



**Does Currency Substitution (CS) explain the phenomenon of
Cryptocurrency Adoption (CA)?**

Tesis de Grado

Mentor

Juan Cruz Lopez Del Valle

Alumno

Tomás Acosta Pimentel

Abstract

Literature has proved that Currency Substitution (CS) is manifested when a country is experiencing macroeconomic instability, characterized by the existence of economic phenomenon's that put in risk the use of local money. Macroeconomic determinants push countries national currencies to fail in effectively perform the functions of: medium of exchange, store of value and value of account. Consequently, loss of confidence in the national currency induced market participants to replace it for foreign currency, where the most popular solution had been demonstrated to be the US dollar. In the last decade, technological progression permitted the existence of a new form of money, cryptocurrencies appeared to take a leader character in the scene of the financial market. Both as money or investment purposes, cryptocurrencies had gained a lot of popularity with the emergence of Bitcoin and current investigation had declared that it has a promising future. The objective of this paper is to investigate up to what extent the phenomenon of CS can explain cryptocurrency adoption. Literature determined that CS is enhanced in certain macroeconomic conditions, but what happen with cryptocurrencies when they are exposed to them? Do determinants of CS have any relationship with cryptocurrency adoption? Panel data analysis and lineal regressions are examined in this paper in order to investigate the relationship of the use of crypto actives with some macroeconomic variables that had been declared by literature and recent studies as the main determinants of CS, between 2013 and 2020.

Keywords: Currency Substitution (CS), Cryptocurrency Adoption, Bitcoin, Macroeconomic Determinants, Panel Data Analysis and Lineal Regressions.

1. Introduction

The use of cryptocurrencies is a recent phenomenon that has captured the attention of the economic environment, both potential investors, regulators, academia and press. Its importance is not slight, as is now globally established in various businesses and retailers with El Salvador being the first country that has officially recognized this type of Cryptocurrency as legal tender (Businessstech, 2021). The first cryptocurrency was created by Satoshi Nakamoto in 2008, named Bitcoin, with the objective of allowing direct money transfer, which means without the involvement of financial intermediaries and government control. Its trading characteristic is unprecedented, as it is traded on regulated exchanges although its prices are unregulated. By 2022, Cryptocurrency has become a speculative instrument for trading of short-term, kept as an investment within the crypto-asset category and utilized as a medium of exchange for transactional purposes.

At the end of the day, the phenomenon we are observing is that of potential currencies (or crypto-currencies) that coexist or replace local currencies in the uses of money. This phenomenon has potential parallels with the Currency Substitution phenomenon, which is well studied in the macroeconomics of emerging countries.

Recalling the traditional roles that money must accomplish: medium of exchange, store of value and value of account, Agenor & Khan, 1992; Clements & Schwartz 1992; Tanzi & Blejer, 1982; El-Khafif, 2002 argued that currency substitution (CS) is an indication of the failure of the national currency to effectively perform these functions due to some underlying macroeconomic conditions such as inflation, persistent depreciation or volatility in the value of the national currency. As a result, CS can be described as a phenomenon where a domestic currency is being replaced by foreign currency due to the failure of the domestic currency to perform its roles effectively. This phenomenon is usually confused and named as dollarization, but as it will be assessed on the following paragraphs, dollarization and currency substitution represent different concepts although they develop over the same circumstances. According to its determinants, Savastano (1996) considers that high inflation is the main cause of CS and dollarization. However, Ize and Levy Yeyati (2003) studied those negative changes in the value of the domestic currency (depreciation) stimulates the process

of dollarization and CS. Furthermore, Luca & Petrova (2013), believes that Capital Controls, in order to regulate the inflows and outflows of foreign currency, can affect the level of CS and dollarization as they find a positive relation between the level of capital openness and the development of CS. There are other determinants that exists but literature exhibit that the main determinants belong to macroeconomic processes.

The objective of this paper will be to investigate to what extent the phenomenon of the use of crypto active agents can be explained with the literature of CS. For what explained above we will investigate the relationship of the use of crypto active with some macroeconomic variables that had been declared by literature and recent studies as the main determinants of CS. In order to answer this question, this work will accomplish lineal regressions and panel data (2013-2019) in order to study the relationship of macroeconomic variables (determinants of CS) and cryptocurrency adoption. According to the results we should expect, the first important aspect is to analyze if the macroeconomic variables are significant when studying lineal regressions and panel data. Secondly, not least important, observe and analyze the sign of coefficients, and try to understand and associate an economic relationship.

For example, in the case on Inflation, that is one of the macroeconomic independent variables that will be present in our lineal models, we should expect the sign to be positive, as inflation increase in countries, people will be more willing and able to consume cryptocurrencies. Moreover, in order to take into consideration this coefficient, the variable should be statistically significant so there is enough evidence to reject the null hypothesis, as changes in these independent variables are associated with variations in the dependent variable at the population level. If macroeconomic variables studied are statistically significant, then we are finding a strong relationship between CS and cryptocurrency adoption, as both phenomenon's share the same determinants.

2. Conceptual Framework

2.1.1 Currency Substitution

As established in literature, the role of money demonstrates three main capacities: as a medium of exchange, store of value and value of account. Considering it as a medium of exchange, it should facilitate a purchase, sale or trade of goods between parties. The only way in which it can do this is if it represents a standard of value and this standard is respected in the whole market. With respect to the store of value, when the time of exchanging, saving or retrieving comes, it must not deteriorate its value. Finally, referring it as a value of account, if it keeps the property as a medium of exchange, it can be used as a value of account for buying and selling goods and services in the whole economy. This will also mean that it will be essential for calculating profits and losses, balances and values for determined assets.

Although people should expect money to accomplish these three main responsibilities, sometimes this does not occur. There are some instances in which due to some underlying macroeconomic conditions, the national currency fails in effectively perform these functions. This comes associated with loss of confidence in the national currency as market participants start to find other options to replace the injured national currency. Currency Substitutions (CS) occurs when currency from a foreign country is being used alongside the national economy taking it some, or all the functions of money. As we mention earlier the functions that money should accomplish, Levy-Yeyati (2003), tries to distinguish between currency, assets and financial substitution. Starting with financial substitution, Nicolo et al. (2003) argues that these can be explained as holding of assets and liabilities in foreign currencies by residents of the national economy. Secondly, assets substitution refers to the situation in which foreign currency serves as a store of value. Finally, currency substitution explains the context in which foreign currency is used as a mean of payment or unit of account, Levy-Yeyati (2003). Balino et al. (1999)., differentiates asset substitution with financial substitution, explaining the dollarization of payments is followed by financial substitution, as people usually holds financial assets in the currency in which payments are made. Instead,

asset dollarization does not relate with payments dollarization, as local people can save in foreign currency but purchase goods and services with local money.

The first priority of markets participants is to protect the value of their goods. In periods of macroeconomic unstableness, usually characterized by abrupt inflation periods and persistent depreciation or volatility in the value of the national currency (Agenor & Khan, 1992; Clements & Schwartz 1992; Tanzi & Blejer, 1982; El-Khafif, 2002), national currency loses its store of value function, so financial substitution occurs first. Then, higher value products such as real state and cars, start to be expressed in foreign currency values, taking over the function of unit of account. The last step, is when foreign currency takes over national currency medium of exchange function. At these points payments all through the domestic economy and being held by a foreign currency instrument. This sequence of episodes can be explained by rational consumers, trying to protect their value in a context of unstable economy.

Currency Substitution is popular in developing countries and transition economies. Despite other currencies are used as substitutes of the domestic currency, the US dollar has been the prevailing instrument of substitution creating the terminology “dollarization”. As emerging economies started to choose the US dollar as substitute, “dollarization” and currency substitution in some case studies were used as synonyms. Calvo & Vegh (1992) try to differentiate the concepts, by explaining that while “dollarization” is a process in which domestic currency is losing the properties of store of value, value of account and medium of exchange, currency substitution is the last step of this process. So, investigation about currency substitution appears in situation where the local currency had already lost the properties of store of value and value of account, and there is a discussion about how accordingly it is functioning as a medium of exchange. Moreover, the World Bank (WB), explain that the term dollarization has been used in literature to explain the process in which foreign money replace domestic money in any of its functions. According to the WB, currency substitution refers to the use of foreign money only as means of exchange. So, an economy can be highly dollarized, but it is not subject to currency substitution. Furthermore, during the last years, literature had introduced the concept of “Liability Substitution”, which

is explained by the WB, as the process by which the domestic banking system or government can have relatively large foreign currency debt obligations. Thus, a country can have limited asset dollarization, but the loans made by the banking system are mostly from foreign currency.

2.1.1 Determinants affecting CS

It is clear that CS is a phenomenon that occurs in a context of macroeconomic unstableness, but for understanding this, we should figure out and explain the circumstances and determinants that provokes an ideal context for the development of CS. The first determinant that we should explain is inflation. The International Monetary Fund (IMF), explains that the phenomenon of inflation measures how much more expensive is a set of goods and services has become over a certain period, usually a year. So, inflation is an increase in prices, that can be transferred to a declined in the purchasing power over time. Savastano (1996) argues that high inflation is often considered the main cause of currency substitution and dollarization. The reason of this is that, considering a highly inflationary environment, costs of use of local currency increase with the loss of confidence in the domestic currency. Rise in prices causes increase in interest rates on domestic currency and foreign currency borrowing becomes the best alternative, which results in a growth of loans from foreign currency. On the other hand, high inflation generates a reduction of investment in assets which has an uncertain rate of return, such as domestic currency deposits, ending in loans expressed in foreign currencies. Regarding to this, Ize and Levy-Yeyati (2003), assume that the decision of market participants to hold foreign versus domestic currency depend on the expected returns on competitive currencies. As interest rates are really important for the expected returns, Ize and Parado (2002), believes that, assuming that interest rate parity holds between both countries, it neutralizes predictable differences in inflations and equates the expected returns in both currencies. Therefore, the believe that the explanation of CS comes from volatility and unpredictability if inflation, rather than its level. Even at low rates of inflation, as long as the expected volatility of the real exchange rate is lower that the expected volatility of inflation, foreign currency will be more attractive. Intuitively, in period of macroeconomic crisis, as well Guidotti and Rodriguez (1992) explained, the Gresham Law

occurs, were in a country where there are two currencies, the most powerful one displaces the weakest one. According to Guidotti and Rodriguez (1992), currency substitution is not only caused by high inflation, thus is the high and persistent inflation that creates an opportunity for foreign instruments as a substitute for domestic currency.

Besides inflation, the depreciation of the exchange rate, is also considered a determinant of CS as changes in the value of the domestic currency will stimulate the CS process. Currency depreciation can be explained as a fall in the value of a currency in terms of its exchange rate versus other currencies. It is usually provoked due to factors such as weak economic fundamentals, interest rates fluctuations, risk aversion among consumers or political instability. Costs of borrowing in foreign currency increase and the value of resident's deposits in local currency decreases when the exchange rate shifts and depreciates. As a result of this, deposits in foreign currency will be more attractive than deposits in local country while loans in foreign currency will be less desirable than loans in local currency. However, although the uncertainty of future depreciations affects foreign currency borrowing, if interest rates on borrowing in local country is high due to high inflation foreign currency borrowing will become attractive generating an increase in the share of foreign currency loans. In addition, Mahmoud A.T. Elkhafif (2002), argues that the role of exchange rate as a mechanism of transmission of the monetary policy is higher in countries that are under the development of currency substitution rather than the ones that do not, being the impact on exchange rate changes (depreciation) more significant in this type of economies. Calvo and Rodriguez (1977) tried to explain that volatility of the exchange rate comes in relation with inflation. Starting by the principle that higher inflation produces a shift in assets portfolios from domestic currency to foreign currency and, under flexible exchange rates, the supply of money is fixed in the short run, the increase in the demand for foreign currency will lead the real exchange rate to rise. However, on the other hand, when inflation is low, the demand for foreign currency shifts inwards, generating the real exchange rate to decrease. Thus, in either case, the authors conclude that the supply for foreign currency adjusts over time so real exchange rate should return to the long-run equilibrium level. The great problem with this explanation is that in developing countries, inflationary cycles are usually linked to a regime switch. There is an oscillation of monetary instruments regarding exchange rate policies, best

explained by Krugman (1979), arguing that central banks of developing countries abandon exchange rates pegs when they run out of reserves returning to fixed exchange rates, or to crawling pegs, when the new stabilization plan starts.

In addition, Capital Controls, represents any measures conducted by the government, central bank, or other regulatory institution to limit the flow of foreign capital in and out of the local economy. Foreign currency inflows can have an impact in development of CS over a country. Usually, businesses and companies, like to match the currency structure of their liabilities and incomes. Luca and Petrova (2013), affirmed that exporting companies, in order to protect against exchange rate risk, took the decision of borrowing on foreign currency as their income was on foreign currency, which contributes and increases to the process of CS. Therefore, as the volume of exports is higher than the local production and the degree of integration to the world of the economy increases (higher share of trade in GDP), the higher the level of currency substitution in the country. So, if there are capital controls, where the government impose restrictions to foreign currency transactions, this will impact negatively in the level of currency substitution of the economy.

2.1.3 Advantages and Disadvantages of CS

With respect to the benefits that CS can carry to a domestic economy, thinking mostly in developing countries, when CS occurs, Schuller (2002), claims that the domestic country (developing) enjoys the reduction of inflation rate from usually a double-digit inflation rate to a single digit of the foreign currency. Furthermore, another advantage is that the transaction cost of converting the domestic currency to the foreign one, that previously it was really expensive, now it is low as the whole economy is under a process of CS. In addition, CS will generate that the interest rates for local borrowers will be low and stable, and that will generate high level of domestic investment and economic growth. With reference to the government, CS give rise to high level of economic openness and transparency and CS help to eliminate balance of payments crisis. Finally, the financial market of the domestic country, which previously was not working due to the loss of credibility of the domestic currency, improve efficiency and quality of the services it sells to the market, fostering financial

integration with the issuing country as well as building credibility with the government by adopting issuing country's policies.

On the other hand, Girton and Roper (1981), Bahmani-Oskooee and Ilker (2003), Yeyati (2004), Boamah *et al.* (2012), and Laopodis (2011) argued that the degree of currency substitution may provoke significant negative implications for the domestic economy. Bawa, Omotosho & Doguwa (2015) explains that CS affects the sovereignty of monetary policy, generates susceptibility to monetary tremors arising from the host nation, and impulses the deterioration of the balance of payments account, exchange rate volatility, and contracting overall output. Miles (1978), Girton & Roper (1981) and Boamah *et al.* 2012, argues that CS affects directly the monetary policy of the domestic country, undermining the transmission mechanism of monetary policies decisions. Moreover, Mizzen and Pentecost (1996) and Chang (2000) explain that CS weaken the freedom of exchange rate strategy and sabotage monetary policy, instead of permitting a country to regulate her monetary posture under an uncontrolled exchange rate, currency substitution creates undue interdiction amongst countries. Finally, Batten and Hafer (1984) tried to explain that currency substitution exposes an economy to external shocks and noted that domestic and foreign currencies should not be considered substitutes. This analysis is consistent with the monetary independence perspective as this author do not tolerate the possibility of missing the monetary policy control with CS. According to them, if domestic currency is substituted with the foreign currency, the domestic money demand would easy be negatively affected to foreign and external shocks, harming the domestic economy.

Institutional Background

2.2 Cryptocurrencies- Bitcoin

After analyzing the main determinants of CS, this paper will try to study if it exists a relation between determinants of cryptocurrency adoption and the literature of determinants of CS. Thus, we will try to study if the literature of CS, can be used to explain the macroeconomic determinants of cryptocurrency adoption.

Cryptocurrency is a digital form of currency and it is used as exchange medium through a technology called “blockchain technology”. It allows direct money transfer, without the needs of financial intermediaries such as banks and the government can’t control these transactions. The first form of cryptocurrency was created by Nakashi Nakamoto (2008), and he named it as Bitcoin. Fantazinni et al. (2004) defined Bitcoin as “...an online decentralized currency that allows users to buy goods and services and execute transactions, without involving third parties...”. The main characteristic of these cryptocurrency is their decentralized structure, where there is not a central structure that regulates and controls the currency, its simple the law of supply and demand, using a peer-to-peer cryptocurrency protocol for making its transactions. Regarding to the most common transactions using this type of currencies, most investors choose them as a store of value, to generate wealth and protect against inflation. As the price of the cryptocurrencies are very volatile, investors used this characteristic to generate wealth and earn profits. By 2022, Cryptocurrency has become a speculative instrument for trading of short-term, an investment within the crypto-asset category and utilized as the exchange/ currency medium for transactional purposes. Bitcoin value oscillates day by day, and at 2021, one Bitcoin value was at approximately USD 67000 and through 2022, it is registering values of 20000 USD. Today Bitcoin is globally accepted in many business and inclusive countries, such as El Salvador, which legalized Bitcoin as legal tender.

2.1.1 Block-chain

As we mention previously, Bitcoin is a cryptocurrency, and as all cryptocurrencies, it does not depend on a central issuer. In contrast, it uses peer to peer (P2P) technology that allows establishing a direct connection between computers that manage transactions and issue Bitcoin. In addition, the system is based on a “blockchain” that includes all complete transactions between Bitcoin users through the peer-to-peer system. Blockchain can be explained as a distributed data base that is divided up among nodes of a computer network. Consequently, as a data base, a blockchain reserves information using a digital, secure and decentralized format, being attracted by cryptocurrencies such as Bitcoin, due to its fidelity and security of record data without the need of a third party. A blockchain, collects

information in groups usually known as blocks, and this holds independent sets of information. Blocks have a limit capacity, and ones filled it closes, no more data can enter the block and it connect to another filled block, forming a chain of data called blockchain. The main objective of blockchain technology is to permit digital information to be recorded and distributed, but not modified. This is the reason why blockchain technology is also known as distribute ledger technology (DLT), as it is the foundation of records and transactions that cannot be altered.

2.2.2 Evolution of Bitcoin price

In order to understand the volatility of Bitcoin value, first we have to figure out the determinants that affects Bitcoin price. As other products, services or currencies in an economy, Bitcoin price depends on perceived value and supply and demand. However, one important aspect that we have to take into consideration is that by design and until now, 21 million Bitcoin will ever be created, as Nakashi Nakamoto (2008) announced, so we can think that the closer the demand of bitcoin is to its limit, the higher the price will be, as we shall think that demand will stay the same or increase. So, we can think that Bitcoin price should continue to rise as long as it continues to grow in adoption and its supply cannot meet demand. However, if popularity shifts downwards and demand falls, there will be more supply than demand. Then, Bitcoin price should decrease unless it maintains its value for other reasons.

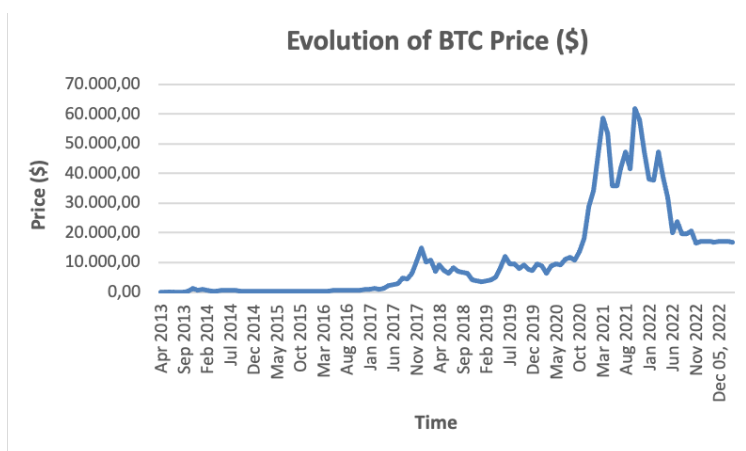


Figure 1)

As we can observe in Figure 1), since the beginning of its creation, Bitcoin experienced high volatility on its prices. Between 2009 and 2013, the price of Bitcoin fluctuated from 2009 USD 0 ending up on USD 687 at the end of 2013. However, in 2014 it lowered to USD 315,21 and maintained its value during 2015 without any abrupt change. By 2016, price increased to 900, which then climbed to 1000 in 2017 ending the year with a sky rocket increase to \$15,345.49. This was the first time, Bitcoin experienced an uncommon growth of its prices, with a percentage increase of 1500%. At this time, economist, investors and even governments started to take notice of this events, and to develop cryptocurrencies and platforms to compete with Bitcoin, as it was gaining a lot of popularity, and did not have any competitor. During 2018-2019, Bitcoin price seasoned small changes of price, maintaining a calm streak and do not experienced fluctuations. Nevertheless, in 2020, the economy suffered COVID-19 pandemic, shutting down the markets and reinforcing restrictions in order to protect the health of people. Starting the year, Bitcoin price rounded at \$6,965.72 and at November of this year, it ascended to \$19,157.16 and finished the year registering \$29,000 in December, representing a 420% of increase during the year 2020. Not surprisingly, the beginning of 2021 started with an increase of the price to surpassing \$40,000 by January and gaining by April levels over \$60,000 registering the highest price of \$63,558, being this the historical highest price Bitcoin ever had. Even so, ending 2021 Bitcoin fell to \$46,164 as the price started to decrease as uncertainty about inflation and the emergence of a new variant of COVID-19, Omicron, continued to scare investors. Between January and May 2022, Bitcoin's price continued to gradually decline, with closing prices only reaching \$47,450 by the end of March before falling further to \$28,300 on May 11. This was the first time since July 2021 that Bitcoin closed under \$30,000. Since this downfall, crypto prices pitched on the following months. Bitcoin dropped below \$23,000 for the first time, and maintained towards today.

2.2.3 Bitcoin as Money

Usually, currency is generated by a nation's government. This money is called fiat money meaning that its value is not backed by gold or another commodity. Institutions within the country, take the role of generating money and redistributed all over the territory. As an example, in the United States, the US Treasury produces the coins and bills that the US

people spend and the Federal Reserve system is the one in charge of distributing the money across the banking system.

As mentioned previously, money accomplishes three functions in the economy: medium of exchange, unit of account and store of value. Regarding to Bitcoin, its medium of exchange capacity, Nakamoto first explained that the main idea of Bitcoin creation was the possibility of doing payments between parties increasing its efficiency and velocity as it missed the step of passing through any financial institution. This suggests that Nakamoto's objective of Bitcoin creation was to use it as an alternative currency. However, nowadays, Bitcoin can be used as a medium of exchange in limited occasions and the number of goods that can be purchased with Bitcoin are confined. Supporting us in past events, Bitcoin medium of exchange property was intensified when Richard Branson, owner of Virgin group, accepted Bitcoin for as a medium of exchange. This episode was important as more companies started to gain interest in cryptocurrencies as medium of exchange. Consequently, if the number of companies and celebrities that use Bitcoin as a medium of exchange increase, is not incorrect to argue that Bitcoin will start to compete with fiat currency, such as the US dollar, affecting its value and thus monetary policy. Although the popularity of Bitcoin seems to open a clean path of development, there is still a lot to work regarding on transaction costs and platforms in order to gain trust and confidence over the market. When talking about transactions costs, most of the Bitcoin transactions include a third party between the buyer and seller of the good, in charge of the process of converting Bitcoin into conventional currencies. This involvement of a third party can be costly, both by time and money. Approximately, it takes more than one hour to confirm a transaction and costs more than 30 USD to complete it. Moreover, the volatility of its price makes people to distrust Bitcoin as medium of exchange as they prefer a medium of exchange that maintains a stable value over time. Differing from Bitcoin characteristics, institutions of conventional currencies, such as the Federal Reserve in the US, targets inflationary goals within the years, serving as useful information for people who own or use this money for transactions or store of value as they have an anticipated outlook of the loss of purchasing power that the currency will have. This is not possible with Bitcoin, as it is not regulated by any institution and as studied earlier, its value is changing day by day. Selguin (2014) defined Bitcoin as a synthetic commodity

money, arguing Bitcoin share features with commodity money such as gold and fiat money such as US dollar. While fiat money is not scarce, is controlled by the central bank and its main feature is accomplishing the role of medium of exchange, commodity money is scarce, and its role instead of being medium of exchange, it is usually used as means of investment. Therefore, continuing with Selguin argument, this opens the possibility to Bitcoin for being used as medium of exchange or as investment.

2.2.4 Bitcoin as Financial Investment

Although Bitcoin was originally created for payment transactions, it has gained popularity as a financial investment alternative due to its price volatility and opportunity to obtain high profits.

Dirk G Baur, KiHoon Hong and Adrian D.Lee (2017), found that Bitcoin return properties are different from traditional investments and consequently offers greater diversification benefits. Furthermore, they analyzed Bitcoin public ledger, and they discover that a third of Bitcoin are controlled by investors, specifically users that rather than trading it they use it as a long run investment while only a minority of them use Bitcoin as a medium of exchange. As the size of Bitcoin investments and other cryptocurrencies transactions is increasing significantly, it is not insane to think that the behavior of consumers and producers can be altered and as a consequence change the application of the monetary policy.

In addition, Glaser (2014) argues that cryptocurrencies appear to behave as assets. In order to explain this, he claims that if cryptocurrencies are used to buy goods and services, then there should exist a relationship between the number of users and volume of transactions, concluding that cryptocurrencies do not appear to be used as means of exchanges, but rather for speculative purposes. This speculative purpose of Bitcoin has encouraged its prices to raise at a level that financial specialist calls this phenomenon a “financial bubble”. In order to understand this concept, it is important to introduce its definition. On the one hand, the first definition was proposed by Garber, where he explains “...is that part of asset price movement that is unexplainable based on what we call fundamentals. Fundamentals are a collection of variables that we believe should drive asset prices. [...] This is no more than

saying that there is something happening that we cannot explain, which we normally call a random disturbance...”. On the other hand, Shiller explains financial bubble as: “... a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, and, in the process, amplifies stories that might justify the price increase and brings in a larger and larger class of investors, who, despite doubts about the real value of the investment, are drawn to it partly through envy of others’ successes and partly through a gambler’s excitement...”. Both definitions, belongs to different approaches to explain the concept, and depends on the principles of the authors. However, its behavior is useful to explain the logic behind the irregularity on Bitcoin price and high volatility. Moreover, Jamie Dimon, CEO of JPMorgan Chase, explained that Bitcoin is difficult to value as it is not a value-producing asset. Different are stocks which represent ownership of real capital, which usually provide a template of future dividends and profits based on a value-producing asset. This characteristic of applying as a “financial bubble”, opens a door to opportunities for investors to gain interests and profits in a market where the price is determined by supply and demand and making Bitcoin and other cryptocurrencies a good alternative for financial investments.

3. Econometric Results

3.1 Data Description and Methodology

In order to study the relationship that exists between CS and the use of cryptocurrency, we run lineal regression, both panels and cross section, in order to see how macroeconomic variables, interact with cryptocurrencies adoption indexes. It is not coincidence that the macroeconomic variables that will be studied are cataloged as the main determinants of CS by literature. Therefore, by running these regressions, we can study the level of incidence that CS determinants have over cryptocurrency adoption indexes and try to find some relationship.

Model

$$y = \alpha + \beta_1 I + \beta_2 D + \beta_3 CC + \beta_4 G + \varepsilon$$

where “y” is Cryptocurrency Adoption Index, “I” is Inflation, “D” is Depreciation, “CC” is Capital Control, “G” is GDP per Cap adjusted to PPP, “α” is the Constant, “β” is the Coefficient of interest for each independent variable and “ε” is the error. Furthermore, as it will be explained above, depending on the population we will study, we are going to apply fixed effects.

On the one hand, regarding the cryptocurrency adoption index, we will work with three different sources, in order to have a partial analysis. The first one is drawn from “Statista”¹, including 2000-12000 respondents of 18-64 years old per country with 55 countries covered. This variable explains the share of respondents that indicated they either owned or used cryptocurrencies in 2020. In order to obtain the data, a survey was made asking people about financial products and giving options where Bitcoin was included. The number represent a percentage of the people that choose Bitcoin over the total people that were asked during the survey. Moreover, this survey was not held at the same time across the studied countries as some countries have their survey earlier in the year and some later.

The second adoption index we studied is the one brought by the “2020 Geography of Cryptocurrency Report”², by “Chainalysis”³ which offers a global crypto-adoption index

¹ Statista is a German online statistical portal that makes available to user’s relevant data from market and opinion studies, as well as economic indicators and official statistics in German, English, Spanish and French, <https://es.statista.com/>.

² The Global Crypto Adoption Index is made up of four metrics : 1) On-chain cryptocurrency value received, weighted by purchasing power parity (PPP) per capita, 2) On-chain retail value transferred, weighted by PPP per capita, 3) Number of on-chain cryptocurrency deposits, weighted by number of internet users and 4) Peer-to-peer (P2P) exchange trade volume, weighted by PPP per capita and number of internet users. 154 countries are rank according to each of those four metrics, take the geometric mean of each country’s ranking in all four, and then normalize that final number on a scale of 0 to 1 to produce the overall rankings. The closer the country’s final score is to 1, the higher the rank.

³ Chainalysis is the blockchain data platform. Provision of data, software, services, and research to government agencies, exchanges, financial institutions, and insurance and cybersecurity companies in over 70 countries.

describing cryptocurrency adoption between countries during 2020. The global crypto-adoption index rank all over 154 countries, working with metrics to rank and normalize a final number between 0 and 1 that represent the share of cryptocurrencies. The closer the countries rank is to 1, the higher the share is. The metrics that this index work on are four: On-chain cryptocurrency value received, weighted by purchasing power parity (PPP), On chain retail value transferred, weighted by PPP per capita, Number of on-chain cryptocurrencies deposits, weighted by number of internet users and Peer- to- Peer (P2P) exchange trade volume, weighted by PPP per capita and number of interest users.

The third and final cryptocurrency adoption index is Google Trends⁴. As the only indexes we found studied events which occurred in 2020, we created a data base, searching in Google Trends the word “Bitcoin”, going country by country, reaching 120 countries. We recall information month by month, between the years 2013 and 2019. By default, Google Trends normalizes in order to make comparisons between countries. It follows the method of dividing each data point by the total searches of the geography, adjusting the time range, to compare the relatively popularity. The first problem one can first think you will have with this index is that results offered by Google Trends are relative to each country, as this result depend on the number of search’s and in each country, this can differ, so results can be biased. However, this possible problem is fixed by including to the panel regression fixed errors by country and year and clustered the analyzed countries, so events that occur in one year are not independent from another and since fixed effects will exploit only the within country-year variation. Furthermore, being able to collect information of the 120 countries between the period 2013-2019, gave us the opportunity of increasing the size of the sample, improving the consistency of our analysis’s.

Although it is not an official adoption index, Google Trends indicators are gaining popularity in recent studies and it is interesting to analyze how this self-made index interacts with the independent variables. Oliver Geraud and Victor A. Ginsburgh (2019) used Google trends to

⁴ Google Trends is a useful search trends feature that shows how frequently a given search term is entered into Google’s search engine relative to the site’s total search volume over a given period of time. Google Trends provides keyword-related data including search volume index and geographical information about search engine users.

measure the short-term economic fall outs of cultural events while Nicolas Woloszkzo introduced an OECD Weekly Tracker of economic activity for 46 OECD and G20 countries using Google Trends. In addition, Seabold Skipper and Coppola Andre, wrote a paper named “...Nowcasting prices using Google Trends: An application to central America...” where they assessed the possibility of using Google Trends to forecast price series in central America finding success and potential avenues in the use of Google Trends to predict and analyze economic features. To produce this index, the word chosen to analyze was “Bitcoin”, so the work consisted in recalling information about “Bitcoin” google interactions in our 120 countries during 2013-2019. Once recollected month by month, it was annualized country by country, in order to compare the different results between the studied years.

On the other hand, focusing in the independent variables, the first variable that we selected as an explanatory variable is inflation. The Average Consumer Price Inflation Rate, from the IMF brings up data about the inflation rate per country and year, were we focused between the 2013-2021 period. With this variable, we will expect as inflation make the domestic currency less attractive, as inflation increases the adoption of cryptocurrencies should rise.

Furthermore, another variable chosen for explaining cryptocurrency adoption is Capital Controls (Cap Control), using the Chinn-in Index, which measures the level of capital openness by combining several binary variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMFS Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The index ranges between -1,9 and 2,3, with high values representing greater financial openness so less capital control. We will use 2013-2019 as 2019 data set is the latest available value for this index. With this variable, we should expect that as the capital control is higher, represented by negative values in the Chinn-in Index, then consumers will be tempted to consume cryptocurrencies, that do not depend on a regulatory institution.

In addition, nominal foreign exchange rates were investigated between the years 2013-2021, and by the use of this exchange rate we calculated the depreciation per year that each country experienced. We name our variable “depreciation”, and represents the following calculation: Being year $X > Y$, foreign exchange rate year $X / (\text{foreign exchange rate year } Y - 1)$ represents

the depreciation in the year X that a country had experienced. Foreign exchange rates data bases were obtained from the IMF. With this variable, we might expect that as the depreciation in a country increases, the demand for cryptocurrencies should also increase.

Finally, our last independent variable will be GDP per cap, adjusted to PPP. The World Bank (WB) provides a data source, where we obtained this data set between 2013 and 2021. The WB describes GDP per cap as the sum of gross value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output, divided by mid-year population. Although literature did not find evidence that GDP per cap can be used to explain CS, and act as a determinant, GDP per cap is one of the main pillars used by countries to measure the level of macroeconomic development. Therefore, it is interesting to study if there is any relationship between GDP per cap and cryptocurrency adoption and how we can link and relate this with CS prior determinants. Comin and Hobijn (2003) try to explain that the rate of adoption of technology in early stages of life cycle is largely determined by the level of economic development of a country. Both agreed that technology is a major determinant of economic growth and consequently, a country's GDP per cap would influence technology adoption. Therefore, following this background, we should expect that as a country has a higher GDP per cap, then the cryptocurrency adoption should increase.

3.2 Results

Once explained the Data and the Method we will use, it is important to analyze the results finding if there is any relationship between CS and Cryptocurrency adoption determinants. In order to give a clear analysis, we separate the results of the lineal regressions in two, where Table 1, uses data source file from (2013-2019) Google Trends index while Table 2 uses data source file from (2020) Statista & (2020) Chainanalysis. Consequently, the idea is to analyze the 2013-2020 period of time, with different data source files. As explained above, in this analysis we run both panels, which has standard errors clustered by the number of years, and regressions, which has robust errors. Fixed effects of both years and countries are added to panel regressions, making the analysis more precise. The idea is to use both panels and

regressions as an instrument to study how independent variables interact with our variable of interest.

We named “Popularity” to the variable that represents the cryptocurrency adoption using (2013-2019) Google Trends data source, “Popularity S” to the variable that represents cryptocurrency adoption using (2020) Statista and “Popularity C” to the variable that represents cryptocurrency adoption using (2020) Chainalysis.

Table 1

VARIABLES	(1). Popularity	(2). Popularity
Inflation	0.00024*** (0.00001)	0.00045*** (0.00004)
Depreciation	0.00198*** (0.00036)	0.00307** (0.00128)
CapControl	-1.17769 (0.87104)	-0.52979** (0.24312)
GDPpercap(PPP)	0.00058 (0.00162)	0.00134 (0.00194)
Observations	784	784
R-squared	0.80784	0.01976
Number of Country1	113	
Fixed Effects	Yes	No

(1). Standard Errors adjusted for 113 clusters in Country

(2). Robust Standard Errors in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1

Table 2

VARIABLES	(1). Popularity S	(2). Popularity C
Inflation	0.40705*** (0.09838)	0.00037** (0.00015)
Depreciation	0.01521 (0.01258)	0.00041 (0.00044)
Cap Control	-0.61495* (0.32627)	-0.01676* (0.00872)
GDPpercap(PPP)	0,08688 0,08182	0.00012 (0.00017)
Observations	55	154
R-squared	0.20563	0.02363
Fixed Effects	No	No

Robust standard errors in parentheses (1) and (2).

*** p<0.01, ** p<0.05, * p<0.1

On the one hand, Table 1, shows the result for (2013-2019) Google Trends data source using different analysis: (1) represent the results of running panels, clustered by country, adding fixed effects to the years and countries, while (2) brings the results of running a regression with robust errors between 2013 and 2019.

From the first column (1), we can observe that both Inflation and Depreciation brought p values smaller than 0,1 and 0,05. This means that these variables are statistically significant, and there is enough evidence to reject the null hypothesis, as changes in these independent variables are associated with variations in the dependent variable at the population level.

Regarding column (2), both Inflation and Depreciation are significant variables as in (1) but CapControl is also significant with a p-value < 0,05. So, in this case, with Inflation, Depreciation and CapControl, there is enough evidence to reject the null hypothesis as changes in these independent variables are associated with variations in the dependent variable at the population level.

On the other hand, Table 2, shows the result for (2020) Statista data source & (2020) Chainanalysis, using lineal regressions with robust errors. As mentioned previously, "Popularity1" represents cryptocurrency adoption using (2020) Statista and "Popularity2" represents cryptocurrency adoption using (2020) Chainanalysis. As we can observe, in both

cases, Inflation and CapControl appear as significant variables, where in (1) Inflation brought a p-value $<0,01$ and in (2) $<0,05$ and CapControl brought the same p-value $< 0,1$ in both (1) & (2). Consequently, in this analysis, we can say that with Inflation and CapControl, there is enough difference to reject the null hypothesis as changes in these independent variables are associated with variations in the dependent variables at the population level.

To sum up, the determinants of cryptocurrency adoption that we found using panels (2013-2019) and lineal regressions (2020) are Inflation, Depreciation and Cap Control.

Inflation

The positive sign of the coefficient explains that as the level of inflation is higher, more people are willing and able to consume cryptocurrencies. As Savastano previously argued, costs of use of local currency increase with the loss of confidence, so people seek new possibilities for maintaining their purchasing power, and here is where cryptocurrencies appear. Regardless if it can be used as an investment or for transactions, cryptocurrencies adoption increases when a country experience inflation. As inflation is one of the main determinants of CS, we have evidence to say that it is also a determinant of cryptocurrency adoption. Furthermore, it is also interesting to observe that while inflation impacts positively on the process of CS, it also has a positive effect with cryptocurrency adoption. This means that inflation, as a macroeconomic determinant, has a similar effect in both CS and cryptocurrency adoption.

Depreciation

Furthermore, the coefficient of depreciation is positive, suggesting that when countries experience depreciation of their exchange rate, this will generate an increase in cryptocurrency adoption. When a country currency begins to depreciate, purchasing power of the local currency decreases. In addition, as Calvo and Rodriguez had anticipated, it is not a coincidence that both inflation and depreciation have a positive effect on cryptocurrency adoption, as inflation and depreciation of the exchange rate usually work together and can be really harmful for the local currency. We can observe that as local currency begins to lose value towards foreign currency, cryptocurrencies popularity increase and people increase

their cryptocurrency adoption. As depreciation is one of the main determinants of CS, we have evidence to say that it is also a determinant of cryptocurrency adoption. The way in which this determinant behaves is similar between CS process and cryptocurrency adoption. In both cases, depreciation has a positive impact in this phenomena's, which means that as depreciation increases, more people will be willing and able to consume cryptocurrencies and CS process will increase, as Calvo and Rodriguez (1977) previously explained.

Capital Control

Regarding CapControl, we should clarify one more time that this index measures the level of capital openness, with parameters between -1.9 and 2.3 where the higher the value, the higher the level of capital openness. Consequently, we can see that the coefficient of CapControl is negative, which means that when the level of capital openness decreases, cryptocurrency adoption increases. As the government implement monetary restrictions to regulate the capital flows, more people are willing and able to consume cryptocurrencies. An economic intuition to explain this result can be that as people have high restrictions on the capital flows of their local currency, less - regulated investments and decentralized products such as cryptocurrencies are a better option for investments. Moreover, we can observe that in this case, the increase in restrictions on capital flows generates incentives in consumers to purchase cryptocurrencies. However, regarding Luca and Petrova (2013), restrictions in the capital flows impact negatively in the process of CS. Consequently, we can find in this determinant an inverse effect: while it increases Cryptocurrency adoption when restrictions on capital increase, it decreases the process of CS. Thus, countries with high capital control tend to have a large share of cryptocurrencies, suggesting that crypto assets may be used to circumvent capital controls.

4. Conclusion

To conclude, the objective of this paper was to investigate to what extent the phenomenon of the use of crypto active agents can be explained with the literature of CS. For what explained above we investigated the relationship of the use of crypto active with some macro variables that had been declared by literature and recent studies as the main determinants of CS.

According to the results, Inflation, Depreciation and Control in Capital Flows (CapControl) are significant determinants of cryptocurrency adoption. As the level of inflation in a country increase, then more people will be willing and able to consume cryptocurrencies. Inflation provokes a loss in the purchasing power of the local currency, usually generating a depreciation of the local currency against the foreign currency (USD). As we analyzed, when depreciation occurs, people increase their demand for cryptocurrencies. Finally, controls in the capital flows had demonstrated to increase cryptocurrencies adoption, so countries with high capital control had demonstrated to have large share of cryptocurrencies principally for being used to circumvent capital controls.

Finally, we conclude that determinants of CS are useful to explain the phenomenon of cryptocurrency adoption. Inflation, Depreciation and Control in Capital Flows, originally presented in literature as the mains determinants of CS, appeared to be significant when we analyzed the macroeconomic determinants of Cryptocurrency Adoption. Therefore, we can affirm that there is a strong relationship between CS process and cryptocurrency adoption, as both share the same determinants. Regarding the determinant's behavior, we found that both Inflation and Depreciation behaves in a similar way increasing CS process and Cryptocurrency Adoption while controls in Capital Flows has an inverse relation, increasing Cryptocurrency Adoption and decreasing CS process.

Although this study has its limitations and more investigation is needed, we believe that it can be relevant to study cryptocurrency adoption when writing papers about CS, as we found there is a clear relationship between both of them. As technology is growing and cryptocurrencies market tends to grow, we believe it can be interesting to include in future investigations the role of cryptocurrencies to the list of determinants and variables when CS is studied.

5.0 Bibliography

Ajibola, I. O., Udoette, S. U., Muhammad, R. A., & Anigwe, J. O. (2020). Currency substitution and exchange rate volatility in Nigeria: An autoregressive distributed lag approach. *CBN Journal of Applied Statistics*, 11(2), 1-28.

Almajali, D. A., Masa'Deh, R. E., & Dahalin, Z. M. (2022). Factors influencing the adoption of Cryptocurrency in Jordan: An application of the extended TRA model. *Cogent Social Sciences*, 8(1), 2103901.

Alnasaa, M., Gueorguiev, N., Honda, J., Imamoglu, E., Mauro, P., Primus, K., & Rozhkov, D. (2022). Crypto, Corruption, and Capital Controls: Cross-Country Correlations.

Aromí, J. D., & Llada, M. (2020). Forecasting inflation with twitter.

Ashford, K., & Curry, B. (2021). What Is Bitcoin And How Does It Work. URL: <https://www.forbes.com/advisor/investing/what-is-bitcoin/> [Last Accessed June 1, 2021].

Basso, H. S., Calvo-Gonzalez, O., & Jurgilas, M. (2007). Financial dollarization: the role of banks and interest rates.

Baur, D. G., Lee, A. D., & Hong, K. (2015). Bitcoin: currency or investment?. Available at SSRN, 2561183.

Beckerman, P., & Solimano, A. (2002). Crisis and dollarization in Ecuador: Stability, growth, and social equity. Washington, DC: World Bank. Costs and Benefits of Dollarization, Myriam Quispe-Agnoli Latin America Research Group Research Department Federal Reserve Bank of Atlanta.

Benigno, P., Schilling, L. M., & Uhlig, H. (2022). Cryptocurrencies, currency competition, and the impossible trinity. *Journal of International Economics*, 136, 103601.

Bhimani, A., Hausken, K., & Arif, S. (2022). Do national development factors affect cryptocurrency adoption?. *Technological Forecasting and Social Change*, 181, 121739.

Calvo, G. A., & Végh, C. A. (1999). Inflation stabilization and BOP crises in developing countries. *Handbook of macroeconomics*, 1, 1531-1614.

Calvo, G., & Végh, C. (1996). From currency substitution to dollarization and beyond: analytical and policy issues. *Money, exchange rates, and output*, 153-75.

Hellerstein, R., & Ryan, W. (2009). The determinants of international flows of US currency (No. 400). Staff Report.

Isakova, A. (2010). Currency substitution in the economies of Central Asia: How much does it cost?. In *The Euro and Economic Stability*. Edward Elgar Publishing.

Komárek, L., & Melecký, M. (2003). Currency substitution in a transitional economy with an application to the Czech Republic. *Eastern European Economics*, 41(4), 72-99.

Milenković, I., & Davidović, M. (2013). Determinants of currency substitution/dollarization-the case of the republic of serbia. *Journal of Central Banking Theory and Practice*, 1(3), 139-155.

Mourmouras, A., & Russell, S. H. (2000). Smuggling, Currency Substitution and Unofficial Dollarization: A Crime-Theoretic Approach.

Neanidis, K. C., & Savva, C. S. (2009). Financial dollarization: Short-run determinants in transition economies. *Journal of Banking & Finance*, 33(10), 1860-1873.

Pepić, M., Marinković, S., Radović, O., & Malović, M. (2015). Determinants of currency substitution in Southeast European countries. *Economic Themes*, 53(2), 162-184.

Sari, V. K. CURRENCY SUBSTITUTION: EVIDENCE FROM INDONESIA. *DINAMIKA: Jurnal Ekonomi Pembangunan*, 8(1), 19-25.

Streb, J. M. (1996). Currency substitution, capital flight and real exchange rates (No. 113). Universidad del CEMA.

Tandon, A., & Wang, Y. (1999). Inflationary finance, capital controls, and currency substitution. *Review of International Economics*, 7(4), 597-612.

Taşseven, Ö., Fitzsimmons, A. P., & Elifoğlu, I. H. (2015). Currency substitution in Turkey: Macroeconomic determinants. *Journal of Emerging Markets*, 20(1-2), 52-69.

Ujunwa, A. I., Ujunwa, A., Onah, E., Nwonye, N. G., & Chukwunwike, O. D. (2021). Extending the determinants of currency substitution in Nigeria: Any role for financial innovation?. *South African Journal of Economics*, 89(4), 590-607.

Wolla, S. A. (2018). Bitcoin: Money or Financial Investment? *Page One Economics*®.

Yeyati, E. L. (2006). Financial dollarization: evaluating the consequences. *economic Policy*, 21(45), 62-118.

