment networks.

Finally, to tie together the new and old, I examine case studies that have proven to be successful, within the US and abroad. There have been many projects in testing stages that have shown the possibility of implementing this new tech to the world. As consumer pressure on major payment providers continues, the financial world will continue to adapt and grow, leading to a more connected and optimized payment environment.

Introduction

The banking infrastructure used today was built nearly forty years ago. As the world becomes increasingly interconnected, it is more important than ever to help ease the flow of money. An outdated network has created friction in the economy that is increasingly felt by consumers. With worldwide economies becoming more reliant on each other, these inefficiencies must be eliminated to help smooth transactions across borders, and even domestically.

Cryptocurrencies began growing in popularity in 2009, with the rise of Bitcoin and leading to many others. They were founded on ideas of a decentralized system, controlled by no single entity but instead reliant on the power of the people. While they never replaced mainstream fiat currencies, as their creators hoped, their financial impacts would prove to be astounding. Built on ideas of collaboration, transparency, and efficiency, cryptocurrency technology provided the perfect solution for a banking system abundant with blemishes.

Many financial technology startups have begun incorporating cryptocurrency's underlying technology into financial projects with astounding results. Blockchain and Smart Contract integration has had tremendous success building a network between banks, big businesses, small businesses, and everything in between. This new form of financial interconnectedness does away with many of the flaws of a decades old financial system, ripe for improvements.

The Banking System

There are several different types of banks that serve different functions: most notably, retail, commercial, credit unions, savings banks, online banks, and the central bank. They all work in an intertwined manner to help consumers save their money, invest their money, find

loans, and spend their hard-earned dollars. As the economies gradually become intertwined, the ability to move money efficiently will become a key aspect of the success of businesses, both domestically and internationally.

Payment Transfers

Automated Clearing House transfers (ACH) are the electronic movement of money from one account to another, primarily used for domestic transactions. Like the majority of banks, many popular apps for sending money such as Venmo and Paypal use this method of transfer. There are two main categories of ACH transfers: debit and credit. A debit is when money is "pulled" from one account into another; most recurring payments automatically withdraw payments from bank accounts in this fashion. Credit transfers, on the other hand, can better be described as money that is "pushed" between accounts. Sending a friend a payment on Paypal would fall into this category (Tierney, 2019). These ACH transfers are only processed three times per day, and sometimes take multiple business days to complete. Credits are generally processed either within a business day or up to two days. Debits, on the other hand, must be processed by the next business day. Upon receiving this money, the bank must then hold onto it for a period of time. To expedite this process, some customers may choose to pay an extra fee, with some banks charging up to $3 for processing fees between banks. Generally, transfers are free. However, it varies depending upon the bank (Tierney, 2019). These ACH transfers come with a few limits. Daily and monthly caps limit the quantity of money allowed to move between accounts. Additionally, if requested after a certain time of day, the transfer cannot be processed until the following business day. This could mean that a transfer sent on Friday with a two-day delivery time might not get to the receiving account until Tuesday the following week.

Wire transfers occur in real time, controlled by two major networks; these transfers are generally reserved for larger and more time-sensitive transactions, with delivery time ranging from a few minutes to a few hours. The Society for Worldwide International Telecommunication, SWIFT, is a collection of major banks that agree on mutual terms for international transfers by providing the sender a SWIFT account number to be used to send money (Saslaw, 2012). For larger transactions, Clearing House Interbank Payments System, CHIPS, is used. They provide a six-digit code that signifies the customer's name, address, routing number, account number, and bank details. This code is stored confidentially and allows users to send their money overseas and domestically. The system handles a significant volume of transactions: "…responsible for over 95% of USD cross-border and nearly half of all domestic wire transactions totaling $1.5 trillion daily" (Saslaw, 2012). Often times associated banks will gather their payments to be sent abroad into one transaction, and CHIPS settles the final payments, which average around $3 million (Saslaw, 2012).

One primary limitation, like other payment networks, is that the system operates only between 9 am and 5 pm on business days. The CHIPS network also only has 48 member banks, compared to upwards of 5,000 among other domestic networks. Costs for these transactions vary depending on the size of the payment, with the standard sender generally paying between $25 and $65 with a major bank, while the receiver gets charged up to $25 (Camp, 2020).

Processing Pain Points

Given this broad introduction to the banking system, there are many evident opportunities for improvement. The first to be discussed is the extremely costly cross-border transactions. Much of the US labor force is comprised of non-citizens, often earning money for their family

back in their home countries. This transfer back home is referred to as a "remittance." In their book, *Age of Cryptocurrency,* Paul Vigna and Michael Casey explain, "The World Bank estimates that the global remittance business is worth somewhere around $500 billion annually in cross-border flows. Countries such as the Philippines and those of Central America, which have large groups of citizens working in richer countries, depend heavily on these homecoming funds to drive their economies" (2015, p. 189). Authorities benchmark the costs associated with these transactions using an estimated money transfer of $200. If a Mexican worker in the US sent $200 home from the US, on average, they would lose $14 between charges incurred by the sender and recipient. This is a 7% tax on people who are already living on extremely small wages. For larger transfers, this average fee slips down to 5%. Authorities estimate the aggregate costs of remittances was about $30 billion in 2017, roughly the same as the foreign-aid budget of the US that year (Cecchetti & Schoenholtz, 2018). Although these averages fall between 5 and 7%, the total friction in the transfer can run as high as 30%, depending upon many factors including country, bank, and dollar amount (Vigna & Casey, 2015, p. 190). The following graph illustrates the steep increase in global remittances from the 1970s up until 2018, roughly increasing $600 billion. With this sharp increase in recent years, one would expect new technology to keep up and adjust accordingly. However, as shown in the next graph, the average fees have only decreased slightly. The global average decreased about 3% while the US had a miniscule 1% reduction in costs. At a glance, it looks like the US is doing significantly better than the rest of the world, with average fees 2% lower. What the graph doesn't show, however, are the countries significantly less developed than the US, including many poorer African and Asian nations.

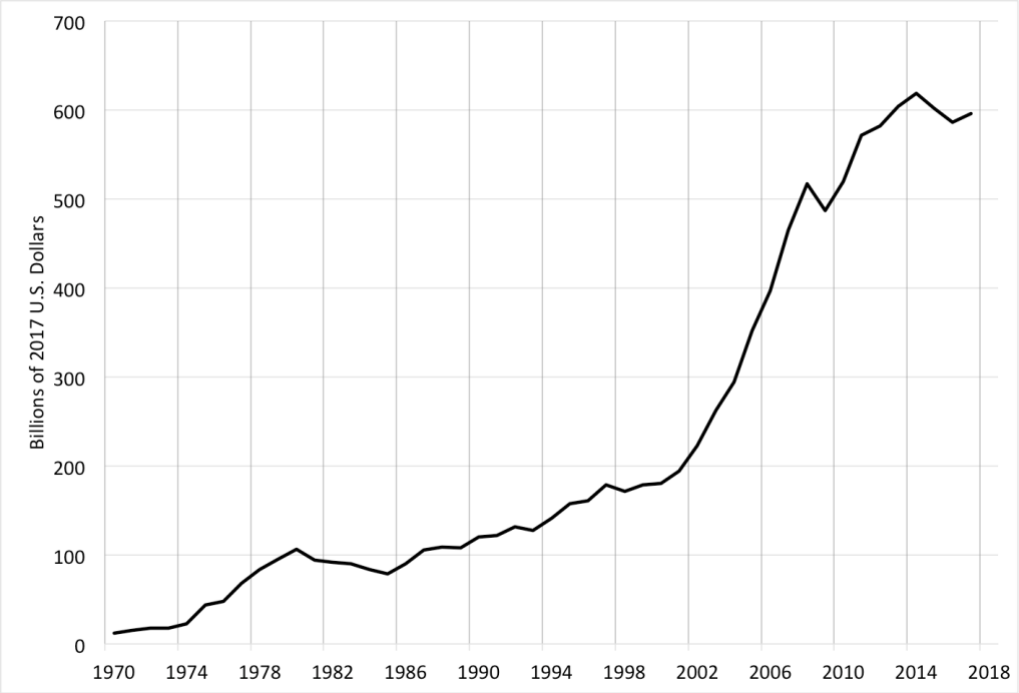

Figure 1: Volume of Remittances (Billions of 2017 U.S. dollars) (Cecchetti & Schoenholtz, 2018)

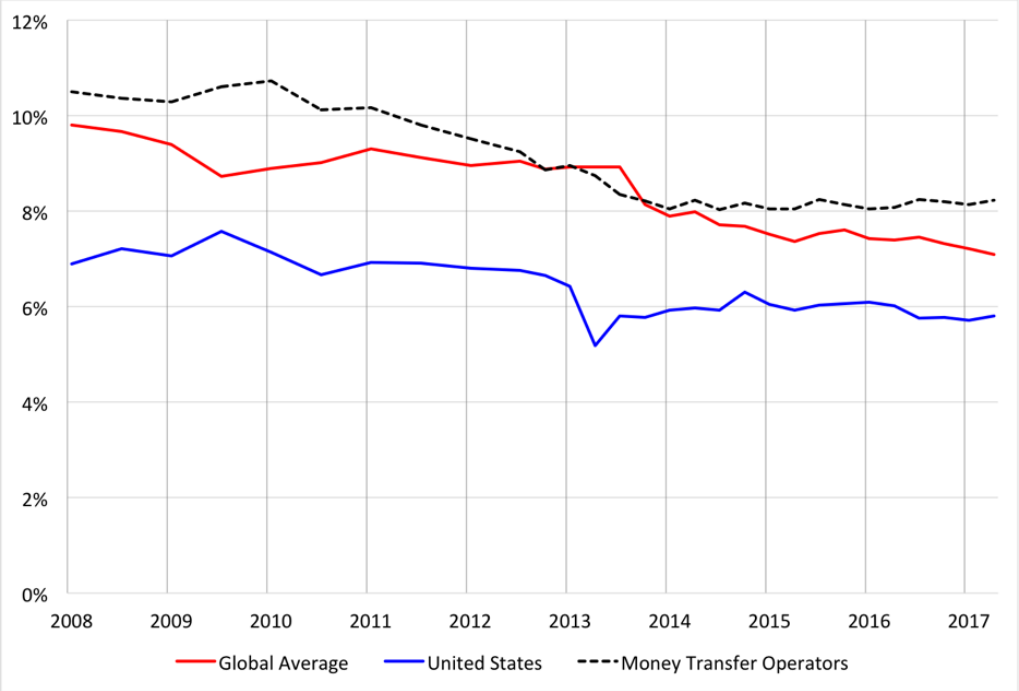

Figure 2: Average Cost of Sending $200 Across a Border (Cecchetti & Schoenholtz, 2018)

There are many opportunities for improvement. In the bigger context, remittances are only a small portion of the total annual cross-border transactions, which, as a whole, average around 1.8 times the global nominal GDP (Digiacomo et al., 2016). Geopolitical issues create a challenging climate for managing these cross-border transfers. Notably, global mistrust between countries, trade wars, compliance norms, and cyber risks lead to significant friction between countries. Digiacomo et al. (2016) breaks it down ever further: "To date most cross-border payments continue to carry price premiums, justified by their underlying complexity, regulatory constraints, and value-added services such as FX." For this reason, there needs to be a focus on the technologies that drive these costs and even the leaders who control regulations. In the coming years, global transfers will only increase. McKinsey estimates the quantity of transfers will grow from 4.5 trillion in 2019 to 6 trillion in the coming years. With a shifting interconnected global business field, impact consumers such as the collected individual, global supply chains, and large businesses will put pressure on governments to align their banking standards. This will offer an easier path to cheaper fees, more transparent systems, and faster payments. In addition, more frequent business-to-business transactions will put pressure on global payment providers to push their technology capabilities and offer better alternatives. McKinsey said that FinTechs have set the goal to develop new systems that would reduce average international fees from $35 down to just $1, lowering them to comparable domestic transaction fees. This would only apply for the "average" transaction and not special or particularly complex transactions. The ensuing graph illustrates the various factors that contribute to these costs. As shown, there are a wide variety of aspects that come into play. But, as payments continue to grow, and banks look to expand their profit margins, there will be a continued pressure on governments and payment operators to offer cheaper alternatives. Analysts

from McKinsey went on to share that most industry experts did not have faith of reaching this $1 price premium within the next 5 years. This major change will require a large overhaul of our banking system with continuous support from fintech startups and pressure from consumers (Digiacomo et al., 2018).

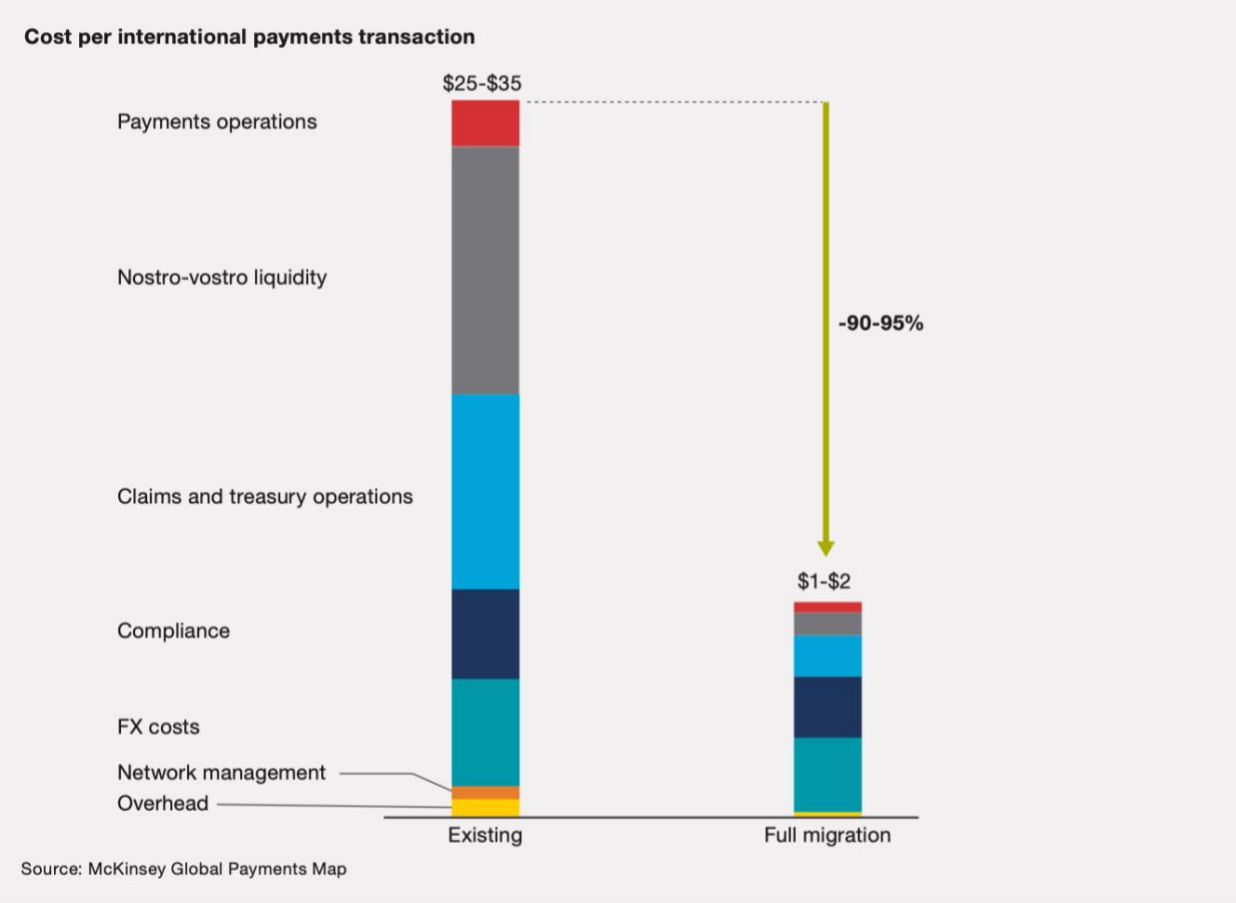

Figure 3: Changing Costs of International Payments (Digiacomo et al., 2018)

These transaction fees are also be apparent in credit cards. Although the consumer may be unaware, they are still getting hit with small and relentless fees every time they swipe their piece of plastic. Most often, these fees are factored into the price, without any indication, to cover the costs credit card companies impose on businesses. Michael Casey and Paul Vigna (2015), authors of the *Age of Cryptocurrency* detail in their book the hidden costs of credit card ownership. They emphasize the main point that in 2013 Visa and Mastercard processed around $11 trillion in transactions. Of this $11 trillion, businesses were charged over $250 billion (p.

100). The authors reference these major payment processors as “fee-charging gatekeepers” (p.5). Many consumers do not take the time to consider the reasoning for cash discounts at gas stations. Businesses can offer gas at a lower cost because they are not getting hit with the additional fees by large credit card processors. In the end, it is the consumer that gets hurt, whether they are aware or not. These costs are simply added onto the bill, sometimes with notice, but usually hidden. Casey and Vigna (2015) continue, “We’ve allowed Visa and Mastercard to form a de facto duopoly, which gives them and their banking partners power to manipulate the market” (p. 101). New FinTech startups will help to even out these transaction costs in the coming years. However, for the time being, the average consumer will continue losing a significant portion of their hard-earned money to these sneaky fees. It is an infrastructural problem that stems from outdated technology unable to keep up with a rapidly growing economy. These fees only get more expensive as the cardholder travels farther from the country. Globalization is leading to an intertwined banking system. With this will come reduced fees. But, such a large, sensitive, and complex space requires careful consideration and slow implementation.

Another primary problem that arises from our current banking infrastructure is the issue of transparency and security. American Express, talking about a study done by SWIFT in 2017, describes:

> Businesses are frustrated by a combination of policies and processes at correspondent banks and architecture limitations of the global payments system, according to the survey, which polled 300 treasury professionals from international businesses of all sizes in 18 different industries. Sixty-four percent of treasurers said they want real-time payments tracking, while 42 percent are looking for instant payments. (Malykhina, 2020)

This excerpt displays the current opacity of the US banking system. Pressure from business and individuals will force major payment processors to offer better solutions going forward. This study done in 2017 provides a detailed picture of the current frustrations apparent throughout different industries, as shown in the following graphic.

Figure 4: The Challenges of International Payments (Redlich, 2017)

There are issues that can be seen by individuals as well as banks. Although the standard user might not be able to understand why their Venmo transfer takes days to process, they feel the same irritation as large corporations. New technologies look to solve these issues using unorthodox methods that will be highlighted later on. The communication between consumers and payment processors offers hope that there are changes to come, paving the way for improvement. The survey takes into account companies of various sizes. They all focus on different aspects of what needs to be solved, specific to the negative impacts they feel. Nonetheless, there is a mutual agreement that technology needs to catch up to growing globalization and online money movement. In the same study, SWIFT noted that a primary cause of the differences in agreement stem from the quantity of money being moved. A small tech

startup in Silicon Valley can offer a great new method of movement for a company under $500 million in value. However, a company that exceeds billions in value would prefer efforts to be focused on an industry overhaul. The quantity of money processed on a daily basis requires more collaboration than the efforts of a few FinTech startups. Giving hope to the future, McKinsey's analysts state, "Tomorrow's cross-border payments will go beyond utility models based on legacy systems and old-school correspondent banking. They will adopt future-proof digital technologies and industry standards that promote cross-country integration and greater transaction efficiency" (Digiacomo et al., 2016).

Cryptocurrency Technology

Cryptocurrencies came into being during the most recent financial recession, in 2008. Today, there are thousands of different cryptos that all have specific functions. The most commonly known include Bitcoin and Ethereum. Many of them share the same major piece of technology, Blockchain, to control their networks. The developments they have made over the last decade have shown to have profound implications to the banking world, offering new ways to conduct business in a more efficient and transparent manner.

Bitcoin

Bitcoin was created by Satoshi Nakamoto. The network first started operating in January of 2009. Over the past couple years, the cryptocurrency has varied in value from a few cents and peaking around $20,000 in 2017. For this reason, it is hard to take the crypto seriously when considering it as a store of value, as with the US Dollar. However, that perspective is all relative. In the US, many people have always been blessed with an economy that could maintain a

consistent Dollar value. On the other hand, in countries such as Venezuela and Argentina, currency fluctuations are painfully all too common. For this reason, they could find a much more logical use for Bitcoin as an actual form of currency. Many US citizens argue the validity of Bitcoin as a form of currency due to major fluctuations, a lack of government backing, and money laundering issues resulting from a level of anonymity. Some view the lack of government interference as the currency of the future. The authors of *The Age of Cryptocurrency* argue, "Launched in the throes of the 2008 financial crisis…without that crisis painfully exposing the flaws of the world's financial system, it's hard to say where Bitcoin would be today" (Casey & Vigna, 2015, p. 13). At this time in 2008, many of the US financiers understood where value could be derived from in a cryptocurrency such as Bitcoin. During recessions, many turn to commodities to store money, such as gold and silver, due to a mistrust in the government's capabilities. Bred in the depths of skepticism, Bitcoin began to take rise in 2009, independent of any central entity. It never fully caught on but did gain the attraction it needed to force the government to recognize it. The current market cap is at $156.34 billion.

It's clear that Bitcoin can no longer be ignored. There are many contrasting viewpoints related to the future of Bitcoin. Some are optimistic for all the various uses and others simply assume it will die off in a few years. One thing that Wall Street and Bitcoin enthusiasts can agree upon, is the power of the underlying technology of Bitcoin, referred to as Blockchain. The key piece of Blockchain is the Distributed Ledger Technology (DLT). Satoshi's initial reasoning for not entrusting a central authority was to avoid collapse. If an overseeing company were to go under, or lose interest, the whole network would go down. Instead, the collective effort to continue the blockchain reduces risk of collapse. While blockchain is a form of a distributed ledger, not all distributed ledgers can be categorized as blockchains. Blockchains are based on

cryptocurrencies and require proof-of-work from the nodes within the network. Distributed Ledgers can be better thought of as a large databased controlled by no single entity. Their shared accessibility allows for the transparency of past transactions with immutability. This immutable aspect ensures nobody can alter prior records, also due in part to the shared control and agreement by majority.

The Blockchain essentially functions as a large excel document, recording every transaction, referred to as the distributed ledger. Each transaction goes through a verification process, which then is recorded into a block. Every computer, referred to as nodes, in the network plays a key role in the verification process. Once a user attempts to send money, an encrypted code is attached to the transfer that can only be unlocked by the party at the receiving address. This transfer is then posted publicly along with 3 key pieces of information: the quantity, the input address and the output address. Complex cryptography creates the coveted anonymity of the blockchain and ensures concealment of individual identities. Once this transfer is then posted to the general ledger, it is attached to the previous transaction's code and added to a block, generally consisting of around 500 transactions, and completed roughly every 10 minutes. Upon completion of a block, every CPU competes to provide the proof-of-work. This process is referred to as mining. Once a node posts their mathematical proof, every other computer votes on the validity of the payment. They solve complex algorithms to make sure there was no double spending of Bitcoins in prior transactions. As long as the majority vote confirms the block, they begin the next link in the chain. The CPU that first solved the equation is awarded a sum of Bitcoins in return for their work. This aspect creates the motivation to continue the process of verifying transfers. Also, there are small transaction fees present for each transfer. This is spread amongst the CPUs and funds the general upkeep of the network.

A possible problem occurs when one set of computers has the majority computing power over the network. With billions and billions of different nodes, it is impractical to control over 51% of all computing power to make a false set of transactions. This is referred to as the 51% attack, derived from the power of majority. Most likely, it would require an investment that is nearly unattainable to override the network. The decentralized system adds new computers every day, each thousands of times more powerful than the standard laptop. However, as explained in the initial paper detailing Bitcoin, "If a greedy attacker is able to assemble more CPU power than all the honest nodes, he would have to choose between using it to defraud people by stealing back his payments or using it to generate new coins. He ought to find it more profitable to play by the rules, such rules that favor him with more new coins than everyone else combined, than to undermine the system and the validity of his own wealth" (Nakamoto, 2008).

The entire system was established on complex mathematical algorithms, far too advanced for humans to solve. The network was set up to eliminate any central authority and promote ease of transfers. It was created with the idea in mind that there can only be a maximum of 21 million Bitcoins in circulation, automatically awarded to computers managing the network. As of now, there are about 18 million in circulation, with 3 million left to mine. The underlying algorithm also takes into account the growing use of Bitcoins by making them harder to obtain by CPUs. For this reason, it would be a waste of time and money to use your standard everyday laptop for these purposes. Generally, the most profitable way to earn Bitcoins is to invest in large scale operations that collectively fund mining projects, taking up huge warehouses full of CPUs designated for this task. Once the 21 million coins are distributed, the cost of mining would be compensated by the small transaction fees from individual transactions. The fees would be pooled together to compensate the node that correctly computed the algorithm correctly and

quickly. The ongoing success of Bitcoin's future can only be made possible by the compensations. Initial investments are high and so are electric bills. However, as computer's advance in technology, overhead costs will be reduced.

The current banking model uses a form of privacy by entrusting their transactions to a third party. Because of this, they must pay a large fee for use of their services and discretion.

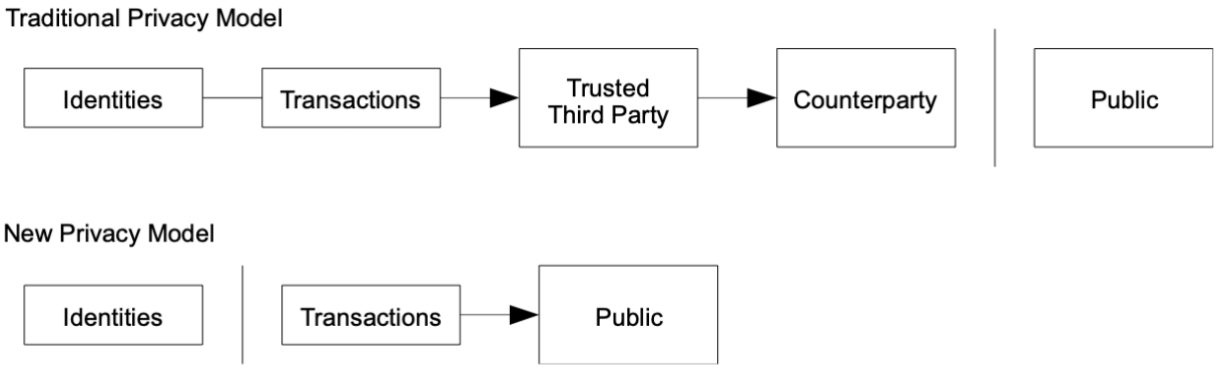

Figure 5: Flow of Information in Blockchain's New Privacy Model (Nakamoto, 2008)

Transactions must go through the third party and then to the receiver. As shown in the graphic, the elimination of a third party offers the ability to reduce cost and drive efficiency, evident through Bitcoin's network.

Blockchain avoids this method of third-party control by the distributed contributions of a decentralized network. Whereas banks can sometimes charge up to $30 per transaction, the Bitcoin network generally charges pennies. Bitcoin transaction fees are structured as bids, which equate to waiting time for the transfer to be completed. The higher end of these bids, at the discretion of the sender, is usually around $.09 and completed in 10 minutes or less on average. A bid of $.04 will usually be completed within an hour's time.

Privacy is ensured throughout the blockchain through the use of Public Keys. These are encrypted codes that uniquely identify each participant. On the general ledger, the timestamp of a

transaction and general keys are present. However, the specific keys are essentially unbreakable unless disclosed by the user, due to their encrypted nature.

Ethereum and Smart Contracts

Ethereum, another cryptocurrency, was developed in 2015. One major difference between Ethereum and Bitcoin was the inclusion of smart contracts. Smart contracts were developed before any cryptocurrencies came to be, but didn't reach mainstream popularity until the release of Ethereum. Smart contracts work similar to an escrow service. Essentially, two people create a line of code recorded into the Ethereum blockchain in order to execute a trade automatically upon certain conditions. Put simply, "They are capable of facilitating an exchange of money, property and anything else of value, ensuring the complete transparency, avoiding the services and accompanying charges of a middleman and eradicating the question of trust between the parties" ("What Are Smart Contracts," 2017). The inclusion of smart contracts into a distributed ledger eradicates the need for a middleman, or any central authority. Once money is sent via the crypto, the ledger holds onto it until the other end completes their end of the deal. Because it is stored in the distributed ledger, the coding cannot be changed. This creates an additional guarantee of authenticity where a fee-based authority once resided. The contracts are able to be written into the Ethereum blockchain and tied to external data. Ethereum's blockchain is very similar to Bitcoin, with the added benefit of smart contracts. The initial creators intended to allow this crypto to help people execute their contracts. By writing in the specific Ethereum compatible language, the contract is permanently held in the ledger until completion. Involved parties can be assured there is no disagreement on what is at stake, the execution date, or amount owed (Hertig, 2017).

Adaptations

As previously outlined, cryptocurrencies can offer a lot of great potential moving forward, if paired with the right ecosystem. The speed, transparency, and security offered by these technologies can help improve many aspects of the current payment technology in the US. Credit Card companies, large banks, and small businesses can all find value in the various technologies that became popular with Bitcoin and Ethereum. Distributed ledger technology, decentralization, and smart contracts all offer incredible advancements. The combined abilities of these technologies can create a new payment system offering higher levels of speed, immutability, transparency and collaboration.

Corda Case Study

R3, a company focused on blockchain technology, recently paired with Mastercard to start organizing a new system, Corda, for cross-border business-to-business payments. Already, they say, “More than 300 of the world's leading financial services firms, technology companies, central banks, regulators, and trade associations” (“Italian banks pioneer the use of Corda Enterprise,” n.d.) have joined their blockchain network, looking for cheaper and faster payment options. Mastercard’s inclusion into this network could have substantial impacts on the future of banking. On Mastercard’s website, they refer to their recent move: “The partnership will provide increasingly innovative, value add services for customers, addressing factors such as high processing overheads, liquidity management and the existing lack of standardization and processes between banks and domestic clearing systems” (Eisen, 2019). The initiative is a landmark move for such a large payment processor, currently making over 74 billion transactions

a year. The focus on B2B will handle relatively larger transactions, where most of the annual cross-border payment fees come from.

R3's Corda network is comprised of over 300 different businesses. They use a distributed ledger to ensure authenticity of payments and no "single point of failure." With this, they can accommodate large scale transactions with faster and more cost-effective methods. They have adapted the DLT to better accommodate strict regulations and security. Kevin Bannerton, Partner at Total Bank Solutions, describes R3's network, "We were looking at a new way to reevaluate the reciprocal deposit market in the US by leveraging DLT, but we knew we needed to have the right architecture, access for regulators and a private ledger. The combination of those components made Corda a compelling choice" ("Italian banks pioneer the use of Corda Enterprise," n.d.). Due to tight regulations on the banking sector, the open platform of blockchain had to be modified to suit their needs. Corda provides the necessary access from regulators with ease and transparency. In this manner, they will no longer have to go through each institution to settle disputes and can instead view everything on a privatized ledger communicated between all participants. A "single version of truth" is necessary to optimize the current state of transaction technology and eliminate the friction caused by unparallel reconciliations.

In 2018, seventeen of the leading banks in Italy partnered with Corda to test run a DLT. They collectively processed a total of 1.9 million transactions with little error. Many financial institutions suffer from lack of communication and standardization. By implementing Corda's network, they no longer experienced from the pains of disconnected ledgers. The distributed ledger allowed for quicker settlements without the painstaking process of slow inter-bank reconciliation. Corda's founders detail, "R3 identified some time ago that these characteristics—

slow, inefficient processes hampered by a lack of transparency and consensus —made interbank reconciliation an ideal candidate for streamlining and automation through its Corda blockchain solution" ("Italian banks pioneer the use of Corda Enterprise," n.d.). Following their initial case study, they are now in the process of incorporating the entire Italian banking sector, around 200 banks. Italy was a great opportunity to test-run this network because of 3 key aspects: a complex regulatory environment, lack of standardization, and inefficient transaction tech in place. Each of these aspects is a core part of DLT's success. Each bank has their own correspondence account that is only owned by them. In creating the network, each bank was assigned as a node and posted their transactions to the distributed ledger, similar to blockchain. The introduction of transparency across accounts helped to resolve the relationship with regulators. Authorities were provided access to the privatized ledger to monitor banking activity and ensure ethical procedures. Each of the Italian banks studied also operated by their own rules and reconciliation methods. DLT's connected ledger allows every bank to follow their transactions from beginning to end and creates a common procedure for handling transactions. Following the implementation, the banks no longer had to deal with disagreements regarding payments and lengthy reconciliation periods as a result of their nonstandard processes. Thirdly, the Italian banks' payment transfer technology had similar issues as US banks'; transaction process times were costly and slow. The collaboration and communication offered by this new network eliminated hours of waste, largely due to the result of human error and a disconnected system. These three pain points created the perfect storm for a distributed ledger integration. Corda was created by bankers knowledgeable of the industry and fit in perfectly to cure banking's ongoing problems.

Each bank can see a list of their transactions in a dashboard. This dashboard includes information about suspended movements, participants, and message centers for easy inter-bank

communication. The collection of information in one single area saves hours and hours on the phones. The application offers an element that allows participants to comment on a particular transaction in the ledger, notify the other of a necessary response, and post additional documents to further elaborate. The consortium of banks found this ability to be incredibly useful to replace sluggish email and phone conversations.

Another important piece of Corda's tech is smart contract execution. As previously described, smart contracts remove the need for interference from a trusted third party. Code is permanently written into the distributed ledger with a set of commands in an 'if-then' format. Once a bank makes a transaction, one account is debited while the other is credited. This further reduces the need for settlements at years end. With the old system, for every disagreement between banks, one must call the other to speak on the phone. If someone doesn't answer, they may wait days for a return message. Then paperwork must be completed and sent between firms. Finally, hopefully after only a few days, successful payment can settle the discrepancy. Smart contracts, instead, ensure the correct amount is sent following an agreed upon condition. Banks can coordinate their payment systems to act in reaction to a set of events. In this manner, there would be consistent and exact transfers without the need for human intervention. The elimination of human error creates thousands of hours of saved time, which will only increase with widespread adoption.

After such a successful trial run, Corda and its partners hope to expand to 200 more banks. This would increase the initial 1.9 million transactions completed to possible hundreds of millions. The founders are very hopeful for future use cases and plan to expand to loans and capital markets, among other functions. Their project is just the beginning of possible applications; it marks a prominent success on the path to financial optimization. This first major

test with a banking system shows how feasible the applications really are, especially in a notoriously complex Italian banking ecosystem ("Italian banks pioneer the use of Corda Enterprise," n.d.).

Barclays' Initiatives

Barclay's is also making tremendous strides using cryptocurrency technology. They have taken on the role of an incubator, encouraging aspiring startups to develop solutions to banking's current problems. Primarily, they focus on a lack of standardization, back-office optimization, and improvements to data processing. In 2018, they held a Hackathon to develop new technologies, with estimated savings "in the double-digit billions," according to Sunil Challa, from Barclays' Business Architecture team. Emphasizing collaboration, they partnered with ISDA, Deloitte, and Thomson Reuters, with judges from Barclays, JP Morgan, UBS, and HSBC.

Describing their goals towards optimization, Andrew Kouloumbrides (2018) of Xceptor, one of the event winners, wrote, "By focusing on back-office processes such as post-trade, we are actually looking to solve a symptom rather than a fundamental cause." Having realized this, they noticed that an important aspect of improving the flow of information actually will start with their front-office operations. The interconnectedness required to maintain a distributed ledger in the banking system will cure the antiquated back-office operations plaguing the industry. Further emphasizing their hopeful future, Barclays says, "For Barclays' customers and clients alike, the innovations from these companies will mean quicker and more secure services, and the efficiencies that could result in cross-sector blockchain adoption could also see falls in the costs of doing business – as information can be securely synchronized in real time" ("How Barclays is exploring blockchain technology," 2019). A major bank's willingness to assist these

FinTech startups is a strong step in the right direction. With Italy proving the invaluable nature of Blockchain, many countries will soon follow. Commenting on Barclays' continuous pursuit of efficiency, Dr. Lee Braine of Barclays' Chief Technology Office explains, "Barclays has explored many interesting uses for blockchain: these include the simplification of payments infrastructure, the use of smart contracts to standardize post-trade processes, and efficiently connecting parties in trade finance and syndicated lending" ("How Barclays is exploring blockchain technology," 2019). Aside from the standard back-office connections, there are many uses for DLT. Barclays has made it a mission of theirs to exploit every opportunity for improvement. Every aspect in the banking industry is ripe for technological innovation, evident in Barclay's proclamation. With an innovative spirit and support for startups, many major banks will see tremendous cost reductions in the coming years, eventually trickling down to lower fees for their customers.

Barclays is the first bank to use blockchain technology for a trade finance purpose with the help of a small startup called Wave. They partnered with Ornua and Seychelles Trading Company to facilitate the movement of nearly $100,000 worth of cheese and butter between the island nation of Seychelles and Ireland. This was the first of its kind, setting the pace for future adopters of this powerful technology. Wave, a blockchain based company, graduated from Barclay's development program in New York. Their initial ideas were soon turned into a reality, empowering future trade partners to effortlessly exchange money for goods with ease and simplicity. Baihas Baghdadi, Barclays' Global Head of Trade and Working Capital, explains:

> In the best case scenario, the trade finance process for this type of deal takes seven or eight days – when you've gone through loading the goods, issuing your invoices, dealing with your home bank, getting those recommendations checked, sending the paperwork to

> Africa and getting it endorsed by the importing bank. In the worst-case scenario, it can take 20 days. Since all this is physical, it's really difficult to accelerate that process. ("Cash Cows - How Blockchain Is Transforming Trade Finance," 2016)

With Barclay's new system, however, processing can occur in four hours or less. Significant changes to back office operations will fundamentally change trade finance going forward. Most importantly, the elimination of paperwork will result in extreme cost and time savings. Barclay's use of DLT will help them to connect all parties involved in a manner that promotes quick settlements. The key aspects of these savings result from more efficient timings, improved documentation control, and courier savings. After the initial testing, the real value will be demonstrated with industry adoption: "We have to keep in mind that this is not only about banks, but also importers, exporters, shipping and insurance companies coming together" ("Cash Cows - How Blockchain Is Transforming Trade Finance," 2016). The bank is currently in talks with major industry bodies and government agencies to seek approval and support. Their successful testing of the software will prove to set the groundwork for the industry moving forward. The approval of these foundational organizations will lead to impactful strides for the industry. It may be a few years before their technology is implemented systemwide; nonetheless, the power of blockchain has been demonstrated and significant savings will quickly attract the attention of major industry players.

Utility Settlement Coins

Fnality is another prime example of a DLT-based improvement coming to the banking system. They have already received over $60 million in funding from 14 major banks, seeking to disrupt the current flaws that DLT may possess. Fnality seeks to create something called a Utility

Settlement Coin (USC). This project creates blockchain versions of five major currencies: the U.S. dollar, the Canadian dollar, the British pound, the Japanese yen and the Euro. While many blockchain projects emphasize the improvement of information flow, they seem to ignore the movement of fiat currency. For this reason, Fnality is looking to create a coin-based system that helps to move money at the same speed information is flowing on a distributed ledger. In previously stated examples of blockchain uses there is an emphasis on the back-office operations of connected organizations. However, the speed at which this information can be processed is subject to the underlying transfer of funds. While a trade finance operation may be able to now process information in under 4 hours, largely due to elimination of a paper trail, the money could still take lengthy periods of time. Speed of currency transfer will still benefit from the trade finance applications. However, immediate payments will still largely remain inconsistent. Focusing on securities exchanges, CoinDesk explains: "In other words, it's all well and good if a stock or bond zips around on a distributed electronic network, but if the cash side of the trade is being done the old-fashioned way, it'll still take days to settle, defeating much of the purpose" (Allison, 2019). This problem has been referred to in the industry as 'cash on ledger' problem – a slow movement of cash between systems (Allison, 2019).

JPMorgan is currently working on their own similar use of this technology, called JPM Coin. Like other blockchain uses, the power comes from collaboration. Although their coin would be specific to JPMorgan's system, Fnality hopes that their USC would serve as a liaison between banks, offering this collaborative nature they aim for. In addition, they also hope to connect the central banks to their respective fiat currency blockchain alternatives. This would allow for the ease of settlement with securities and cash. Coindesk elaborates: "Stepping back, trade settlement today requires businesses to hold accounts in multiple locations to handle cash

and securities, splintering liquidity and leading to a mess of post-trade pipes and buffers that kick in and delay the settlement of the trade" (Allison, 2019). Given this collaboration, Fnality believes it would lead to immediate settlements, reduced counterparty risk, and the freeing up of capital. There are still many hoops they will have to jump through in order to accomplish this task. Although, with backing from major institutions such as NASDAQ, Credit Suisse, UBS, and Barclays, just to name a few, their goals are in sight. Further integration with market infrastructure will lead to greater value. Their initial plans for implementation involve simple payments, and eventually leading to more complex currency or security swaps (Allison, 2019).

An article written by Brian Brooks details the unified efforts by the private and public sector to develop new technology. The US government has shown support of a digital fiat currency with major supporters including the Central Bank, already exploring their own ideas, and the former chairman of the Commodity Futures Trading Commission. Both play an impactful role in the formation of new technology and advise the industry to pursue these major advancements. Historically, the government has indirectly embraced new technologies by setting "guard rails for innovation within the financial system" (Brooks, 2019). This has proven to be the best manner in which to regulate and empower individual startups. Being the world's dominate reserve currency, it is more important than ever to stay on top of technology and prevent a shift towards a new fiat currency. The US has consistently been a leader in FinTech due to their collaborative approach between the government and the private sector. Brian Brooks (2019), editor for Coinbase, adds, "The U.S. is the world's leader in technology innovation, but that leadership is provided by the private sector, not by the government. We think USDC and other fully backed stablecoins like it are great examples of how the U.S. can take the lead without the exerting unnecessary control over technology decisions that are providing increased

access to our financial system." With their important position in the financial world, the advancements in liquidity will have profound impacts on the market as a whole. Their continued focus on improvements is imperative towards creating a more inclusive, frictionless global economy.

Implications

Despite these optimistic aims, it is important not to forget the lengthy process to make this transition. A few years ago, before these case studies were conducted, there was concerns regarding major banks' willingness for adoption. As costs for the customer are cut down, major payment vendors lose significant profits. In 2013, Visa and Mastercard processed over $11 trillion in payments, costing merchants around $250 billion (Casey & Vigna, 2015, p. 100). Further, the writers of *Age of Cryptocurrency* explain, "The bottom line is that even if Bitcoin doesn't keep growing, even if none of the other 'altcoin' cryptocurrencies catch…we've seen a way of doing business that is faster and cheaper, that cuts out the middleman and the rentier…once you see this, there is no way to unsee it" (Casey & Vigna, 2015, p. 12). At first, banks were hesitant to give up their dominant role in the banking sector. As the situation progressed, however, they recognized the system was headed in a direction with or without them. At the end of the day, banks will have to decide whether they will have to embrace this technology or be replaced by it. The underlying theory of eradicating the middleman is a threatening proposition to banks. For years, they have profited off their size and untouchability. However, when power is restored to the individuals, bank's profits are at risk. The distributed power of blockchain allows any person with a computer to contribute to the system. This balanced system of monitoring transactions prevents fraud and central governance. Startups may

have impactful measures in place for the everyday consumer in niche spaces. When it comes to the standard business to business transactions, banks will be hard to avoid. For that reason, the best-case scenario might be a combination of power and technology, as we have already seen. However, while banks might risk lower profits due to a shift from the need for a central autority, they can make it up in other ways. The average citizen is inherently untrusting of a network made of anonymous computers. The banks have shown they can adapt to monitor the transfers and security throughout the process, almost taking on a central role, but not quite. This would provide them a new opportunity for income by verifying every transaction. Although they would no longer be a singular central authority, it is important to include them for adoption purposes and legitimacy.

Another important implication to take into account is the time it takes to clear transactions. In Bitcoin, it can sometimes be quite lengthy waiting for even the smallest transactions to occur, albeit not the extent of delayed banking payments. This is in large part due to the security and collaboration involved. A majority of the users must authenticate the payment before it is made part of the ledger. At the time being, Bitcoin only processes millions of transactions per day, dwarfed by the trillions of payments across the entire banking system, whether that be credit card payments or large reconciliations between banks. For these processors to keep up with the banking system's demands, significant modifications will have to be made to the distributed ledger technology. Although, since these decentralized ledgers are private, there will be significantly less nodes to verify transactions, thus significantly speeding up the process. With such a large focus on new technologies, startups will continue embracing the challenges to create the powerful results we hope to achieve.

Conclusion

Although means may vary among FinTech projects, the end goal remains the same: collaboration, speed, and transparency. This will only be achievable with the support of all major industry players. The transition will be slow, with regulatory and technical hurdles playing in effect; but the outcomes will be tremendously impactful. An infrastructural overhaul has been overdue for some time. The increasing role that startups will play in financial technology opens the door for incredible advancements. Regulatory powers have begun to take notice of groundbreaking ideas and have opened their doors to new opportunities. In the coming years, costs are likely to drop tremendously as banks seek to optimize their processes for maximum efficiency. Blockchain and smart contracts will lend their hand in changing the back office of the entire economy. There are many projects in progress that vary in their specific targets. Some are focused on small transfers and others that strictly apply to large corporations. However, it is the unorthodox and abstract manner in which FinTechs operate that is likely to lead to success.

The key driver of value from these technologies will come from the industry's ability to collaborate. As with the example regarding trade finance, there are many pieces of the puzzle that must communicate in a synchronized manner, including banks, payment processors, importers, exporters, and shipping companies. One of the most important aspects of this network will involve governments. The US has shown they are receptive to new technology; but it will require much more than the local government to really create an impactful change. The geopolitical atmosphere is tense, with trade wars, cyber threats, and compliance risks constantly posing a threat. The more governments that are on board, the greater value these solutions will offer. The success will be defined by the skill in which FinTechs can navigate a changing geopolitical environment to connect all the pieces to the puzzle.

References

Allison, I. (2019, June 13). 14 Banks, 5 Tokens: Inside Fnality's Expansive Vision for Interbank Blockchains. Retrieved March 15, 2020, from https://www.coindesk.com/fnality-utility-settlement-coin-central-bank-token-blockchain

Barclays. (2016, November 01). *Cash cows - how blockchain is transforming trade finance* [Press release]. Retrieved from https://home.barclays/news/2016/11/how-blockchain-is-transforming-trade-finance/

Barclays. (2018, October 30). *Barclays in the news: trading aces* [Press release]. Retrieved from https://home.barclays/news/2018/10/barclays-in-the-news--trading-aces/

Barclays. (2019, July 10). *Less hype and more collaboration: how Barclays is exploring blockchain technology* [Press release]. Retrieved from https://home.barclays/news/2019/7/less-hype-and-more-collaboration--how-barclays-is-exploring-bloc/

Brooks, B. (2019, November 4). The U.S. Should Let Private Companies Create Digital Dollars Says Coinbase Lawyer. Retrieved March 29, 2020, from https://fortune.com/2019/11/04/digital-dollar-coinbase/

Camp, A. (2020, March 3). Wire transfer fees for 10 major US banks. Retrieved March 20, 2020, from https://www.finder.com/bank-fees-wire-transfers

Cecchetti, S., & Schoenholtz, K. (2018, February 19). The Stubbornly High Cost of Remittances. Retrieved March 10, 2020, from https://www.moneyandbanking.com/commentary/2018/2/18/the-stubbornly-high-cost-of-remittances

Cointelegraph. (2017, December 6). How Blockchain Technology Works. Retrieved March 8, 2020, from https://cointelegraph.com/Bitcoin-for-beginners/how-blockchain-technology-works-guide-for-beginners

Digiacomo, N., Denecker, O., Höll, R., & Niederkorn, M. (2016). Rethinking Correspondent Banking. *McKinsey on Payments*, *9*(23), 3–10. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Financial Services/Our Insights/Rethinking correspondent banking/Rethinking-correspondent-banking.ashx

Digiacomo, N., Denecker, O., Höll, R., & Niederkorn, M. (2018). A vision for the future of cross-border payments. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Financial%20Services/Our%20Insights/A%20vision%20for%20the%20future%20of%20cross%20border%20payments%20final/A-vision-for-the-future-of-cross-border-payments-web-final.ashx

Does Bitcoin/Blockchain make sense for international money transfer? (2020, March 1). Retrieved March 15, 2020, from https://www.saveonsend.com/blog/Bitcoin-blockchain-money-transfer/

Eisen, S. (2019, September 11). *Mastercard and R3 partner to develop new blockchain-powered cross-border payments solution* [Press release]. Retrieved from https://mastercardcontentexchange.com/newsroom/press-releases/2019/september/mastercard-and-r3-partner-to-develop-new-blockchain-powered-cross-border-payments-solution/

Hertig, A. (2017, March 30). Ethereum 101: How Ethereum Works. Retrieved March 10, 2020, from https://www.coindesk.com/learn/ethereum-101/how-ethereum-works

r3. (n.d.). *Italian banks pioneer the use of Corda Enterprise for interbank reconciliation—opening the way to a full production roll-out*. Retrieved from https://www.r3.com/wp-content/uploads/2019/04/Spunt_CS_R32018.pdf

Malykhina, E. (2020). Corporate Treasurers Seek Improvements in Cross-Border Payments. Retrieved March 25, 2020, from https://www.americanexpress.com/us/foreign-exchange/articles/improvements-needed-in-cross-border-payments/

Nakamoto, S. (2008, October 31). Bitcoin: A Peer-to-Peer Electronic Cash System. Retrieved February 20, 2020, from https://Bitcoin.org/Bitcoin.pdf

OFX.com. (2020). What is CHIPS? Retrieved March 10, 2020, from https://www.ofx.com/en-us/faqs/what-is-chips/

Redlich, D. (2017). The future of payments: a corporate treasury perspective. Retrieved March 10, 2020, from https://www.swift.com/node/138896

Saslaw, M. (2012, February 23). International Money Transfers. Retrieved March 15, 2020, from https://www.simple.com/blog/international-money-transfers

Tierney, S., Spencer, & USA Today. (2019, May 20). ACH Transfers: How They Work. Retrieved March 10, 2020, from https://www.nerdwallet.com/blog/banking/ach-transfers/

Vigna, P., & Casey, M. J. (2016). *The age of cryptocurrency: how Bitcoin and digital money are challenging the global economic order*. New York: Picador.