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Can a cryptocurrency become the next
global reserve currency?

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1 Introduction

The rapid rise of globalization and digitalization has connected the world so strongly. We can interact virtually on our smartphones with anyone, anywhere, anytime. We exchange daily information and services peer to peer instantaneous over the Internet. Goods are being traded from all over the world. A dominant global reserve currency tied to a country feels out of place in such an intertwined world, change is imminent. This thesis discusses the potential of cryptocurrency to become a global currency, the benefits and the possible risks posed by cryptocurrency when adoption takes off.

As a consequence of the financial crisis in 2008, several countries called for reforming the international monetary system. Zhou Xiaochuan, the governor of the People's Bank of China, for instance, argues that "the desirable goal of reforming the international monetary system is to create a global reserve currency that is disconnected from individual nations..." (Xiaochuan, 2009). Also, the United Nations (2009) reported that there are flaws with the U.S. dollar as the dominant global reserve currency and discuss the involvement of the Special Drawing Rights (SDR) or the issuance of a new currency, such as the Bancor¹, to handle international liquidity.

Throughout history, money has changed drastically. One of the first innovations of money was the coinage of precious metals (Mundell, 2002). Coinage allowed users to quickly recognize the value of the precious metals as they were made uniform and marked, removing the friction of weighing precious metal for each payment. Quickly this innovation got copied and used by several countries around the world. However, when commerce moved away from the local town square and moved on to ships and ports around the world, carrying coined precious metals became expensive. Consequently, money evolved into paper money, a form of money that was lighter to carry around. Paper money removed the risk and costs of carrying coins for longer distances but required trust. Suddenly trust became an essential part of money. The state ended up being the guarantor of that trust.

Nowadays we have the ability of internet banking, but also new clever payment methods like iDEAL in the Netherlands or new specialized payment providers like PayPal or WeChat, delivering us near-instant payments. These services are a response to what people want and what the economy needs in this globalized world. The invention of Bitcoin was a response by Satoshi Nakamoto after the global financial crisis in 2008 to bypass the current banking system, which requires trust in central banks and banks. Nakamoto believes that central banks and banks cannot be trusted, as banks breached trust in the past and will continue to do so (Nakamoto, 2009).

¹ Suggested by Keynes at Bretton Woods Conference in 1944 as a supranational currency that would provide international liquidity.

Nakamoto (2009) envisioned that Bitcoin would become a peer-to-peer electronic cash system, that would allow users to transact with each other without the need for an intermediary to ensure trust. Years after the invention of Bitcoin, we not only have Bitcoin but also more than thousands of other different cryptocurrencies actively being traded. These cryptocurrencies are not exact copies of the Bitcoin system. Cryptocurrencies vary in their way of reaching consensus, costs, speed but also what friction they wish to tackle in the economy, the use-case. Nevertheless, all cryptocurrencies share one key element, no need for a trusted intermediary.

An area in the global financial system that heavily depends on intermediaries is the cross-border payments market. The cross-border market transaction value was \$156 trillion in 2014 and is a market that is growing continuously as the world globalizes. Banks, the intermediaries, dominate this market capturing up to 95 percent of the revenue generated by cross-border payments. To date banks have done little to replace the legacy systems in the back-office that are involved in cross-border payments, remaining an expensive and troublesome experience for customers, especially for small firms and individuals. (Niederhorn, Bruno, Hou, Istace, & Bansal, 2015)

In the digital world, there is no difference between an information exchange going to a domestic or a foreign recipient; the digital world is borderless. And as the economy is becoming more borderless through e-commerce and global trade, the global payment system is remaining far from being a borderless experience. Cross-border payments can get routed through multiple banks and networks resulting in delays, limited transparency and high costs for the receiving and sending parties. An estimated 1.6 trillion dollars per year are the costs for all cross-border transactions over the world. Shutting out smaller banks, companies and customers from participating on a global scale. (*Solution Overview, 2017*)

Cryptocurrencies have the potential to revolutionize the global payment system by cutting out the intermediaries that are needed nowadays for international payments and settlements. Resulting in a frictionless global payment system, real-time messaging and settlement of transactions for smaller banks, companies and customers. Existing intermediaries in the international payments market might be forced to change their internal organization due to lowered entry barriers allowing for new players on the market or becoming completely redundant.

A cryptocurrency that tries to solve the cross-border payments market by working with banks and institutions is Ripple (XRP). I will go more in-depth into Ripple as it is a cryptocurrency that is more efficient, faster and cheaper than Bitcoin, but usually is overlooked by the masses.

However, for cryptocurrency to reach mass adoption, institutionalization and regulation are as important as the innovative qualities of such a cryptocurrency. Central banks and regulators can be expected to be skeptical of the new form of money, cryptocurrency. Adequate regulation would be needed to embrace the new technology and give it room to develop fully, but at the same time prevent

any destabilization of the economy. Furthermore, parties that profit from the former system are expected to be against the adoption of cryptocurrencies as they could potentially harm their revenue stream.

The question can a cryptocurrency become the next global reserve currency will be answered by a historical overview of all forms of money we have seen in the past, how and why global reserve currencies rise and fall, and the important determinants of currencies that are used globally.

Furthermore, the basics of the new form of money, cryptocurrency, will be explained and a more in-depth analysis of the current situation of the cross-border payments market, and how Ripple tries to solve this friction. In Section 4, we will compare different forms of money with cryptocurrencies, on economic factors, supply structure and macro-financial stability risks; an attempt at defining what kind of money cryptocurrencies are.

Section 5 will compare different attributes of cryptocurrencies to existing forms of money from a user-perspective, clarifying the potential benefits for end-users. Furthermore, in section 5 I will discuss the potential benefits and challenges of adopting cryptocurrency from the central bank and bank perspective. At last, a discussion on whether cryptocurrency can become the next global reserve currency, replacing the international role of the U.S. dollar.

2 History of currency

2.1 Functions of money

Money fulfills a purposeful role in the economy: facilitating the exchange of goods and services, removing the high friction of a barter economy.² In a barter economy, the high friction is caused by the requirement of double coincidence of wants, meaning that for each exchange, each party must offer the exact good or service the other party wants (Wolla, 2013). These wants between two parties are satisfied more efficiently if society agrees upon a mutually accepted representation of value, money. Theoretically, society can agree upon any good to become their representation of value, for example, potatoes or glass (Perkins, 2018).

However, how well a currency serves as money depends on how well it fulfills the functions of money. The functions of money, according to macroeconomics books are unit of account, a medium of exchange and a store of value (Abel & Bernanke, 2005). Unit of account, money measures the value of various goods and services in the same unit. As a medium of exchange, it facilitates a seamless experience in transactions. Finally, as a store of value money needs to be safe, reliable and retaining its purchasing power over time.

These functions are not independent of each other. For instance, if money cannot fulfill the role of a store of value, consequently using it as a medium of exchange is not desirable as you risk to lose value after the transaction. When money is not desirable as a medium of exchange, the adoption of the money halts, hence the market will not mature nor stabilize. And finally, if money is not used for exchange or store of value, it is impractical to use the currency as a unit of account, as adoption within the society is non-existent (He et al., 2016).

2.2 Forms of money

Throughout history, we have seen different forms of money; from gold bullion, coinage, paper money all the way to internet banking and private e-money. The one key element behind these innovations has been reducing friction that older forms of money had. In the next subsections, we will go through different forms of money and how they came to change.

² In economic theory barter economy is usually pointed as the first type of economy, however written examples of such economies have never been discovered. See (Humprey, 1985).

2.2.1 Commodity money

Early forms of money consisted of assets with intrinsic value. These were mostly precious metals like gold, silver or copper. Money that carries intrinsic value is also known as commodity money. The reason for precious metals as the representative of value is thanks to the natural properties of these metals. Gold, silver and bronze are relative to other goods hard to obtain and limited in supply, which is important to maintain value over time. They are durable through time, but also good for repeated usage. Finally, precious metals are divisible; when made into smaller units precious metals will not lose their value (Asmundson & Oner, 2017). The properties of precious metals allowed them to serve the three functions of money better than any other good at the time. The first coins were produced in the Greek city, Lydia in Asia Minor around 600 BC. Quickly coinage spread to other cities over the world as many saw the benefits of coining precious metals in a uniform form, removing the need for weighing during transactions (Mundell, 2002). Monetary policies like we know today were non-existent, at most in some cities the local authorities supplied coins of precious metals with a symbol, ensuring the users of a verified amount and purity of the coin (Goldberg, 2005).

2.2.2 Paper money

As the world developed, commerce moved to ships and therefor covered longer distances. Carrying precious metals around on ships became expensive, risky and inconvenient. As a result money in the form of paper became a new form of payment. Early forms of banks started to accept deposits of precious metals and in exchange, the customer obtained a paper note that claimed ownership of these precious metal deposits, a so-called banknote. The development of the banknote started in the seventh century in China, as merchants desired to avoid the heavy bulk of copper coins in large transactions (Bowman, 2000). Banknotes are a form of representative money, a medium of exchange that has no intrinsic value of itself but has a claim on a certain commodity like gold or silver (Mundell, 2002).

Banks started to realize that not all customers withdraw their money at the same time, which opened the opportunity for the bankers to invest or lend out, the deposits of their customers. Banks that started investing and lending generated such substantial income that most banks started to shift their way of banking. Instead of charging fees for safe storage of customer's gold, the bankers started paying their customers to deposit gold, the interest we know of today. Eventually, this form of banking, fractional-reserve banking, became the most practiced banking form over the world (Mishkin, 2012).

2.2.3 Central authority and FIAT money

Banknotes as popular as they became over the world, there was an inherent problem with private banks issuing banknotes. The private banks continuously issued banknotes far exceeding the gold or silver they had in deposit. A sudden loss of confidence in the bank would lead to a bank run and inevitable bankruptcy. Central banks became necessary as a lender of last resort, providing liquidity to private banks if they had to deal with a bank run.

The first central bank, the Bank of England, was founded in 1694 after England's loss against France in 1690. England had to rebuild its navy. However, no public funds were available and the credit of the government in London was (Roseveare, 1991). As a workaround they introduced the Bank of England, the lenders would give the government gold and in exchange, the lenders would become part of the Bank of England and enjoy privileges, such as the issuance of notes.³ However, the creation of a modern central bank was established only after the Bank Charter Act of 1844. Which restricted authorization to issue new banknotes to the Bank of England, hence the Bank of England was in control of the money supply. Furthermore, the Bank Charter Act was stated that the issuance of each British pound by the Bank of England was backed 100 percent by gold, which started the gold standard currency era. Gradually all over the world private issued banknotes were set to be replaced exclusively by banknotes that were authorized and controlled by national governments.

After World War II many countries came together in July 1944 to negotiate a new international monetary system, also known as the Bretton Woods Agreement. Besides establishing the International Monetary Fund (IMF) and the World Bank, the countries agreed to a fixed exchange rate of currencies. The idea was to peg all currencies to a reserve currency, the Bancor a supranational coin suggested by John Maynard Keynes. The United States, that came out as a big winner of World War II and controlling two-thirds of world's gold, objected and proposed their U.S. dollar as the reserve currency for which each country would peg its currency to. Countries agreed as long the U.S. would link its dollar to gold for a fixed rate of \$35 per ounce (Asher & Mason, 1973; Prestowitz, 2003).

This meant that not each issued dollar would be fully backed by gold, but the U.S. government would guarantee to all foreign central banks they could exchange the U.S. dollar for a fixed rate of gold. Countries that pegged their currency to the U.S. dollar indirectly had a fixed value in terms of gold (Lipsey, 1975).

Consequently, as the supply of gold is fairly fixed, the U.S. dollar became the next important reserve currency to obtain by central banks, after all, you were assured of a fixed exchange with gold. To obtain U.S. dollars countries were forced to run a positive current account with the U.S., taking dollars out of their hands. As a result, the U.S. quickly ran a current account deficit. The U.S. was forced to limit its

³ Tonnage Act 1694

deficit or allow other countries to increase their claim on the U.S., this dilemma between short-term domestic and long-term international objectives was identified by Triffin in 1960, nowadays also called the Triffin dilemma. A country whose currency is used as a global reserve currency must be willing to supply the world with its currency, thus operating with an inevitable trade deficit (Cohen, 2012; Despres et al., 1965; Eichengreen, 2005).

The current account deficit, paired with the extraordinary expenditures of the U.S. in the Vietnam War caused the U.S. dollar to be way overvalued. The U.S. was forced in August 1971 to end the international convertibility of the dollar with gold, also known as the Nixon shock. From this point on the international monetary system was not backed by gold anymore and by 1973 all industrialized nations no longer kept their currency pegged to the dollar.

The period after Bretton Woods Agreement is also known as the Free Float era, major currencies from this point on had freely floating exchange rates not backed by gold. The money we know as of today is called fiduciary money or fiat money, which is a currency that has no intrinsic value and has been established as the legal tender and issued by the government. Fiat money's value is fully derived from the trust in government, maintaining its power and credibility. If the government is competent and authoritarian, it can declare a currency — the dollar, euro or yen for example — as its official medium of exchange for paying taxes or settling debts. Members in its society that are willing to participate in the economy are forced to accept the legal tender in their trades (Goldberg, 2005).

Additionally, the government will control the supply of money to ensure its scarcity to retain its value, meanwhile making sure there is enough to facilitate the economy or to achieve its macroeconomic policies. Throughout history, there are instances where countries failed to keep their money scarce, resulting in high inflation leading up to derail the economy. More recently, hyperinflation in Venezuela reached according to the IMF ten million percent.⁴ As a result, 3 million — a tenth of their population — Venezuelans fled the country rampant of shortages of food, medicine and other basic necessities (Hylton, 2018). Highlighting the importance of a competent government and the trust needed from society to maintain value as fiat currency.

2.2.4 Internet banking and e-money

Digitalization has reshaped the economy; nowadays a significant part of our lives are spent on digital platforms such as Facebook, Instagram, Amazon and Google. For China and Asia on platforms like Alibaba, Tencent and Baidu. Internet banking was an important step in delivering online payments to users of the Internet, allowing e-commerce to develop. However, the unbanked are mostly excluded

⁴ Inflation Rate IMF 2018 retrieved on 6 May 2019 from <https://www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD/VEN>

from participating in online trade (Osborne Clarke, 2018). As observed by Mancini-Griffol et al. (2018), there is a rapid rise of acceptance of financial networks such as AliPay and WePay in China, PayTM in India and M-Pesa in Kenya, these services are labeled as e-money. Simply e-money is a digital payment mechanism that represents and is denominated in fiat money (Natarajan, Krause & Gradstein, 2017). Providers of e-money accept funds in fiat from their customers, which allows them to transact value between electronic wallets restricted on the same network. These new forms of private money offer stable nominal value, security and liquidity in the virtual world for people that have no access to banks or because they experience them as more convenient than the banking alternative. Allowing for their customers to participate in e-commerce, digital peer-to-peer transactions and money integrated with social networks with easy-to-use interfaces.

2.3 History of international currencies

Historically one currency dominated as a medium of exchange internationally. The first currency that had an international role was the silver drachma issued by ancient Athenians in the fifth century BC. Roman's golden Aureus followed closely and most likely circulated simultaneously with the silver drachma. The golden Aureus dominance came to an end after a long period of heavy inflation, causing it to become less widely accepted outside the Roman Empire. Roughly in the sixth century CE the Byzantine Empire currency, solidus, became the dominant international currency and remained in circulation internationally until the 11th century CE, even though the Arabic dinar was a close second. In the late Medieval Period, the in Florence issued fiorino was the most commonly used money across the Mediterranean for trade (Timmer, Dailami, Irving, Hauswald, & Masson, 2011).

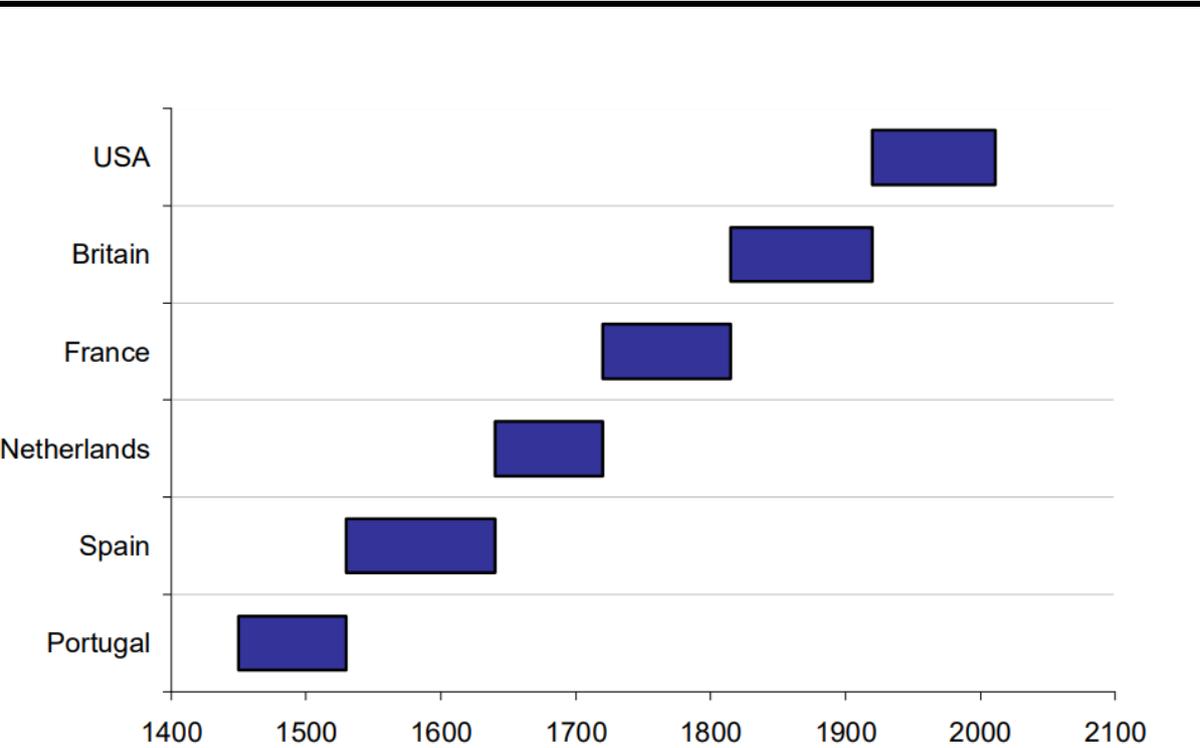
Internationally currencies before the Age of Exploration remained relative locally, only at the beginning of the 15th century CE when Portugal and later on Spain started its expeditions with their navy to Africa, India, Asia and Brazil did trade occur on such large distances. Consequently, the Portuguese and Spanish currencies became primarily used in global trade overseas. However, the Portuguese succession crisis, the Fall of the Iberian Union, wars and revolutions eventually led to the fall of the Portuguese and Spanish currency dominance (Page & Sonneberg, 2003).

In the 17th century, the dominant international currency was the Dutch guilder. With the work of the Dutch East India Company in Asia, the Dutch became the most important nation for the trade of spices, positioning themselves to profit from the high demand for spices in Europe. At this point paper money slowly replaced coins in the economy. After the Anglo-Dutch war and the increased competition on the spice market led to the fall of the Dutch guilder. A period of political dominance by the French in Europe under the young general Napoleon Bonaparte, extending their French influence and military

presence in Germany, Italy, Spain and Poland. Napoleon’s empire was short-lived following his defeat in 1815 (Page & Sonneberg, 2003).

While the French conquered Europe, the British Empire was busy with the Industrial Revolution, setting them apart from Europe. As a result, the British Empire became the largest exporter of manufactured goods and the leading importer of raw materials and food; up to 60 percent of global trade was in the hands of the Britons and the British pound. The dominance in commerce and trade halted after World War I, as the British Empire became bankrupt and the U.S. took over the role of the biggest economy of the world. However, it was only after the Bretton Woods Conference in 1945 that the U.S. dollar officially became the dominant international currency (Timmer et al., 2011).

Figure 1: Global reserve currencies since 1450, the U.S. dollar, British pound sterling, French franc, Dutch guilder, Spanish peso and Portuguese real.



Source: Erste group, 2011

In figure 1 above you can see the transition cycle of dominant currencies internationally since 1450. Each period of dominance lasts roughly 80 to 100 years, the cause of these transitions are complex and are a process of multiple years. What we can observe is that the usually the nation that is leading in commerce over the world, will have the privilege of a global dominant currency and the fall of a dominant currency is usually paired with the fall of the economy, because of wars and government failure.

2.4 Determinants of international currencies

For a currency to become an international currency it has to fulfill, also at least one of the three criteria for foreigners. However, historically a dominant global reserve currency that is used as a medium of exchange, like the dollar, serves also as a unit of account and store of value internationally (Truman, 1999).

The important determinants of the internationalization of currencies can be divided into two groups, economic and political factors. In which the political factors can be divided into two categories, the direct and indirect channel (Helleiner, 2008).

2.4.1 Economic factors

The stable value of a currency is highly important for the confidence of foreigners to use the currency in question. After all, many institutions and individuals will hold the international currency for an extended period. Investors will be maintaining international bonds, multinationals expose themselves with their working balance, and central banks possess the currency as a reserve. If volatility is an issue, these users are at risk of losing value. Hence a currency that maintains its purchasing power over time and has lower holding risks will be preferred above other currencies (Tavlas & Ozeki, 1992).

Furthermore, central banks and investors seek for currencies with deep and developed capital markets. And secondary markets that are large and liquid allows them to acquire significant positions in currencies without the fear of losing value and lowers the transaction costs of the currency (Cooper, 1997; Lim, 2006).

Another factor for international currencies is the size of the economy it serves. As you may expect, an economy with a substantial international output and trade will have a currency with a lot of activity in the world economy. Trading on a large scale creates significant foreign exchange transactions that are highly liquid; hence large countries can rely on their issued currency for all their trades. Currencies from smaller economies will have a hard time to develop efficient and competitive markets in foreign exchange (Lim, 2006).

As with more goods and services, there are great benefits to be gained when more parties start using a certain medium, be it software, language or in our case an international currency. In the world of currencies, network externalities play an important factor in the internationalization of a currency. Network externalities spiral into a vicious circle, after all, more parties to lead to more liquidity, more liquidity leading to quicker settlements, leading to more parties and so on (Kindleberg, 1967). Network externalities also lead to the rise of inertia and path dependency. Basically, the currency used in the past is favored to be used in the future. The dollar as the dominant global reserve currency has binding advantages relative to other currencies that did not become dominant in the past, as it is hard to change existing behavior of institutions and the public (Chinn & Frankel, 2007; Krugman, 1984).

2.4.2 Political factors

Helleiner (2008) argues that there are two channels for how political factors influence the internalization of a currency, the direct and indirect channel. Through the indirect channel, the political influence the currency's international usage by sparking confidence, liquidity or transactional networks. On the other hand, the direct channel does not use any of the economic determinants as a channel to increase the usage of a currency internationally.

Through the indirect channel, the issuer sparks confidence and incentives its own currency by domestic and institutional policies. Not only economic fundamentals will increase confidence in a currency, but also military power or the domestic politics in the issuing state influence the trust in a certain currency. For instance, the U.S. military power boosts the foreigner's confidence; foreigners see the dollar as a 'safe heaven' when political instability on an international level occurs (Helleiner, 2008). Domestic policies boost confidence in their through limited government and pro-creditor framework. As an example, the euro has a credible European central bank that mandated to pursue low inflation and is legally independent of governments, which ensures foreign users of the stability of the currency (Walter, 2006).

Additionally, political factors can increase liquidity in financial markets. Sterling's global reserve dominance prior to the dollar's rise was in large part to the deliberate practices by the British Empire. British institutions established themselves in their colonies and colonial banks opened offices in London. These financial institutions issued banknotes locally in colonized countries and held assets and liabilities in London. The established practices by the British Empire helped to enhance the liquidity of the British pound (Eichengreen, 2005). For the U.S. dollar, the Federal Reserve of the U.S. played a pivotal role in the liquidity of the dollar on financial markets. Dollar's international role through the creation of the Fed that was able to boost the financial markets of the dollar through activities such as

rediscounting and open market purchases (Broz, 1993). This helped the U.S. in dollar-denominated trade, competing with London's financial market (Eichengreen & Flandreau, 2012).

Politics can influence the usage of certain currency more directly as well. A dominant state could impose its currency in its colonies in a very direct way by forcing them. Direct, but more subtle influence of politics can be aid packages, a promise of market access and military protection, which could encourage a country to adopt a foreigners currency (Helleiner, 2008). As an example, in the early twentieth century, the U.S. slowly became a powerhouse and started settling its military, political and economic influence in many Latin American countries. As Latin American countries became highly dependent on the U.S., the U.S. promoted their dollar in different countries like Honduras, Cuba and Panama. Mostly it was the adoption of the dollar alongside their local currency, a dual currency system. Displaying that actively being involved in foreign policy is an important factor for international usage of your issued currency (Helleiner, 2003).

3 Cryptocurrency

3.1 Digitalization

Digitalization has changed the world we live in; nowadays we exchange information, services and emojis daily through electronic systems, peer-to-peer. Moreover, the same applies to money. We exchange value progressively more through electronic payment systems. However, the problem with transferring money through the digital space is the lack of trust of the digital file being legitimate. The lack of trust is due to the nature of digital files; after all, digital files can be copied many times over. Consequently, digital money creates a lack of trust between parties, as digital money might have been spent more than once, also known as the double-spending problem (Chohan, 2017). The lack of trust has historically been solved by placing a centralized, trusted party between two transacting parties. For instance, a private bank, government central bank or any other financial institution. The trusted parties maintain private ledgers of accounts, validating each transaction and ensuring the payer has the funds for each payment.

However, to ensure the integrity, performance and availability of an electronic system that is maintained by intermediaries go paired with high costs and physical infrastructure. The intermediaries store and protect vast amounts of data and strict frameworks by law are in place to ensure the safety, profitability, consumer protection and financial stability. All these factors force the intermediaries to charge high fees to generate profits (Sullivan, 2012). With the emergence of cryptocurrencies, the need for an intermediary between two transacting parties is in the past and opens up the potential for new economic activities.

3.2 New form of money: Cryptocurrency

3.2.1 Creation

According to the OECD (2008), since the 2008 global financial crisis, the trust of people in the financial institutions all over the world took a hit. Quickly after the economy collapsed, 31 October 2008, Bitcoin and its technology blockchain were introduced with the idea of separating money from the state and becoming a peer-to-peer digital cash system. The creator of Bitcoin, Satoshi Nakamoto, stated on a forum: "The root problem with conventional currencies is all the trust that's required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust".⁵ Blockchain technology would become the guarantor of trust by solving the double-spending problem of digital money.

⁵ He stated this on a forum when he released the first version of Bitcoin early 2009
<http://p2pfoundation.ning.com/forum/topics/bitcoin-open-source>

A decade later, the cryptocurrency market is flooded with thousands of different cryptocurrencies and has peaked at a total market value of 800 billion. The three most important cryptocurrencies at the moment of writing are Bitcoin (BTC), Ethereum (ETH) and Ripple (XRP). In table I below you can find the market capitalization and market share of these three cryptocurrencies.

Table I. Cryptocurrency market capitalization and share

	Market capitalization (billion)	Market share (%)
BTC	\$ 213.7	62.5
ETH	\$ 32.7	9.6
XRP	\$ 17.7	5.2

Source: Coinpaprika.com retrieved on 29 June 2019

3.2.2 What is a blockchain?

To understand what a blockchain is, we first need to know what Distributed Ledger Technology (DLT) is. DLT basically is a ledger that records data and shares it to multiple computers across the network, called nodes. Each node can propose new information to the shared ledger. This would cause problems if we would like to utilize DLT for sensitive information. As an example, the payments market, every node participating in the network could propose false transactions and as there is no intermediary to validate all the transactions you have a double-spending problem. A blockchain solves this by having the nodes reach an agreement on valid information, in our case transactions. The agreement between nodes is done by a predefined consensus mechanism, which validates and ensures the correct sequencing of transactions. Subsequently, these validated transactions are set in a block, when the block eventually is filled up will be locked cryptographically and broadcasted to every node in the network. These blocks with transactions cannot be altered once validated and locked up; creating a chain of blocks, a blockchain (Houben & Snyers, 2018).

3.2.3 Consensus mechanism

There are different ways of consensus mechanism for nodes to reach an agreement. I will only discuss the mechanism that Bitcoin, Ethereum and Ripple use. Bitcoin and Ethereum have a consensus mechanism called Proof of Work (PoW), whereas Ripple has an algorithm called XRP Ledger Consensus Protocol (XRP LCP) to reach an agreement.

Proof of Work

The dinosaur of cryptocurrencies, Bitcoin, and other cryptocurrencies similar to Bitcoin rely on the validation process on Proof of Work. In the PoW system, the nodes that participate in the network solve a cryptographic puzzle for each new block they like to add to the chain. These cryptographic puzzles contain information of all historical records on the blockchain; consequently, as the chain grows the cryptographic problem becomes more complicated. The PoW over time requires a significant amount of computing power⁶ to solve these puzzles by trial and error. The validation process of PoW cryptocurrencies is often referred to as 'mining' and the nodes as 'miners'. If a 'miners' solve the puzzle, the blockchain rewards the 'miner' with a new mined coin, in our case a Bitcoin. The reward acts as an incentive for the 'miners' that uphold the network. However, miners are also free to ask a 'miners fee' for each transaction a user wants to add in the next block. As the amount of transactions each block can record is limited, the 'miners fee' can accrue to unreasonable prices. Consequently, Bitcoin transactions can become really expensive for the users, or if you opt not to pay the 'miners fee' your payment on the network might not be added in the next couple of blocks or not at all (Natarajan, Krause & Gradstein, 2017).⁷

XRP Ledger Consensus Protocol

Unlike PoW systems, the XRP ledger has no miners to reach an agreement on what transactions are added to the next block. The verification process on the Ripple platform is handled by an algorithm (XRP Ledger Consensus Protocol). Simply said, each node on the network maintains and shares a possible version of the next ledger. Reaching consensus is a process of multiple rounds of nodes relaying candidate transactions for the next block, with each round changing its threshold on agreement. For example, a transaction goes to the next round if 50% of the nodes recognize the candidate transaction. If the candidate transaction does not reach the threshold, it is excluded for the next round with a higher threshold. The process is repeated until a certain threshold is accomplished, for the XRP LCP it is now set at 80 percent. (Cohen, Britto & Schwartz, 2017)

During consensus, each node will evaluate every proposal with a specific set of servers, the Unique Node List (UNL). The UNL is a list of 'trusted' nodes for the server. Each server makes its own UNL. The UNL is required because without the UNL a group or individual could pass through invalid transactions

⁶ At the moment of writing the estimation of Bitcoin's electricity usage is estimated to be equal to the Czech Republic. Retrieved on 27-06-2019 from <https://digiconomist.net/bitcoin-energy-consumption>

⁷ At the moment of writing the fee of a transaction verification on the next block (10 minutes) is \$5.52, which for a single transaction is a significant transaction cost. Retrieved on 27-06-2019 from <https://bitcoinfees.info/>

by running a lot of nodes on the network and gaining disproportionate power in the consensus process (Chase & MacBrough, 2018).

3.2.4 Definition of cryptocurrency

After a decade of cryptocurrencies existence and buzz, the definition remarkably is still not set. Many policymakers like the European Central Bank (ECB), International Monetary Fund (IMF), Bank for International Settlements (BIS) and the World Bank have tried to define cryptocurrencies. However looking into the various definitions made by policymakers, Houben & Snyers (2018) conclude that there is no accepted definition of the term cryptocurrencies across the different institutions.

Houben & Snyers (2018) gave a try to establish a suitable definition for cryptocurrencies through a critical analysis of the definitions that have been made already by policymakers on an international level. The definition they ended up with for cryptocurrency is:

“A digital representation of value that (i) is intended to constitute a peer-to-peer (“P2P”) alternative to government-issued legal tender, (ii) is used as a general-purpose medium of exchange (independent of any central bank), (iii) is secured by a mechanism known as cryptography and (iv) can be converted into legal tender and vice versa”.

3.3 RippleNet and XRP

Due to Ripple’s DLT that is vastly superior relative to the old PoW-systems of Bitcoin and Ethereum, XRP has far more scalability, speed and is cheaper. Compared to newer cryptocurrencies, it has a matured and working DLT and the first-mover advantage. Furthermore Ripple, the FinTech company that utilizes and builds software on the XRP ledger, early on saw that the global banking system of today is outdated and that cross-border payments have high friction.

As a result, the Ripple team has focused on solving international payments for enterprises with the ecosystem RippleNet. The adoption of enterprise firstly begun with setting up a new financial messaging system, xCurrent. The new financial messaging was needed because the Ripple developers deemed the current messaging systems like SWIFT not capable of supporting instantaneous settlements. Therefore they focused on xCurrent, to make it a top-notch financial messaging service that eventually could deliver instantaneous settlements with the currency XRP all over the world (CB Insights, 2019).

3.3.1 Cross-border payments currently

The cross-border payments and settlements are typically done through correspondent banking. Correspondent banking is the process of financial institutions providing each other the access to payment systems in areas where they are not direct participants. Furthermore, the correspondent banking allows for actual value to be passed on in international trade, settlement. After all, SWIFT is only a messaging system for payments and does not move value across borders. Setting up a correspondent banking relation between two financial institutions requires setting up a bilateral contract between the two parties which contains all conditions of intraday funding, options for same-day processes, lifting fees, the way of communicating and the opening and maintaining of nostro and vostro accounts (Huls, 2015).

Bilateral correspondent contracts

There are thousands of banks around the world. Setting up bilateral correspondent contracts with all banks would take up too much time and costs would be too high to uphold. A common practice is for a bank to have limited correspondent banks in a country. Usually, one or two correspondent banks per country are enough. The selected correspondent bank is then used to forward payments to other banks in the country by using their local network. This way payments sometimes are redirected through multiple banks and often the sender and the beneficiary bank is not aware of all involved banks.

Correspondent banking is a highly concentrated market due to the high barriers surrounding cross-border transactions. He et al. (2017) explain that at first, high fixed costs for complying with regulation and back-office operations require big banks. The second reason is that only banks with large balance sheets can take on credit risk from large value cross-border payments and maintain liquidity. At last, network externalities play a big part in concentrated market power. Big banks are more likely to attract client banks, as bigger banks have more connections to other banks, jurisdictions and currencies

Nostro & vostro accounts

Banks that have a correspondent banking relation need to keep track of how much money is managed by one bank on behalf of the other and vice versa. These accounts in corresponding banking are usually referred to as nostro and vostro accounts. A bank that opens an account at any other bank is a nostro account, your money, held by another bank acting as a service provider (ECB, 2010). The correspondent contracts are bilateral, so the other party opens an account on its name in your bank as well, called a vostro account. The arrangement of nostro and vostro accounts allows banks to operate in countries with limited infrastructure of their own. The nostro/vostro accounts are pre-funded such that the service providing bank only has to settle the payment internally, so there is no need for a settlement

for each transaction being made by either bank. The service providing bank will debit (credit) the vostro account when making (receiving) payments in the name of the other bank.

3.3.2 Cross-border payment inefficiencies

Cross-border payment inefficiencies until this day are remarkably high. Cost ranging from 25 to 35 dollars per transaction, transactions are taking up to three to five days and lack of transparency in pricing, tracking and timing for the consumer. The average cost per cross-border payments is according to Niederkorn et al. (2016) build-up of: “compliance (13 percent), trapped liquidity (34 percent), foreign exchange risk management (15 percent), and claims, treasury and other operations (38 percent)”.

Most of these global payments are made by transacting banks, 95 percent of B2B and B2C cross-border transactions are in the hands of banks. For C2C and C2B banks, share sits around 65 percent. (Niederkorn et al., 2015; Digiacomio et al., 2018)

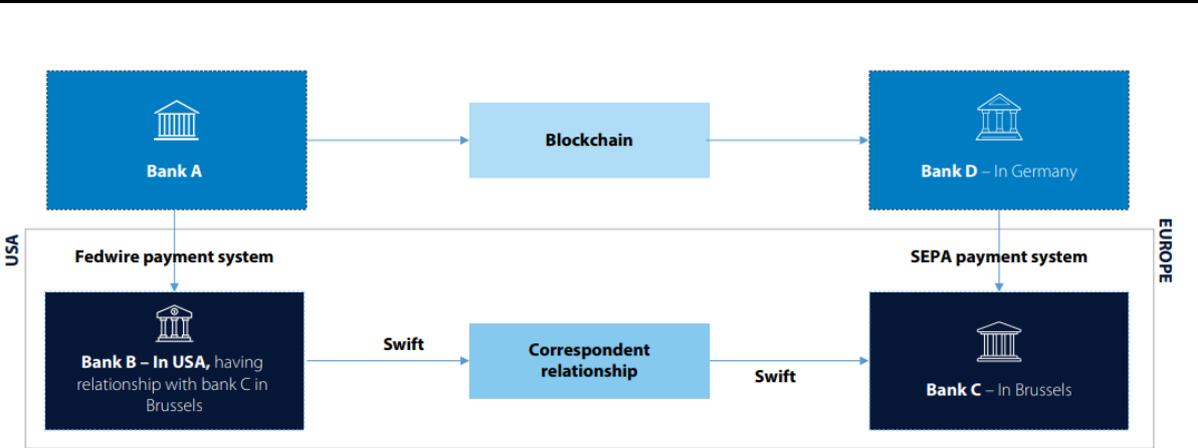
According to Niederkorn et al. (2016), these shortcomings emerge from legacy technology, rigid regulation and a concentrated market structure. Compliance within multiple countries is high. Bilateral relationships require banks to maintain liquidity over the world and exposure to foreign exchange rates. The process of payment operations requires large back-office departments to handle claims and disputes manually. Furthermore, the market power of correspondent banks allows them to extract revenue through direct fees, foreign exchange spreads and delaying transactions on purpose to invest the liquidity

3.3.2 xCurrent

Ripple’s software, xCurrent, is designed around the open, neutral Interledger Protocol (ILP) that enables two different ledgers or networks to work together, interoperating. Enabling banks to continue the use of their existing day to day systems that ensure banks of compliance, information security and risk frameworks. Meaning that the xCurrent works with the existing bank’s infrastructure and is able to interface with the bank’s systems using an API interface or through a translation layer (the ILP) that can consume traditional payment message formats. All banks that utilize xCurrent can directly transact with each other, which eliminates intermediaries in the process and messaging services like SWIFT from the process. As seen in Figure 2 below, a blockchain or in our case xCurrent excludes any central agencies or correspondents from the payment process. This leads to reduced costs, increased settlement speed and more transparency for the sender and beneficiary bank. To enable cross-border settlements via xCurrent, banks can leverage their existing nostro/vostro

relationships with other banks or use external market makers to provide foreign exchange liquidity for various currencies. Allowing for all members of the network to message and settle payments instantaneous making xCurrent the first, *global* real-time gross settlement (RTGS) system. Furthermore, the service is available 24/7, unlike the existing RTGS from the Eurosystem (TARGET 2) and the Federal Reserve Bank (Fedwire) that have operating hours (*Solution Overview, 2017*).

Figure 2: Illustration of cross-border payment through traditional and blockchain system



Source: Ravishankar, 2018

3.3.3 xRapid

The product xCurrent does not necessarily solve the nostro/vostro relationships and their costs, after all, liquidity is needed to settle payments. Cryptocurrencies can offer a solution by becoming the bridging currency, allowing for settlement for cross-border payments without the need for nostro and vostro accounts. Banks that are connected on RippleNet can choose for on-demand liquidity by issuing xRapid. The xRapid product automates the process of instantly moving money to other countries. The sending bank simply initiates a payment in its local currency, xRapid will convert this local currency to XRP through a cryptocurrency exchange. When the transaction is converted in XRP, it will travel over the XRP ledger to the destination country. Arrived on the destination, XRP will be converted to the local currency and through xCurrent it will be forwarded to the beneficiary. The whole process takes

about 1 to 2 minutes with the cryptocurrency XRP as the liquidity provider and saves up to 70% of cross-border payment costs (*On-demand liquidity*, 2019).

3.4 XRP

XRP is the native currency on the XRP ledger, also called ripples. In 2012 a 100 billion XRP was created, and by code, no new XRP can be created. However, the transacting value of XRP can be done in smaller forms than 1 XRP, the smallest identifiable part is up to 6 decimal places of one XRP, called a drop. The XRP was specifically built for payments, making its performance on speed, low-cost and scalability better than alternatives like Bitcoin and Ethereum. Users of the XRP ledger confirm and settle transactions in 4 seconds compared to an hour Bitcoin needs to settle. Cost per transactions through XRP averages at around \$0.0001. Whereas Bitcoin's transactions fees vary highly, from \$0.10 all the way up to \$35 per transaction.⁸ The XRP ledger can handle up to 1500 transactions per second compared to 32 transactions per second for Bitcoin. Additionally, the XRP ledger can scale even up to 50,000 transactions per second, VISA daily averages at an estimated 1700 transactions per second on average (*Solution Overview*, 2017).⁹

On the XRP ledger, the currency XRP has two functions. First, preventing the system of any abuse the network, for example, from spamming the network with low-value transactions to overload it. The XRP ledger requires a minimum transaction cost of 10 drops (0.00001 XRP) for each transaction. Transactions cost automatically increase when the load on the network is heavily increasing, making it very expensive when deliberately trying to overload the network.¹⁰ These transactions cost in XRP are not collected by anyone but destroyed. Paired with no future creation of XRP, means that XRP is a deflationary currency. Second, XRP was created to become a bridge currency between many different assets that are possible to be traded on the XRP ledger. Becoming the centerpiece of anything with value: fiat currencies, cryptocurrencies, commodities, securities and even loyalty points (Cohen, Britto & Schwartz, 2017).

⁸ Source: <https://bitcoinfees.info/> retrieved on 29 June 2019

⁹ Based on VISA's claim of 150 million transactions per day. Retrieved on 28-05-2019 from <https://usa.visa.com/run-your-business/small-business-tools/retail.html>

¹⁰ XRP ledger <https://xrpl.org/transaction-cost.html>

4. Are cryptocurrencies money?

Since the price surge in 2017 of cryptocurrency, media and the public are heavily interested in the market. Bitcoin increased in 2017 up to 1880 percent relative to the prices of January 2017 pulling a lot of attention. A magnitude extra Ripple increased roughly in the same time frame 27.000 percent.¹¹ Also more cryptocurrencies showed abnormal return on investments (ROI) in a very short time frame. The high prices and ROI attracted a lot of attention to the cryptocurrency market as an investment asset, but little prevalence for cryptocurrency as a form of money.

Nevertheless, the emergence of cryptocurrency and the attention it gets, the important question arise around the role of cryptocurrencies in the economy. Do cryptocurrencies satisfy the three functions of money; store of value, unit of account and a medium of exchange? How do they compare to the monies we know today and in the past?

He et al. (2016) tried to answer these questions in their paper. This thesis will elaborate further on their assessment of cryptocurrency as a form of money, but also add XRP to the table of comparison as this thesis argues it to be a far superior cryptocurrency relative to Bitcoin, which the IMF used as their representative of cryptocurrency.

4.1 Intrinsic value

He et al. (2016) used Bitcoin as the representative of cryptocurrencies. In their research into cryptocurrency as a form of money, and argue that Bitcoin and other cryptocurrencies hold no intrinsic value. According to He et al. (2016) cryptocurrencies are intangible assets floating around in the digital world. Thereby the marginal cost of replicating, for example, the Bitcoin or Ripple blockchain, is zero. Since their code is open-sourced and no legal entity protects the intellectual property. Strictly economically speaking Bitcoin or Ripple price converge to zero eventually, as multiple blockchains identical to Bitcoin or Ripple can be made.

However, I believe this view is perhaps a bit shortsighted. Cryptocurrencies are more than a code that can be copied multiple times; cryptocurrencies reached a consensus within a large group of people that believe, trust and value the technology. Copying the code will not yield you the same value and network activity. According to Tu & Ju (2019), cryptocurrency holds intrinsic value, not in the traditional economic sense but holds value in the sense of consensus, cultural significance and trust in the original blockchain. There is value in people using and trusting the original chain of blocks. For example, look at the world of art, artwork can hold great value, even though the art in question can be easily recreated. Any forgery, identical or better, loses value.

¹¹ Coinpaprika.com

Furthermore, cryptocurrency could like gold derive a part from its intrinsic value from its use-value. Gold has been the most popular money throughout history. The intrinsic value of gold is derived from its efficacy as a medium of exchange, as it fully accepted as a medium of value all over the world. But why gold, what makes it so special? After all, anything can be used as a medium of value. We could trade all over the world with eggs, diamonds or sand. However, these goods are not a good form of money. After all, eggs are fragile and will expire which is not ideal for everyday usage or saving. Diamonds are not fragile nor have an expiration date, but diamonds are brittle and not divisible or combinable. Sand is plentiful and therefore of low value, rendering it impractical as a medium of exchange. Just imagine buying a pizza with sand, you would need multiple kilos worth of sand. Eventually, you stumble upon gold and realize it works perfectly as money. After all, gold is durable (it will not rot or rust), it is divisible and combinable, homogenous and it is scarce, which makes it an excellent medium of exchange. Thus, gold derives its intrinsic value from the natural properties it has on Earth. Cryptocurrency has exactly the same properties as gold, its durable, it is divisible and combinable, homogenous and it is scarce. Except that cryptocurrencies are intangible goods, but in return for being intangible, you get a potentially more effective medium of exchange that is fully suited for the digital world.

4.2 Functions of money

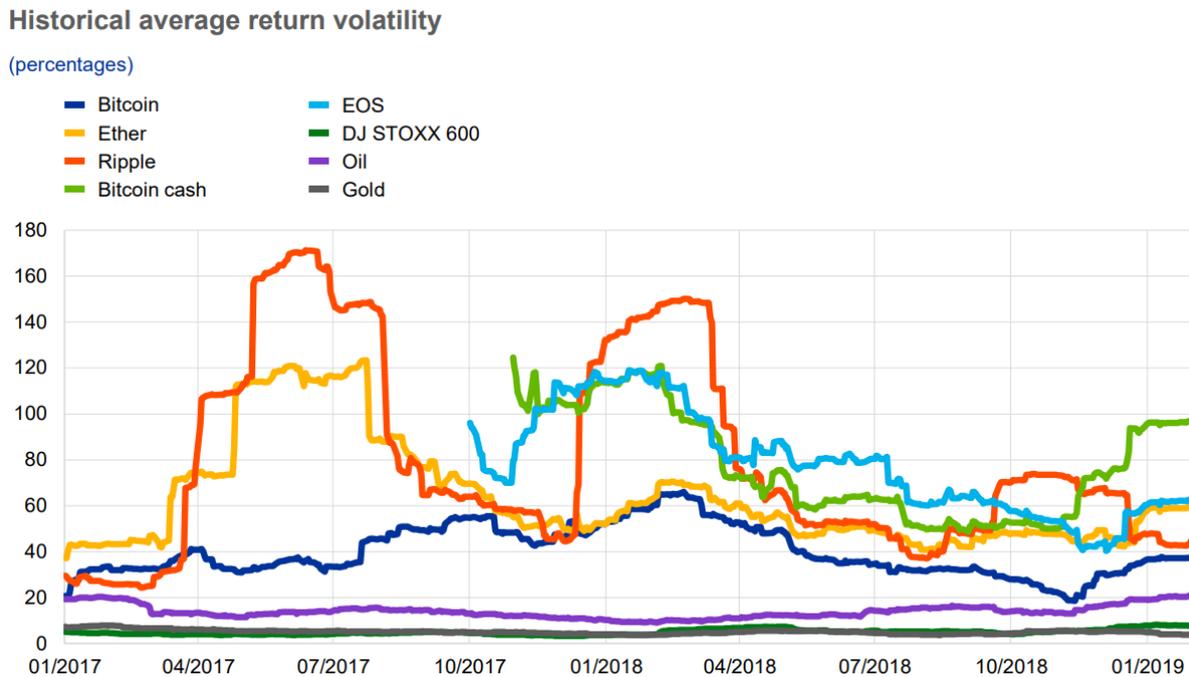
4.2.1 Store of value

For money to function as a store of value, it is crucial for it to be safe, liquid and retaining its purchasing power over time. Cryptocurrencies are extremely volatile. Last two years, the historical volatility of cryptocurrency surpassed the volatility of the European stock and bond markets, but also the more volatile oil and gold prices, showing how volatile cryptocurrencies really are. Under these circumstances, lenders and borrowers are unwilling to extend credit or borrowing in a volatile market would be too risky. Too high devaluation of cryptocurrency and the lender loses money, high appreciation and the borrower cannot repay his debt. Additionally, the price volatility seems to be disconnected from any economic or financial factors, which makes cryptocurrencies nearly impossible to hedge or forecast (Yermack, 2013).¹²

However, as the market matures, the volatility tends to decrease and be more comparable to the likes of gold and oil. For instance, in Figure 3, we can see that Bitcoin has lower volatility compared to the newer cryptocurrencies like Ethereum and Ripple. Arguable due to the larger investor base and its relatively higher maturity as an asset compared to other cryptocurrencies (Bullman et al., 2019).

¹² As cryptocurrencies become more adopted, the more interconnected they become with other financial markets, I argue the price will then become more related to economic or financial factors.

Figure 3. The volatility of cryptocurrencies compared to stocks, bonds and commodities



Source: Bullmann et al. (2019)

4.2.2 Unit of account

One can measure in units the amount of cryptocurrency bought or used and cryptocurrencies are dividable in smaller units. For example, 1 BTC can become 100 million satoshi, or 1 XRP can be divided into 1 million drops. Cryptocurrencies can be used as a measure of value directly; for example, in the cryptocurrency market, other currencies are often measured in Bitcoin. Bitcoin is a unit of account in the niche market of cryptocurrencies.

In the mainstream, Bitcoin or any other cryptocurrency, does not represent value directly like the dollar or euro does. Retailers that do accept cryptocurrency payments, still quote their goods or services in fiat money. The cryptocurrency payment is simply the fiat quote converted with the live exchange price of the cryptocurrency (He et al., 2016).

4.2.3 Medium of exchange

To function as a medium of exchange, a cryptocurrency should facilitate a seamless experience in transactions between two parties. The process between two parties exchanging via a cryptocurrency is seamless, arguably more seamless than bank deposits as we know them today. Hence no

intermediary is needed. Thus a cryptocurrency transaction is very similar to a cash transaction, arguably making it a better medium of exchange experience than traditional money. However, cryptocurrency is not a legal tender like national currencies are, meaning that cryptocurrencies are only accepted if both parties agree to it.

Additionally, the crypto market proved itself as a highly speculative market with high return of investment, with this knowledge cryptocurrencies are mainly hoarded by people and not used as an alternative payment method. Limiting the natural adoption of cryptocurrency as a medium of exchange. After all the owners of cryptocurrencies are economically disincentivized to spend their Bitcoin and Ripple. Halting the adoption, as there is no pressure from consumers on the retailers to accept cryptocurrency as payment. Since a medium of exchange has to have a large enough of acceptance in a certain jurisdiction to be practical and efficient, cryptocurrency, for the time being, cannot function as a widespread medium of exchange.

4.3 Comparison of currencies

He et al. (2016) compared cryptocurrencies, existing currencies and historic currencies on more characteristics. Below you will find Table II & III that compares the cryptocurrencies Ripple and Bitcoin to the dollar, gold bullion and the gold standard on economic characteristics, supply structure and macro-financial stability risks. The tables are based on the one He et al. (2016) used in their paper.

Comparing these different forms of money on economic, supply structure and macro-financial stability risk factors show us that cryptocurrencies are not the first currency in history that is issued privately and decentralized. While cryptocurrencies are not comparable to legal tenders like the dollar and euro, we have to keep in mind that money has changed significantly throughout history and will continue to change in the future.

Comparing the two cryptocurrencies, Bitcoin and Ripple, with gold bullion in Table II & III one can only conclude that both types of money are fairly similar on the set characteristics. Bitcoin even shares the same characteristic of high production cost, the process ironically also called mining. For now, cryptocurrencies are still a very niche market and generally not accepted as a medium of exchange, a unit of account or store of value. Although nor gold bullion is nowadays a widely accepted medium of exchange or unit of account, still has its place as commodity money as a store of value. Bitcoin, Ripple and other similar cryptocurrencies, therefore, should qualify as commodity money, like gold bullion is and has been for thousands of years.

Table II. Characteristics of Currencies: Economic factors

	Ripple (XRP)	Bitcoin (BTC)	USD (fiat money)	Commodity money (gold bullion)	Gold standard
Intrinsic value	Yes	Yes	None	Yes	None
Claim to issuers	No	No	Yes	No	Yes
Legal tender	No	No	Yes	N/A	Mixed
Used as a medium of exchange	Small, but rising especially in online retail*	Small, but rising especially in online retail*	Yes	Yes	Yes
Used as unit of account	No*	No*	Yes	Yes	Yes
Used as a store of value	Yes, but exposed to volatile market and high exchange risk*	Yes, but exposed to volatile market and high exchange risk*	Yes, exposed to risk of inflation	Yes, exposed to risk of commodity's price cycle	Yes, exposed to risk of devaluation

Source: He et al., 2016

*Rapidly evolving technologies, could improve

Table III. Characteristics of Currencies: Supply structure and macro-financial stability risks

	Ripple (XRP)	Bitcoin (BTC)	USD (fiat money)	Commodity money (gold bullion)	Gold standard
Supply structure					
Monopoly / Decentralized	Decentralized	Decentralized	Monopoly	Decentralized	Mixed
Supply source	Private	Private	Public	Private and public mining	Mixed
Supply Quantity	Fixed	Fixed	Flexible	Inflexible	Mixed
Supply rule	Tied to the code	Tied to the code	Rule-based (inflation target)	Tied to commodity in bullion	Tied to commodity in reserve ratio
Supply rule change	No	Yes, in agreement of majority miners**	Yes	No	Reserve ration can be changed and economized
Cost of production	Low	High	Low	Very high (mining)	Low
Macro-financial stability risks					
Risk of hyperinflation due to over-supply?	No	No	Yes, with mismanagement/ loss in trust	Limited	Possible, ending convertibility
Risk of long-term hyperdeflation	High	High	Low	High	High
Base money quantity changes to temporary shocks?	No	No	Yes	No	Possible, changing reserve ratio/exchange rate
Can the issuer be lender of last resort with outside money?	No	No	Yes	No	Yes, to some extent for credible issuer

Source: He et al., 2016 and XRP ledger developer portal

** Changes the original code, minority might shift away of using the blockchain.

5 Conceptual framework: Is there a role for cryptocurrencies?

The previous section shows that cryptocurrency, for now, cannot function as money or generally as a payment method. After all, to become a fully widespread used currency, the money in question has to effectively function as a medium of exchange and a stable store of value. To function as a medium of exchange and a stable store of value, money has to be mass adopted by the institutions and the people. Thus we are dealing here with a chicken and egg problem.

Historically the adoption of new forms of money share all one key element, reducing friction in today's economy and thereby increasing economic activity. Thus for cryptocurrency to reach critical mass, they need to solve frictions in the economy, either by outperforming traditional money on speed, trust, cost-effectiveness, financial inclusion or holding risk.

So in tackling this key question: Do cryptocurrencies offer net benefits? We explore two sides. First, what can cryptocurrencies offer to end users relative to other existing forms of money? Second, what potential benefits and challenges do cryptocurrencies offer to central banks and banks beside the cross-border settlement discussed in section 3. While tackling this question, XRP is the cryptocurrency used as a measure.

5.1 User Perspective

Mancini-Griffol et al. (2018), in their paper, ranked different forms of money for certain criteria from the user perspective. In figure 4 below, you will find spider charts that are fairly similar to the ones Mancini-Griffol et al. (2018) use in their paper for the ranking. However, as Mancini-Griffol et al. (2018) considered Central Bank Digital Currency (CBDC) only for domestic use, they did not use cross-border transaction costs as an attribute in their spider charts. Contrary in this thesis, cross-border transactions plays a major role, so in my spider charts, cross-border transactions cost are included. Additionally, I added another attribute, which I think is highly important for end-users, which is user-friendliness. User-friendliness will compare the ease of using and storing the form of money for the end-user. Furthermore, I left out CBDC, as CBDC is not a concrete plan, let alone production-ready. While all other forms of money in the evaluation are already in circulation.

The evaluations are visually presented in Figure 4. The higher scores are captured farther from the center. The more attractive a particular attribute is, the more space it covers on the spider chart. Transaction costs with a high score mean that costs are low and transparent for the end-user. In the appendix, you can find in Table A.1 all explanations for each score.

A comparison between my cryptocurrency spider chart and the one from Mancini-Griffol et al. (2018) can be found in Figure 5. For each attribute that differs from Mancini-Griffol et al. (2018) chart, I will explain why I disagree with their given score.

Scalability

Mancini-Griffol et al. (2018) evaluated cryptocurrencies low on scalability, with the argument that cryptocurrencies are not suited for large payments. However, Mancini-Griffol et al. (2018) do not give a clear explanation of why they think cryptocurrencies are not scalable for large payments.

Luckily cryptocurrencies are already in circulation and the blockchains are completely public, so one can easily find large payments are being done daily on the Bitcoin and Ripple blockchain. For the Ripple blockchain, there is even an automated Twitter account (@XRPL_Monitor) that fetches information on the XRP ledger and tweets out all payments that exceed 5 million XRP that happen on the XRP ledger. Every large payment on Bitcoin and Ripple are treated the same as smaller payments. Costs are not an issue.

Scalability to micropayments is more of a concern for some cryptocurrencies. As an example, Bitcoin is not suited to support micropayments as the Bitcoin blockchain only allows for 32 transactions per second and has relatively high transaction costs due to their mining fees. Ripple, on the other hand, is a blockchain that was made with payments in mind, properties of low cost and the speed allow for scalability from micropayments to large payments.

Anonymity costs

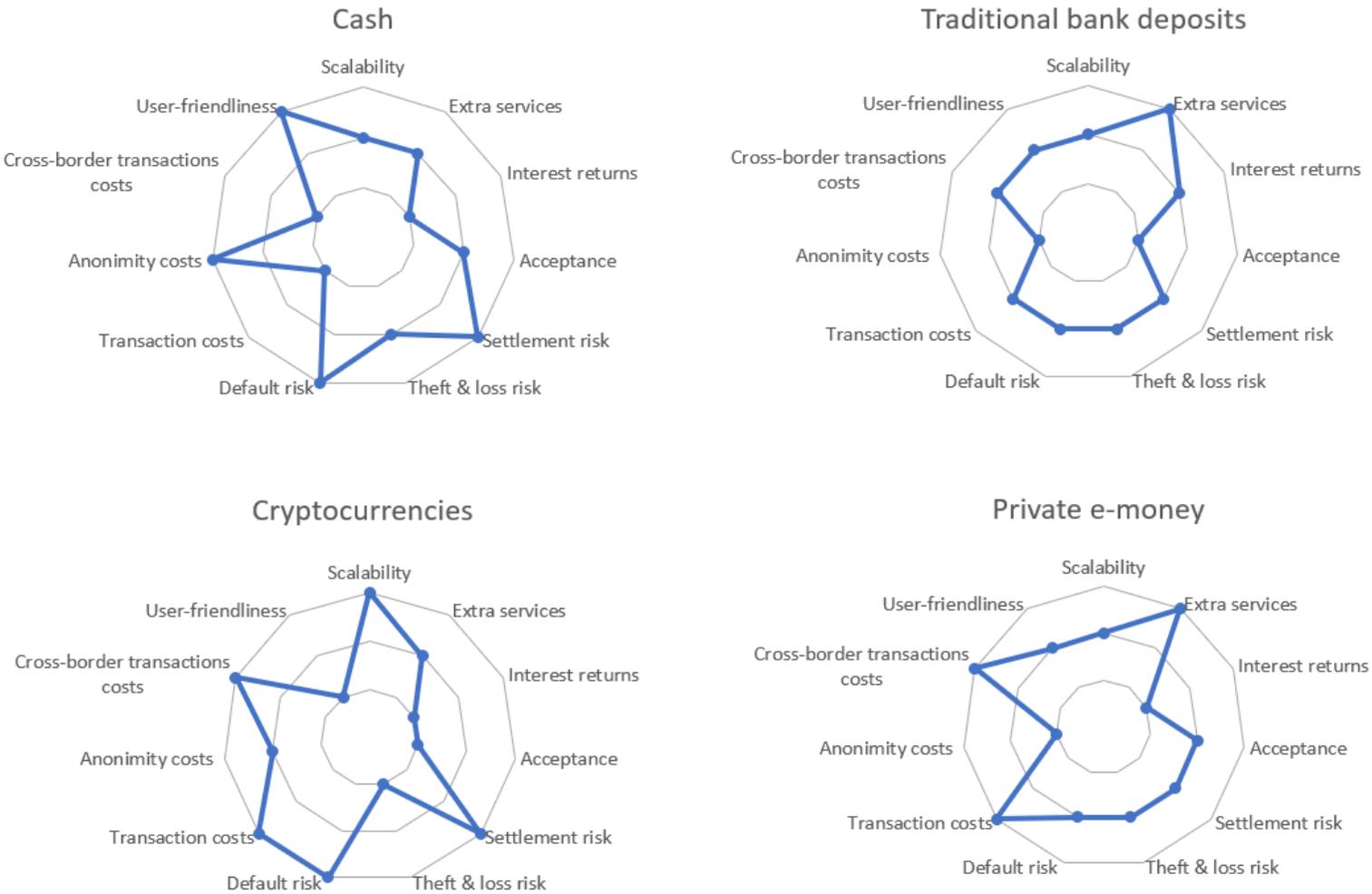
An important criterion that stands out, according to Mancini-Griffol et al. (2018) is anonymity; they believe that cryptocurrencies offer full anonymity. End-users benefit from anonymity as it protects them from customer profiling, commercial use of personal information. However, it is simply wrong that cryptocurrency offers full anonymity. On a cryptocurrency platform, the identities of users are protected and hidden by their address or account. The identity of a cryptocurrency user remains unknown. However, the details of each transaction in an open blockchain are fully public. Consequently, cryptocurrencies do not offer full anonymity, but pseudo-anonymity (He et al., 2017). The pseudo-anonymous nature of open blockchains allows for anyone that makes a great effort and deploys advanced data analytics to find the identity of users (Houben & Snyers, 2018).

Settlement risk

Cryptocurrency received a low rating for settlement risk, and as an explanation was given that there are lags and sometimes cryptocurrency struggle to establish finality. But like cash, when a transaction is fulfilled, the settlement is instantaneous. Yes, Bitcoin sometimes has slow transactions speeds, however when the transactions come through, so does the settlement simultaneously. However reaching finality is a legitimate concern especially for PoW systems like Bitcoin, miners that control 51 percent of the hashing power, could alter the longest chain, creating a hard fork. Meaning that you

end up with two networks, that share the same transactions upon the point of splitting. The way the consensus protocol on the XRP ledger differs from PoW system makes it less likely to fork as there is no incentive for forking (no mining, running nodes on the XRP ledger is done because you care for a stable network and believe in the technology).

Figure 4. The attractiveness of different forms of money for users



Transaction costs

Mancini-Griffol et al. (2018) evaluated transactions as poor, with the reasoning that cryptocurrencies have high energy requirements. For Bitcoin, this might be true as Bitcoin struggle with high mining fees when the blockchain is heavily used. Other cryptocurrencies that do not work with PoW as a consensus mechanism, transaction cost are low. If we take Ripple as a measure, transaction cost for the users are even low on micropayments, as for each transaction the Ripple platform only burns approximately ten

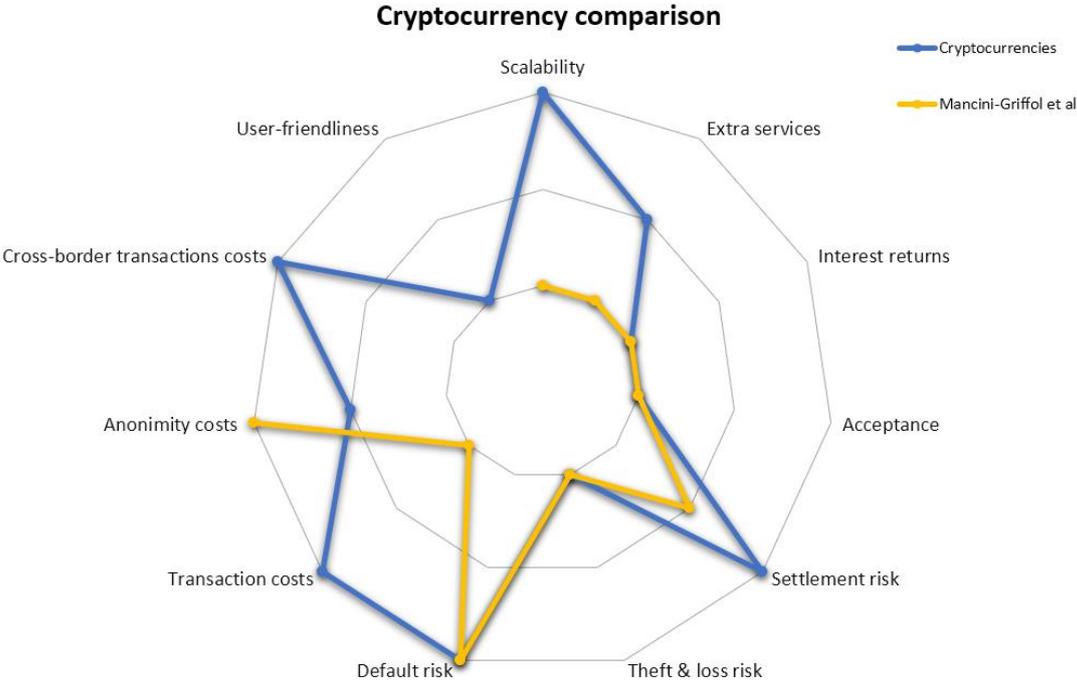
drops of XRP, approximately \$0.0004. The low costs on payments allow for a new form of economic activity through micropayments.

Extra services

The extra services blockchain technology like Ripple or Bitcoin provide is heavily underestimated by the poor score given by Mancini-Griffol et al. (2018). Cryptocurrencies services at the moment are still relatively limited, as the technology is new. However, there is already the integration with social media; cryptocurrencies can be transacted over social media platforms like Twitter, Reddit and Discord. The same way private e-money is integrated with their social media platforms, which received a high score by Mancini-Griffol et al. (2018).

Furthermore, cryptocurrencies blockchain are open, anyone is allowed to build applications on it or use it for an existing application. Open blockchains are not owned by a party, so everyone is free to build on top of it — the same way people build applications on top of the internet. The potential for extra services on cryptocurrency blockchains is tremendous.

Figure 5: Comparison between Mancini-Griffol et al. (2018) and my evaluation



5.1.1 Cryptocurrencies as an alternative form of money

Cryptocurrencies would not strictly dominate other forms of money, as is evident from Figure 4. Cryptocurrencies would closely compete with private e-money on cross-border transactions and transaction costs, where cryptocurrencies only stand out when it comes to scalability, settlement and anonymity. While private e-money at the moment delivers more services, user-friendliness and more security on theft and loss.

The benefits cryptocurrency mostly provides cheap cross-border transactions and direct settlement. For the common people, cross-border transactions are rare and whether a settlement is instantly settled does not change their way of making payments greatly. Furthermore, cryptocurrencies are far from easy to use, to obtain cryptocurrency one needs to set up an account at a cryptocurrency exchange. Once the cryptocurrencies are bought, you have to transact it to an account or address that allows you to store your cryptocurrency safely. There may be a market for cryptocurrencies as a replacement for cash, pseudo-anonymous transactions, but as acceptance is low development of this market will be hard. Altogether, I believe cryptocurrency's adoption by common people and retail is still years away. The world and the technology are not ready for yet for the peer-to-peer digital cash use case Satoshi Nakamoto envisioned.

However, the adoption of cryptocurrencies does not have to start at the bottom and work its way up. As an example, the growth of the internet was not adopted bottom-up, but top-down. Governments (military) and universities were the first to adopt and build on the internet until it eventually reached retail and the people. Financial institutions and governments could become the first adopters of cryptocurrencies. After all, cross-border transactions are mostly done by the banking sector and therefore would benefit most from the efficiencies cryptocurrencies offer on cross-border transactions. Global payments and its frictions are a big opportunity for cryptocurrencies to solve and a good entry point to become the next form of money.

5.2 Central bank and bank perspective

We have concluded that the main benefit of cryptocurrency is the cross-border nature and its efficiencies it could provide to the existing financial system. In this subsection, we will look further into other potential benefits for central banks and banks. As well as the challenges that could potentially slow down or halt down the adoption of cryptocurrency.

5.2.1 Potential benefits

A new safe asset

In the modern economy, safe assets are the cornerstone of keeping the financial systems running, by providing a reliable store of value, serve as collateral in financial transactions, fulfill low-risk requirements and serve as a pricing benchmark. If these safe assets like cash, treasuries and gold disappeared, markets for collateralized transactions would collapse, financial institutions that rely on low-risk assets would crumble and the well-functioning of riskier segments in the financial world would derail (IMF, 2012; Garcia, 2011).

Prior to the recent banking crisis, global imbalance in the supply and demand for safe assets occurred. The rapid growth of emerging economies increased the demand for safe assets substantially. However, these emerging markets could not provide any safe assets as their financial systems are still in the process of developing. Consequently, the US and EU financial markets were incentivized to create new safe assets. These private label 'safe assets' were created by securitization of riskier assets. After the fall of Lehman Brothers, the private label 'safe assets' quickly lost their safe AAA rating, the realization that many of these 'safe assets' were of questionable value led to the meltdown of the financial markets. This led to a further shortage of real safe assets as panicked investment banks, hedge funds and asset managers turned to only high-quality short-term treasuries and gold (Caballero, 2010; IMF, 2012).

As the world keeps developing, more and more emerging market economies will boost the demand for safe assets. Competing private stores of value cannot provide sufficient insurance against global shocks, as the global system will prefer the riskiest ones (Gourinchas and Jeanne, 2012).

Cryptocurrency could potentially provide a new form of safe asset to the financial world. Like gold, it is nobody's liability, safe from government failures, but also safe from erosion of value and scarce. Surely cryptocurrencies need to prove themselves first as a reliable store of value, but with maturing of the cryptocurrencies market, it seems inevitable that it will lose its highly speculative and volatile characteristics.

Financial inclusion

As cash usage is diminishing over the world and banks not rushing to serve rural and poor regions, leaving those in poverty disconnected from the economy, hence the rise of financial networks. These new forms of private money offer stable nominal value, security and liquidity in the virtual world for people that have no access to banks or because they experience e-money as more convenient than the banking alternative.

Cryptocurrencies accommodate the same features the providers of private e-money do, except that cryptocurrencies are safe from customer profiling by e-money providers (Mancini-Griffoli et al., 2018). As cryptocurrency is an open system, if central banks and banks adopt cryptocurrency, it means that all the unbanked all over the world suddenly have access to the same blockchain and currency banks are using.

Currency with no ties to government

Since the emergence of fiat money, money has been closely tied to governments. Fiat money requires that governments and financial institutions are credible and for people to trust the system and for the money to retain its value. Historically we have seen, that when a currency is tied to a country or a government, it is inevitable that the currency eventually will lose its globally dominant position. After all, a war that bankrupts the country or government failure will ensure the downfall of its currency. Throughout history, gold has been the only form of money, that has always been accepted all over the world and provided value no matter in what state the world was in.

If central banks and banks would adopt cryptocurrencies to provide liquidity and bridge value over the world. The cryptocurrency could become a new currency that derives its value from providing the world frictionless cross-border transactions. There would be no issuer of the global medium of exchange; consequently the failure of a government could not ensure the collapse of the global currency as with today's system.

Furthermore, a global currency that is not issued by a single country, but based on the value of global cross-border transactions would be effectively a basket of all currencies that partake in cross-border trade. All benefits and burdens of the global currency would be shared more broadly or stop existing. For example, the Triffin dilemma is not an issue; governments do not have to decide between global or national monetary policy.

5.2.2 Challenges

Compliance and regulatory challenges on the international level

Cryptocurrencies at the very basic level pose challenges for regulators, as the definition of cryptocurrencies does not fit easily in an existing box. Cryptocurrencies combine properties of currencies, commodities and payment systems and classifying cryptocurrencies in one of those boxes has legal and regulatory consequences on the ecosystem. Thereby monitoring cryptocurrencies is difficult, as reliable information and statistical data are hard to obtain due to the nature of cryptocurrencies. Due to the nature of pseudo-anonymity in the cryptocurrency market, there is a real threat of money laundering and terrorist financing. The Financial Action Task Force (FATF) therefore already started to impose the Consumer Due Diligence (CDC), Know Your Customer (KYC) and other AML/CTF measures on cryptocurrency exchanges.

However, if cryptocurrency comes fully adopted, the need for getting out of cryptocurrency becomes obsolete, as cryptocurrency is widely accepted. New initiatives like the TITANIUM project that will research, develop data-driven techniques to find identities on the blockchain could support law enforcement. Nevertheless, a more structural regulatory approach is desirable. A balance must be found in containing the risk of the new technology and not stifling innovation (Houben & Snyers 2018). Additionally, cryptocurrencies have a cross-border reach, which makes it for national authorities if they decide on regulation, difficult to enforce these laws and regulations. Thus for adequate regulation around cryptocurrencies, it is of significant importance for national authorities to come together and come up with a regulatory response on an international level (He et al., 2016).

Central banks and banks are heavily regulated by governments; adopting cryptocurrency will not happen until regulators start making clear laws concerning cryptocurrency and its usage for the banking sector. Furthermore, banks that mostly benefit from correspondent banking are incentivized to lobby against the adoption of cryptocurrency. After all, it threatens their position in the market and their revenue stream.

Monetary policy

For now, cryptocurrencies have no real impact on monetary policy, as the market is too small to have a significant impact. However, some real concerns arise if cryptocurrencies become more widely used such as structural deflation, flexibility to respond to money demand shocks and change of transmission channel for central banks (He et al. 2016).

Structural deflation is a monetary disaster, at least that's what we economists have learned over the years from the likes of economists Keynes and Friedman. Especially Keynes has been a big opposer of deflation and developed a line of reasoning which later became the liquidity trap argument (Bagus, 2015). Basically, deflation hinders the growth of the economy, and with no growth eventually, through

a vicious cycle, our financial system collapses. As cryptocurrencies are fixed in their supply through their code, deflation is inevitable if demand rises. Thus like the gold standard or the Sterling, the economy would run on limited reserves. The modern fiat currencies are flexible in their supply, such that monetary policy can encourage consumption and growth.

Furthermore, if cryptocurrencies were widely used as a medium of exchange in the economy, that would greatly affect the impact national central banks have through monetary policies on the state of the economy, business cycles. These challenges are comparable with countries that do not have a national currency of their own and therefore minimal impact on their monetary policy, for instance recently Greece in the Eurozone or dollarized countries like Ecuador, El Salvador and Zimbabwe (Levendis & Seyler, 2013; Bennett, Borensztein and Baliño, 1999).

Financial stability

One of the characteristics of the cryptocurrency market is the high volatility, which attracts a lot of new players (especially from young generations) who like to speculate on an asset and hopefully make quick profits. For now, there is no real threat from the crypto market to destabilize the traditional markets, as the cryptocurrency market is still too small to have any impact on other financial markets.¹³ As an example for Bitcoin belongs to a small group of holders, the top 10.000 hold 58 percent of all BTC.¹⁴ Thus in drastic price corrections, the impact is limited to a small group and thus a small part of the economy. However, if central banks and banks adopt cryptocurrency the volatility could potentially threaten the financial markets. As the market is not limited to a small group of investors, but the whole global economy.

Furthermore, the adoption of private money and new payment services could erode an important revenue stream of traditional intermediaries like banks. As stated by He et al. (2017) existing intermediaries benefit from high barriers to entry, after all, there are high fixed costs required to interface with users, comply with regulation, build trust in services and operating large back-offices. Correspondent banks potentially could lose their revenue from cryptocurrency solving the cross-border transaction market. Big correspondent banks would be pressured to shorten the traditional payments chain or risk losing their market share to new players.

¹³ No effect on the rest of the economy when the cryptocurrency market retraced up to 95 percent beginning of 2018.

¹⁴ <https://bitinfocharts.com/top-100-richest-bitcoin-addresses.html>

6 Discussion

This thesis discusses the potential for a cryptocurrency to succeed the U.S. dollar as a global reserve currency. Throughout history, dominant global reserve currencies rise and fall, because of the failures of governments. Global reserve currency would usually transition to the currency tied to the country with the largest economy, most developed financial markets and global political power. Many therefore expect that the Chinese renminbi or the euro is the next dominant global reserve currency. However, another potential candidate could be a new form of money, cryptocurrency. Cryptocurrencies are a rapidly evolving technology and market that offer benefits like, increased speed and efficiency in making cross-border payments, deepening the financial inclusion and decentralizing money. Nevertheless, cryptocurrency cannot become a form of money that is used internationally if cryptocurrency is not used as a medium of exchange.

From an end-user perspective, retail and common people, the benefits of using cryptocurrencies are not significant for now. Bitcoin and Ripple do not offer enough to end-users and retail for them to adopt this new form of medium of exchange in their daily life. After all cash, traditional banking and private e-money offer a lot of flexibility for the end-user to satisfy his different needs. Except cryptocurrencies could provide stability in countries where the trust in their own issued currency is lost by government failure, for instance, Venezuela.

Furthermore, nobody could have predicted in the 70s the Internet applications we have today. For instance, Netflix would have been unimaginable back in the days. As the required bandwidth to stream video like we do today was impossible back then. The same applies to blockchain and cryptocurrencies, the technology is still in its infancy and retail solutions are years away.

For cryptocurrencies, as a new form of money, it is important to solve friction in the economy today, so adoption takes place. We have discussed the significance and the potential cryptocurrencies have in the cross-border payments market. The market today is plagued by old legacy systems and inefficiencies. If a cryptocurrency can solve these frictions in cross-border payments it would revolutionize the way we make payments globally.

Meanwhile, the cryptocurrency would become an important asset in settling payments all over the world, achieving high liquidity in markets, network externalities and potentially less volatility. Cryptocurrency, in this case, could become a full-fledged currency and potentially replacing one of the biggest use cases of the dollar.

However, the adoption of cryptocurrencies as we discussed will pose many risks and threats to financial integrity, tax evasion and effective financial regulation. While risks to monetary policy and financial stability could emerge as adoption takes off. Consequently, adequate regulation will be

needed before cryptocurrency can move to the next step, from a speculative asset to an asset with real utility in the world.

The cryptocurrency market and the ecosystem is still in its infancy and the surrounding regulations and policy are yet to be established. Therefore, the dollar is unlikely to lose its dominant role as a global reserve currency in the near future to a cryptocurrency. The size of the U.S. economy and its financial systems, the strong tendency towards inertia in currency usage, all suggest that the dollar will remain the anchor to our global economy for the coming years. Nevertheless, a cryptocurrency can become the next global reserve currency, as long regulators and current stakeholders of the cross-border payments market do not stifle the innovation of money.

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Appendix

Table A.1

	Cash	Traditional bank deposits	Cryptocurrencies	Private e-money
Scalability	M: not for large value transactions	M: not for small or micro transactions	H: all transactions possible	M: could be expended to large-value transactions
Extra services	L: none	H: access to all bank services	M: integration with social media and other networks	H: integration with social and financial services
Interest returns	L: zero yielding	M: interest, but below policy rate	L: All the big cryptos no interest, could be offered depending on platform	
Acceptance	M: limits to change, some retailers stopped accepting	L: only person-to-business and business-to-business, POS terminals needed	M: person to business, business to business, person to person, but only within network	M: person to business, business to business, person to person, but only within network
Settlement risk	H: none; immediate settlement	M: some delay	M: immediate settlement, reaching finality for some platforms a risk	M: some delay
Theft & loss risk	M: hard to recover / claim; no cyber risk	M: can reverse transaction & claim ownership	L: hard to recover / claim due to anonymity and transactions being irreversible	M: can reverse transaction & claim ownership
Default risk	H: none, a central bank liability	M: deposit insurance	H: to the extent the code is solid, not a liability	M: no deposit insurance, some safeguard in place
Transaction costs	L: need to physically meet	M: service fees	L: transaction costs are usually low, PoW systems not ideal	H: cheap
Anonymity costs	H: full anonymity	L: not anonymous	M: pseudo-anonymous	L: not anonymous
Cross-border transaction costs	L: impossible, need to physically meet	L: very expensive and slow	H: makes no distinction between domestic and cross-border transactions, quick	H: makes no distinction between domestic and cross-border transactions, quick
User-friendliness	H: straightforward, everyone knows how to deal with cash	M: relative easy, internet banking for older generations not straightforward	L: Wallets, secret key, public key, addresses that are extremely long, managing all makes it even hard for younger generations	M: friendly user interface and relative easy, for older generations not straightforward

Source: Mancini-Griffoli et al., 2018

Note: Score are H (high), M (medium) and (L) low with the end user as perspective. For instance, a high score on transactions cost means that costs are low and thus attractive for the users.