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# Saving our Savings

A beauty contest of monetary alternatives to keep reserve value and to allow for companies and individuals to transact more efficiently

## João Pedro Marques Barroso

*Master* in, Business Administration

Supervisor:
*PhD* in Management,
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Invited Associate Professor, Iscte

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"Many people believe that the free market, despite some admitted advantages, is a picture of disorder and chaos. Nothing is "planned", everything is haphazard. Government dictation, on the other hand, seems simple and orderly; decrees are handed down and they are obeyed. In no other area of the economy is this myth more prevalent than in the field of money."

Murray Rothbard, "What Has Government Done to Our Money?"

**Abstract**

Purpose – The main objective of this thesis is to study what commodities/assets/currencies can be considered as "feasible alternatives" to fulfill the role of "money" in society in comparison to the already established fiat currencies in circulation. Between those same alternatives, which specific advantages each have and what is their potential future.

Design/Methodology/Approach – Dividing the study into two main sectors, the quantitative part looking into past prices of each possible currency and a qualitative part looking specifically into the characteristics that they have. For the first part, the main focus is on the concept of reserve of value, driven by the more or less stable the currency has been, and for the second part, six characteristics are laid down as thru them, a specific commodity can be analyzed properly.

Findings - Gold is clearly the one performing the best for the quantitative analysis while Nano and Monero are the currencies with "the best characteristics for money". Surprisingly, in general, the quantitative analysis is not so good for precious metals while some cryptocurrencies do perform better than what was expected.

Research limitations/implications – A 2-year period of analysis while making all assumptions and conclusions in a context of a bull market and with historically very low interest rates.

Originality/value – The study provides a methodology easily appliable to more commodities while crossing a comprehensive and extended multi-factor criteria.

Keywords – Precious metals, Cryptocurrencies, Monetary Policy, Reserve of Value, Money.

JEL Classification System - **E14** Austrian Economics; **G11** Portfolio Choice.

**Resumo**

Meta – O principal objetivo desta tese é estudar quais ativos/moedas podem ser consideradas como "alternativas viáveis" para preencherem o papel de "dinheiro" na sociedade em comparação com as já estabelecidas moedas fiduciárias em circulação. Entre essas alternativas, quais vantagens específicas cada tem e qual o potencial futuro.

Design/Metodologia/Abordagem – Dividindo o estudo em dois principais setores, a parte quantitativa observando preços passados de todas as potenciais moedas e a parte qualitativa, observando especificamente as caraterísticas que detêm. Para a primeira parte, o principal foco é no conceito de reserva de valor, conduzido pela mais ou menos estabilidade que a moeda tem mostrado e a segunda parte onde seis caraterísticas são analisadas para cada ativo em específico.

Resultado – O ouro é claramente aquele que mais se destaca na análise quantitativa enquanto Nano e Monero são as moedas que detêm "as melhores caraterísticas como dinheiro". Surpreendentemente, em geral, a análise quantitativa não mostra uma clara supremacia dos metais preciosos enquanto algumas cripto moedas preformam melhor do que o esperado.

Restrições da Pesquisa – O período de 2 anos de análise enquanto todas as suposições e conclusões são feitas e retiradas no contexto de um "bull market" e com taxas de juro historicamente baixas.

Originalidade/Valor – O estudo fornece uma metodologia facilmente aplicável a mais ativos enquanto cruza uma análise compreensiva com um critério de múltiplos fatores.

Palavras-chave – Metais preciosos, Cripto moedas, Política Monetária, Reserva de Valor, Dinheiro.

Sistema de Classificação JEL – **E14** Economia Austríaca; **G11** Escolha de Portefólio.

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### 1. Introduction and Context

Businesses and companies of the most varied backgrounds and markets need to always be updated with the most efficient ways of allocating resources. This is a preposition that can be misleading when we look at the current economic system we live in where companies with a certain size and political influence over society can be the exception to this rule, nonetheless, for the majority of companies, the ones that can be labelled as "small" or "medium" sized companies, must play by this rule on a regular basis.

The inevitability of recessions and expansions, the so called "business cycles" dictates that from time to time, because the economic scenario is not stagnant or fixed, there will be fluctuations and within those, recessions are the ones that make agents in countries and nations the most anxious.

During the "hard times" of recessions, companies shut down, and individuals have greater difficulties to pay off their debt, to meet contractual obligations and to keep the same lifestyle and choices without reviewing it for the costs they represent.

But it is during times of crisis that some people take actions contrary to the ones the majority takes. It can be stated too that most people think of regular financial decisions in a "short term mentality", living a lot of times in a "paycheck to paycheck" way of spending what their salary pays and not saving anything or almost anything in their bank accounts. But even for the ones that save, the ones that are more cautious and sacrifice the short term comfort for later, their rewards for waiting are at risk, not because of their responsible actions but because of external human factors perpetrated by the ones that gather enough power to make decisions that affect all of our lives, from the way transactions are made between two different parties, to the value that money has when being used for its reserve of value purpose.

Having stated this, the inherent problem that motivates this research is the recognition that the difficulties that transaction fees, barriers, taxation, regulation and inflation create might already have a solution or more, not a conventional one perhaps and not necessarily mutually exclusive to the system already in place, but this is an exploration of what alternatives already exist and how can they be the answer for present and future problems, more specifically, "Saving our Savings" is a direct call for the greater and greater need for assets to be considered as reserves of value, no one, not even the richest bank accounts or the oldest financial institutions are exempt from the fluid nature of what is considered valuable and useful throughout time and space in human society, and what we take for granted today can in the future become disposable and useless.

Always taking in consideration the subjectivity of the value people give to things, it seems that for many decades, companies and individuals forgot that the value and utility of the dollar, the euro and other fiat currencies around the world rests in two main pillars: 1. The confidence in the institutions that safeguard the emission of the currency have from the public; 2. The mandatory nature that fiat currencies have, always backed by the forced circulation subscribed by the law makers and the state run institutions.

As seen by many examples of governments around the world, confidence in the institutions can be shattered very easily and very quickly, it takes irresponsible public policy not many years to downplay a once strong economic tissue in a country and sometimes, not even because of specific government policy, economies of the most varied geography and characteristics can be largely affected by the inner economic cycles that are present in the nature of the economic system itself, contemplating a better or worst scenario dependent on the type of reaction each specific country has towards it.

Independently from what causes these crises and these cycles to happen, there is no colder reality than the one that small/medium companies and "average" individuals are the ones that are most affected. In order to depend on themselves and keep the value of their production and efforts, monetary alternatives play a big role on defining what loses value in times of trouble.

What are the mechanisms to avoid the fluidity of state developed "solutions" to economic downturn? What are the alternatives to fiat currencies? Can past experiences and assets used before fiat currency in some way make a comeback? Or can modern technologies provide a new paradigm of options for companies and individuals?

The objectives for this thesis are to make a clear and straightforward analysis of these types of questions and to provide, with solid arguments, a perspective of what can be done by the ones most affected by the inner dangers of storing wealth in the mainstream fiat currencies and to more easily transact that same wealth easily.

The study will begin with a literature review starting with more general and macro-economic concerns of monetary policy and the way it has been regarded by previous studies and authors. From then on, it will become more and more focused on the specific solutions that can be provided and how they are regarded in the academic world, starting to implement the idea of precious metals and cryptocurrencies for the solutions proposed.

Then, the research design and the hypothesis for the study and the methodology that is going to be used are going to introduce the next and most important part of the document, the data presentation and discussion of the results.

Finally, after all has been taken in consideration and analyzed, a summary regarding the conclusions that I've arrived at and the recommendations and limitations that the study has, proposing at the end what can and could be done for future studies regarding the same or similar topics.

## 2. Literature Review

The banking system did not change profoundly with the financial crisis of 2008, despite the increasing attention that the institutions and the most varied banking corporations got with the scandals and the alleged corruption cases at that time, a lot of more regulations were put in place but the attitudes of the banks and even the attitudes of the fiscal authorities weren´t extensively modified (Viorica, 2013).

The way the "extra-regulation" is put in place and to what extent it works is still an open debate, but historically, mainstream financial institutions have been able to "play the game by the rules" at their favor (Rothbard, 1983), eliminating competitors along the way and seizing greater portions of the market available as well as expanding that same market into wider frontiers as it has been happening in the past decades. Contrary to popular belief, the banking sector is heavily regulated and at least since the industrial revolution and the end of the 18th century, the tendency has been for the greater and larger centralization of the system and the incorporation of it in the hands of central banks and political and economic central planners (Rothbard, 1963). Because of that same centralization, the major tendency for cartelization and the cooperation between government policy and the major players in banking, consumers are the ones that get the least benefits from the system. Monopolies never help the consumer (Rothbard, 1983).

In this trend of centralization, we can define a variety of very important moments that have been building momentum until our present day, one of the most notorious examples of this scenario was the Nixon drop off of the gold standard in 1971 (Rothbard, 1983).

Keeping it short, the gold standard is the direct link between the currency being put in circulation by the central bank and the reserves of gold that that same bank has in its reserves. The price of conversion is kept fixed by the authorities and the incentives to keep the currency or exchanging it for gold plays out its part in the rest of the market. This system acts as a limitation for the expansion of public spending and, normally therefore, as a limitation to the public debt being increased repeatedly. Because the amount of gold in reserves is more stable and difficult to increase, the system defaults to a more controlled way of spending that same money (Rothbard, 1983) and that is why during times of policy instability like it happened during World War I, the Gold standard is "temporarily suspended" in order for the states to increase their spending and overall debt (Bernstein, 2000) to satisfy their new extreme needs of funding the new effort.

In a context where the gold standard ceases to exist, like has occurred from 1971 on under the Nixon administration, the major economic policy instrument, public spending, can shift

substantially, using the same instruments of taxation and debt, the first loses importance when compared to the latter to finance public spending. As seen from the 70's on, the tendency has been for the rapid expansion of public spending and for public debt, reaching levels above 100% of GDP in a large amount of countries in the past twenty years and as the gradual tendency for this increase was being laid down since the past forty to fifty years (Rothbard, 1983).

In general terms, understanding these first concepts and relations between the restraints lifted from the central banks' capacity for the issuance of money and the consequences it has on the public sphere way of operating its finances and investments is a "straightforward" economic group of concepts and explanations (Rusakova, Saychenko, 2016).

A more complex debate nonetheless starts to erupt from this simple analysis of macro-economic factors. But why would this matter for the small business owner? Why would public spending and the issuance of money influence in some way the lives of private citizens or medium-sized companies? The answer is not that simple anymore, but in a large scale, the way the issuance of money operates influences a lot the shape and form of the banking system. That same banking system, from the way it gives credit to the way it rewards savings in the form of interest to its depositors and other characteristics of it, will later influence the way the society in general acts economically (Donaldson at all, 2019).

This reality can be seen when following the differentiation between two types of projects that need capital to be invested, what can be called "traditional projects" and "innovative projects" (Donaldson et al, 2019).

The two of them are options that an entrepreneur might have when starting a new venture, "traditional" here represents businesses and business ideas that have already been tested repeatedly, things like restaurants, bars, shops, etc. It is perceived as a type of business that is not "disruptive", in the sense that those are a lot of times, models that are established as entrepreneurial ventures (with a higher personal risk because of it when comparing to working for somebody else), but when comparing with the innovative type of business, the "traditional" ones are much less riskier.

This is a fact because of the nature of the second entrepreneurial venture, the innovative type is associated to the "new", to the type of innovation that is labeled as a "game changer" or in some form or another, has characteristics and lines that present themselves as never have been tested before, not necessarily "reinventing the wheel", but in some form representing some advancement in the knowledge acquired prior (Donaldson et al, 2019).

The objective of "breaking it down" in these two groups is to understand how the banking system influences the way businesses and entrepreneurial ventures are financed and how the base of the system can influence the base of the hundreds of companies present in the economy.

In the economic reality of starting a business, whether it is a traditional or an innovative one, there are only two ways of gathering capital to finance it, either the person/group of people taking the venture have their own capital to finance it, or they need to get in debt or in some form of commitment where outside investors might get some participation in the company or benefits from its future possibility of success. Most commonly than not, asking for credit is the option to start a business, and this is where the distinction between traditional and innovative stand out the most (Donaldson at all, 2019).

Because of the lower cost of capital that banking institutions have when compared to non-banking institutions that finance entrepreneurs (venture capitalists are one of these examples), they normally have a bias and a preference by default to make capital available to traditional ventures.

The cost of capital of each institution appears to naturally influence the type of project that the owner of the capital finances. In the case of non-banking institutions, granting credit appears to be a higher risk model, being stricter in the way they make capital available and because of it, more aware of the decisions the entrepreneur makes as well as demanding more from him in return.

Obviously, the disadvantage of this scenario is the first to take our attention, providers of capital that want more from the people they finance, make the receiver of the credit more dependent and more open to stricter rules made by the provider. Higher interest when paying back that capital and less "margin of error" from the part of the entrepreneur.

But the advantages must be taken in account too, especially with the fact that higher demands from the creditors make the project owner more disciplined and more invested in the project itself, making him a more resilient entrepreneur and as a consequence, a generally more efficient and meticulous decision maker along the process of polishing and upgrading its own skills needed for the business and the project itself (Donaldson at all, 2019).

 It is in this regard that we can acknowledge that the issuance of money and the pillars of it in the core of the economic system and the type of government established can influence almost the whole of the banking system in practice. Because of it, the way businesses and individuals get access to a large amount of their needed financing process defines the way most of the companies will work in the globalized economy.

Without changing the fact that the fiat currency is the preferred type of currency all over Europe and all over the world (Viorica, 2013), differences from country to country are a reality not to be ignored. The best example of it is the way Great Britain regulates its banking system in comparison to a lot of states around Continental Europe, some of them even having state run commercial banks in the market itself as we see in Portugal to this day (Viorica, 2013).

Once established the connections and links between the core of the system and the "waves" it produces until it reaches the credit and financing market in general, it must be explored the way some of the main principles in fiat currency might denigrate and make it harder for entrepreneurs and common citizens to invest, to make their transactions more efficient and to store some of their wealth in safer alternatives.

It is well established in the economic debate themes like inflation.

Before, the concept of inflation was merely "the increase in the supply of money and credit" or "the increase in the amount of currency in circulation" (Hazlitt, 1964). It is curious how over time this general definition has been simplified to simply "the generalized rise of prices of goods and services", giving no direct link between the role of the central bank and its emission of national/transnational currency and the consequences it has on prices, overtime, the definition established turned the attention off from the issuance of money to merely describe the economic situation when the prices overall rose, stating no specific reason for it to happen. This deflection of attention is a clear expression of the way people used to intertwine the role of government and its consequences on the general prices of goods. With the new definition taken forward, that connection is not so clear, besides the fact that paper money has a greater tendency to inflate now when comparing to the times when the dollar was still linked to the gold reserves (Rothbard, 1983).

Knowing how harsh inflation can be for the savings of an economy (Greaves, 2010), there is even other "elephant in the room" to be discussed when looking at the banking system and its fiat currency pillars: transaction costs, transaction processing speed and supervision from central power over them.

The difficulties regarding migrant populations in developed countries when trying to send money over to their countries of origin is well known. Besides the worrisome time commercial banks take to conclude these types of transactions, the fees applied by those same banks and the taxation that takes place by the states where money is being transitioned is a massive burden, sometimes taking a total of 17% of the money send just to arrive at its desired destination (Dierksmeir and Steele, 2016).

It is in this context that alternatives arise, for the problem at hand, two main alternatives take place in the debate, precious metals on one side, being viewed as "already tested alternatives" because of the historical weight that these types of materials bring with them, being used throughout a lot of centuries in the most varied societies (Fan et all, 2014) and cryptocurrencies, the "new wave" of alternative money, also called altcoins because of their disruptive nature within the mindset of the modern banking system and fiat money printing established. Available to us because of the blockchain technology used for the first time with the creation of Bitcoin in 2008 (Luther, 2015).

Starting with the former, the case for precious metals presented against fiat currency is sometimes driven specifically for "the case of gold against fiat currency". Being the most popular of all precious metals and previously holding currencies from central banks accountable, the so called "historical argument" is one that aims for the stability and reliability of gold and precious metals throughout their existence and most importantly, during periods of turmoil like economic and financial crisis, being already tested for millennia and still being massively used today due to its unique characteristics (Rothbard,1963).

The "stability argument" is normally associated to the reaction of gold specifically in this case because of its resilience and strength in keeping prices with the initial impact that economic downturn as on unemployment rates, GDP growth and other important variables in the economic constitution of nations and countries. Regarding the phase that comes next, what we can call "the medium term price of gold", during economic downturn it appears to have a general tendency for its appreciation and increase in value when compared to the fiat currencies that are bought and sold with it and prices of other products, normally the so called "complex products" like cars and houses, show the opposite trend when compared to the one expressed by gold (Rusakova and Saychenko, 2016).

The "guarantee of value" that gold and other precious metals provide is one that even without a gold standard of the dollar is still praised on the regular markets of buying and selling gold as any other commodity or product, being regarded as more trustful when comparing it to fiat currency because of its limited nature of quantity in circulation and its durability/easiness at storage and more trustful when compared to cryptocurrency because it maintains the physical characteristics the people got used to on physical coins and paper money, being widely accepted in the minds of the people that precious metals are to be trusted as a currency or as some form of storing wealth, becoming since the dawn of time a symbol of wealth and status preserved until the generations of the second half of the 20th century and 21st besides the fact that their

coins and paper money were no longer made of gold or redeemable directly at the bank (Fan et all, 2014).

Hypothesizing about the future, in the case of a general loss of perceived value from the public towards the established currencies with the enforcement of the state and centralized authority, gold and complementarily other precious metals like silver would certainly be there to "fill the void" and become once more the hegemonic acceptance mechanisms for trade and wealth storage (Rusakova and Saychenko, 2016). The case can even be argued that it is not the case now simply because fiat currency has the advantage of being written down into law in the form of mandatory circulation, making it harder for non-mandatory possible currencies to proliferate as such in society (Rothbard, 1983).

Next, and without going in deep to the nature of cryptocurrency, it must be stated that it is a type of currency that was born out of the decentralized blockchain technology that makes transactions possible by the network created as a consequence of the contact made between holders of cryptocurrency used without any centralized authority dictating the "rules of the currency", or the quantity of that currency issued (Catalini and Gans, 2020). This is one of the main characteristics that attract fundamental value investors, because of the way it "plays the game by different rules", in its core, by a parallel scenario outside of the regulatory agencies' supervision.

By default, it is an innovation that can be of great use for individual citizens and companies, being able to transact anonymously and with the exemption of government taxes and regulations as well as without the fees and processes of validation that banks and financial institutions normally apply, it is a technology and a type of currency created as a consequence of the "democratization" that the Internet brought to our lives. Firstly, on an information and entertainment basis, but now transitioning to the monetary use and currency development as well (Dierksmeir and Steele, 2016).

Besides the opportunity, cryptocurrencies have existed for at least a decade and its adoption is still far from what we can call "generalized", for now at least, the adoption of crypto has been restricted to a fringe of people with intentions that normally are unknown because of the anonymity that the technology provides (Al-Amari et all, 2018), more than that obstacle for research, it is still possible to induce what are some of the main purposes of adoption of crypto while it is not generally accepted, mainly based on the tax benefits it might provide for companies or the possibility of avoiding fees for international transactions, it can be stated that to facilitate the creation of a borderless money transaction across the globe was one of the main purposes of crypto (Nakamoto, 2008).

Nonetheless, there is a large portion of the people who study and investigate cryptocurrencies that accuse it of being a pyramid scheme or some sort of speculation mechanism for short term profitability (Dierksmeir and Steele, 2016). In the core of the discussion, it is still needed to figure out if cryptocurrencies satisfy the main characteristics that money must have to be considered "successful in its task", that is after all where conclusions can be drawn about it.

Unfortunately, for the exploration of this theme and the cryptocurrency concept, it is Bitcoin that normally is analyzed while ignoring most of the others that are already in existence and present in major crypto markets, probably because of its "premium exposure" and attention given for being the first and consequently the most popular to come into existence. One criticism that is directly aimed at the literature and the way it builds itself, it has already been studied multiple times the way Bitcoin employs in it what we can call "the fundamental characteristics of money to be considered money" (Kirby, 2018), of which three are the most important and thereby discussed: 1 – Reserve of Value; 2 – Transaction Properties; 3 –Unit of measure.

It is clear that as a unit of measure, Bitcoin has no real problems, just like dollars and euros are divided into cents, Bitcoin is divided in satoshis and any amount can be traded, but as a reserve of value, Bitcoin´s value and subsequent translation into price should be much more stable than it currently is and in what regards its transaction properties, in the scale that Bitcoin is already at the fees and the transaction timings are getting worst and worst (Whirty, 2018).

Nonetheless, it can be argued that this first cryptocurrency, its problems and limitations notwithstanding, has been "paving the way" for other cryptos with better "money characteristics" (Tomkies et all, 2019), but this is a process that has been taking years to establish itself as mainstream and cannot be seen as so at least in the present.

Right now, what can be argued is that there is a possibility for the mainstream adoption of crypto if we look at what is needed for that adoption, some cryptocurrencies are already established in specific markets because they are designed with specific characteristics for that use (Eibner et all, 2018), that is a small but good sign for the future of cryptos. From another perspective, not mutually exclusive from the previous, is the use that the blockchain can have in other economic utilities and non-economic contexts like the ones regarding data storage or other financial and management advantages of adoption (Ruoti et all, 2020).

But it would be naive to think that just because a lot of the motivations for adoption of crypto are intertwined with the concern of avoiding taxes and regulations prompted by the state, that the state would have no role to play in the possible adoption of it for the generality of people

in society, after all, the state plays an enormous role in the reasons for adoption of fiat currency (Lansky, 2018) and the reasons for the abandonment of precious metals in the common life of its citizens.

Instead of looking at the state as an entity that cannot adapt to new paradigms in society, we can see that the state does not act in a single universal way when challenged by innovations, such as cryptocurrencies, to the powers that be. It can be said that in the case of cryptocurrencies, the reaction of the state will be a lot more interesting because of how much the technology puts in check, it might even be argued that extreme reactions and policies made by government authorities can be counterproductive even for the keeping of its own structures while stating at the same time that the most diverse strategies have been put in place already, from ignoring the crypto market as a whole to implementing moderate regulation on the exchanges that allow this type of market to exist in a larger scale (Nabilou, 2020).

It is in the basis for the regulation or state intervention in the crypto market that a lot of moral and ethical reasons, in the perspective of many, issues that are still not satisfied and settled in what regards the uses that cryptocurrencies and the reasons why they are adopted by some. From possibly financing terrorist activities to tax evasion and money laundering schemes, a lot of regulators and state officials are now paying more and more attention to crypto users and the motivations they have to be involved in this growing market (Lovell, 2019).

 After all, the presence of the state and its perspective towards new incoming currencies besides its own is very important for the general acceptance of those new commers. The majority of people, consciously or unconsciously have a tendency to trust "government guarantees" and so there is a conclusion that might be drawn for the general adoption of cryptocurrencies as the new accepted method of payment and reserve of value for the generality of members in society in the future, or the government endorses cryptocurrencies as legitimate money or the economic situation in a country becomes one of hyperinflation, incentivizing people to search for alternatives to fiat currency as a whole regardless (Luther, 2016).

Good examples of these situations are the way various currencies were adopted throughout history, being very important the way kings and government leaders started adopting certain currencies because they started becoming popular amongst the populous or vice-versa, endorsing a certain currency from their part being a very efficient way of giving it legitimacy amongst the public as a consequence. Other situation possible is the already mentioned hyperinflation economy like in the case of Venezuela and their overprinting of national currency into circulation. For that case, the government already lost a lot of its legitimacy to the point where it doesn´t matter what is the official currency endorsed by it, all that matters is

that the population wants to survive and so they search for currency alternatives to the national one (Luther, 2015).

Overall, these are the reasons that motivate people to adopt new currencies, besides the possibly better alternatives that already exist in precious metals and in cryptocurrencies, even in mixes between those two in the form of cryptocurrencies backed by other assets (like gold, for example) (Belke and Volz, 2015), the state, like it or not is still today not just only a monopoly of the use of force to implement the law but a mechanism and a whole structure of legitimacy in the eyes of the public and that can be confirmed in the way the gold standard was abandoned or when legal reserves of banks are altered, state intervention adapts itself too and that adaptation will be very important for the future use of "alternative money" in a more traditional sense of the revitalization of precious metals as currency or the more futuristic and technologically advanced cryptocurrency model (Vieira, 2015). After all, if it is not the legal support of the state that makes these alternatives viable, it must be the economic burden of hyperinflation (Luther, 2015).

### 3. Research Design and Hypothesis

Because of the nature of the research and the organization selected, the chosen hypothesis for testing are divided into two different sets, first the ones aimed at analyzing the stability of the currencies under analysis, (the "statistical analysis" and then, the hypothesis for qualitative analysis, aimed at the characteristics and functionalities of each currency.

### 3.1 Statistical/Stability Hypothesis:

As already established in the literature review, when comparing gold and bitcoin it is clear which of those two is the most stable (Fan et all, 2014). It is not as granted what conclusions can be achieved when translating this comparison to other precious metals and other cryptocurrencies, but we may say that there is a tendency for the rest of the paradigm to be the same, despite differences in prices and popularity of precious metals, these might fall into the same tendencies with their peers and cryptocurrencies might follow the same ones as bitcoin. With this said:

H1 – Precious metals are more stable than cryptocurrencies overall.

In this sequence, I risk affirming that:

H1.1 – The most unstable precious metal is more stable than the most stable cryptocurrency under analysis.

From the three precious metals taken in account, the question to which is the most stable can be asked. Based upon the fact that gold is the most popular and the precious metal with the higher market cap and so the higher value in circulation in the market, I propose:

H2 – Gold is the most stable precious metal.

Therefore:

H2.1 – Gold is the most stable currency.

If bitcoin is established as a more volatile alternative in comparison to gold, it can even be argued that the popularity and exposure of bitcoin made it the cryptocurrency with the higher market cap. Nonetheless, this status might work on the inverse direction of the same argument made for precious metals.

Because precious metals have been used as currency for millennia, their stability might be linked to different variables, but one thing is certain, instant public exposure and media attention to an asset or product, when related to high valorization and high profitability driven out of it, makes that same asset grow even more in price. Imagining a scenario where bitcoin is stable is very difficult.

So, I propose:

H3 – Bitcoin is not the most stable among cryptocurrencies.

### 3.2 Qualitative/Characteristics Hypothesis

When comparing the precious metals under analysis, the value and price of gold are the highest among them because of its comparative scarcity and historically it was very useful throughout the ages because of its malleability and easy transformation into bars of gold, into artifacts and into coins (Bernstein, 2000). In our days, because of the technology advancements, gold preserves a lot of its value because of its scarcity, but not just that:

H4 – Gold has the best characteristics as a currency in comparison to other precious metals.

Besides that, it still must be argued that cryptocurrencies, being a very recent and innovative type of currency made out of the age of the internet and with a core nature that is favorable for its transactions in comparison to precious metals and other "physical currencies", I arrive at:

H5 – One of the cryptocurrencies in analysis is the currency with the best characteristics overall.

### 3.3 Final/Conclusion Hypothesis

Because of the stability of precious metals and especially gold and the speculation that cryptocurrency characteristics will prevail as a winning factor for the future, I hypothesize that:

H6 – In the long-term, cryptocurrencies will overthrow precious metals.

## 4. Methodology

### 4.1 Data

All the data regarding precious metals for the analysis are from commodity futures trading. Because futures prices are strictly linked to the price of those same precious metals on the spot market but most of the market trading of these products is in this format, it was decided that it would be coherent to use futures prices.

Cryptocurrencies are selected from major exchanges in the market, in this case Coinbase and Binance, but all the data was collected from the Investing.com website, including the futures of Gold, Silver and Platinum.

It is important to state that the criteria for the selection of cryptocurrencies has been based upon the assumption that the ones that are relevant for the study are the ones that directly fulfill the "currency characteristics" only, or the ones that propose themselves to do it.

Cryptocurrencies that do much more than that were not selected. Ethereum and Stellar Lumens for example, were considered extensively, but because they propose themselves to do much more than simply the characteristics of traditional money like the use of innovations along the lines of "smart contracts" or the use of a wider open source platform to facilitate the development of new programming technology, in order to avoid comparisons and misguided analysis by comparing currencies that fulfill different purposes, those same cryptocurrencies that go beyond "the utility of money" were all dismissed from the study.

Restricting ourselves to cryptocurrencies with the exclusive intent of trying to overthrow the use of fiat currency and precious metals the following cryptocurrencies were selected for analysis:

- Bitcoin
- Nano
- Litecoin
- Monero
- Dash
- Zcash
- Bitcoin Cash
- Bitcoin SV

All of them different from each other in the way they operate, but all of them with structures and ways of functioning that only aim at delivering the following characteristics:

1 – Scarcity;

2 – Durability;

3 – Portability;

4 – Divisibility;

5 – Fungibility;

6 – Concealability.

Scarcity – Facing unlimited necessities, scarcity is the economic reality that the means used to achieve the satisfaction of those same necessities are limited;

Durability – Is the ability of a product to remain functional, without requiring excessive maintenance or repair, when faced with the challenges of normal operation over its design lifetime. The more it lasts without profound changes in its composition, the more durable a product is;

Portability – The capacity to move a product from one place to another. The easier it is to move it, the more portable a product is;

Divisibility – It is possible to divide into smaller units of value in order to facilitate transactions and mathematical counting it properly;

Fungibility – One unit is viewed as interchangeable with another, providing no loss of value if changed after transactions in the economy in multiple occasions;

Concealability – The capacity of withdraw or remove from observation, cover or keep out of sight in order to keep privacy and avoiding being at risk for the store of value in the form of currency.

These are the characteristics that precious metals in the past and fiat currencies in the present are supposed to have in order to be adopted and considered as money in and overall society and all the cryptocurrencies selected do try to have these same characteristics achieved, besides the fact that they try it through blockchain technology in a lot of different ways.

### 4.2 Sample Size and Time Span of the Data

To gather enough resources for the analysis, a 2-year time span was selected, translating into a total of 104 weeks to draw conclusions out of it for 3 different precious metals and eight different cryptocurrencies each.

Regarding the beginning and end date for the collection, the week of the 26th of November of 2018 was selected and two years forward we arrive at the respectively week of the 26th of November of 2020. The weeks that mark the beginning and end of this period start respectively in the 2nd of December of 2018 and the 22nd of November of 2020.
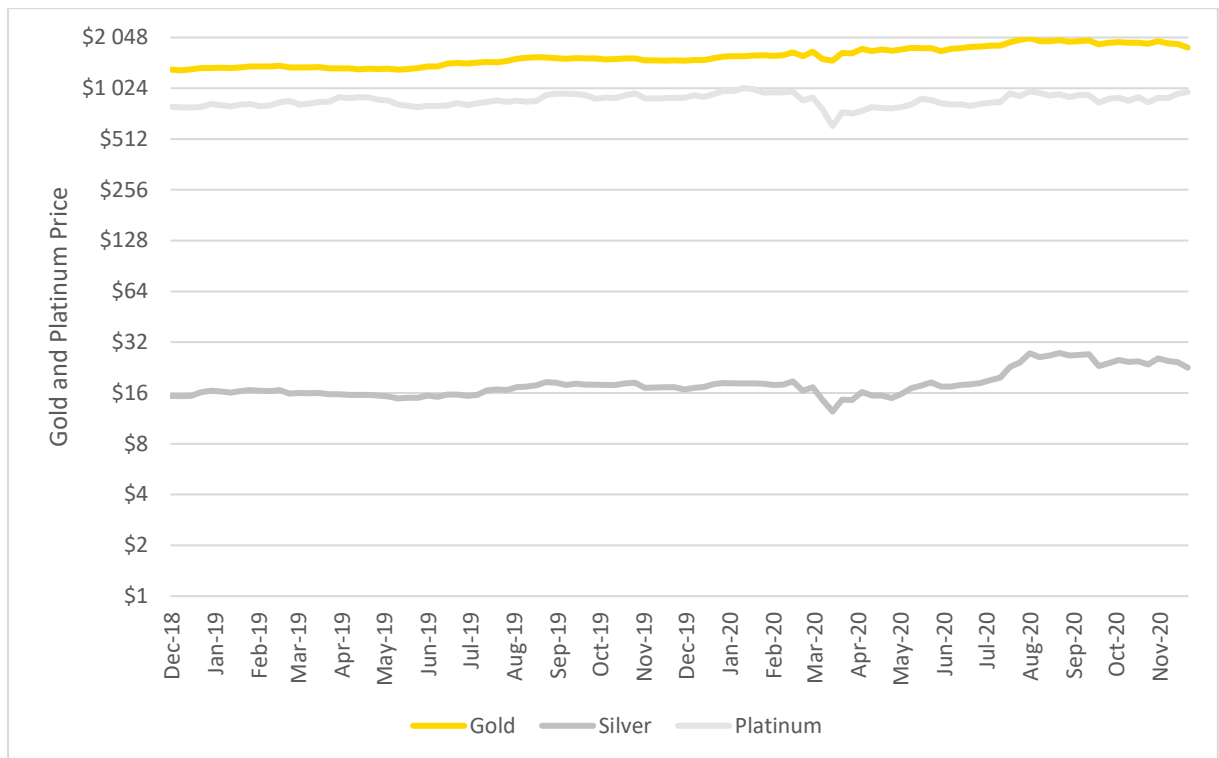
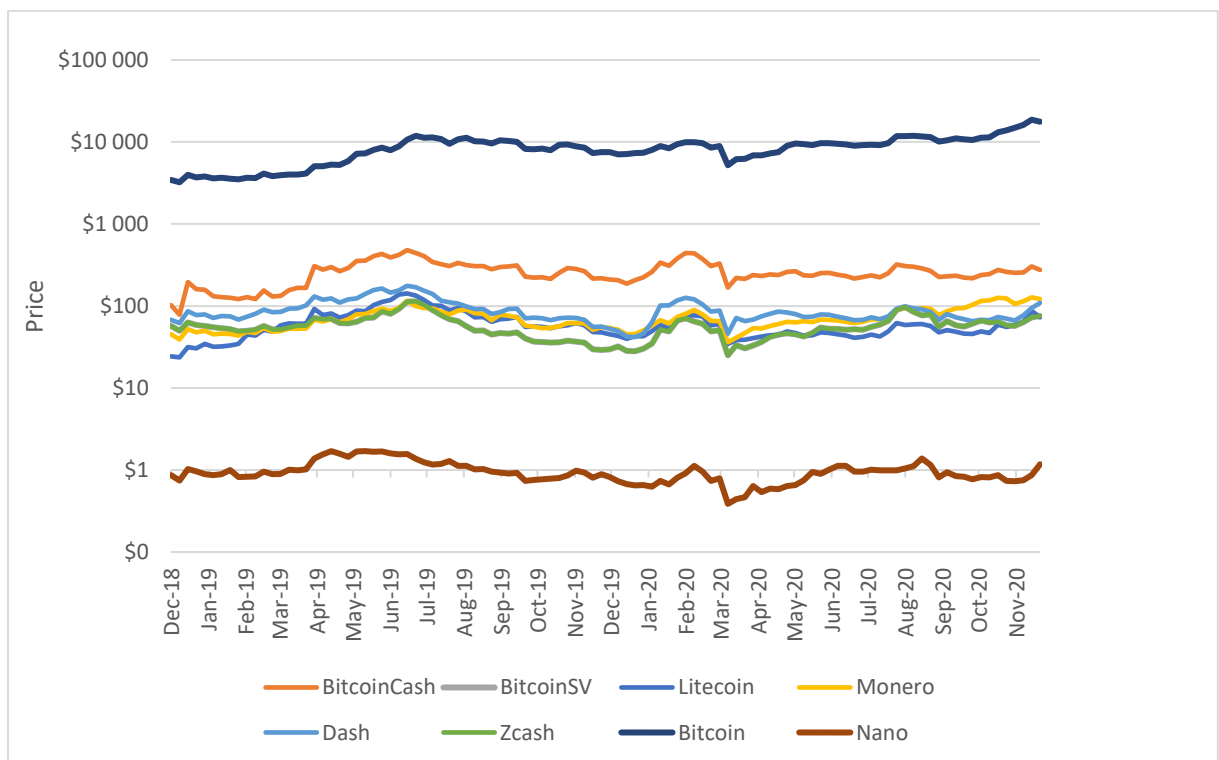Figure 4.1 Precious Metals Prices



Figure 4.2 Cryptocurrency Prices

## 5. Analysis and Discussion of Results

### 5.1 Statistical analysis

In the data set of 104 weeks analyzed, what can be found is that all the possible currencies have normal or approximately normal distributions and so, the values presented by the excess of kurtosis become relevant for the drawing of conclusions.

Because the analysis is made with the "excess of kurtosis" and not simply the kurtosis itself, the reference we have for the normal distribution is not a value of 3 but of 0.

From the regular analysis of normal distributions, interpreting the value of the kurtosis (or excess of it) tells us about the distribution between extreme cases and the ones closer to the mean. Besides the kurtosis analysis, the skewness analysis is important too.

Skewness should be interpreted as a metric that tells us about the position the outlier values occupy in the distribution, generally above the average or bellow it, respectively with positive or negative values.

In the case of currencies or possible assets that might become currencies, having the tail of the distribution on the left side (negative skewness) means that the extreme values, the ones that are further from the mean, are bellow that same mean.

It is preferable for a currency to have the most stable value possible, but in the case that stability is not achieved, or at least not in a generalized manner, it would be better to have a positive value for the skewness, in order to have the extreme values and outliers on the higher end of the distribution. If something, the person holding that type of currency or asset would increase the value of its own wealth, because it is stored in that specific above the average scenario.

In this context, from the precious metals, only gold presents a lack of kurtosis with a value of -1,04, representing the most platykurtic distribution in all the analysis.
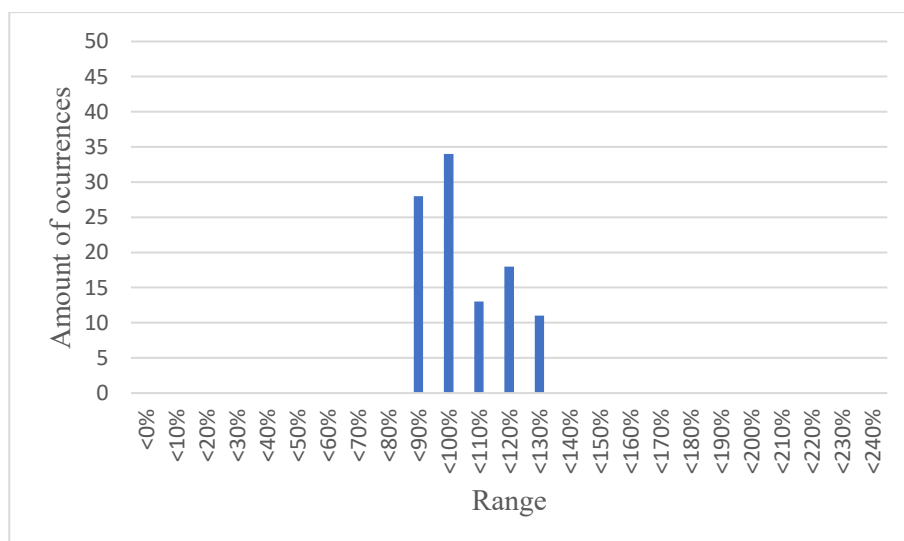


Figure 5.1 Gold Futures Prices (average = 100%)

From the group of cryptocurrencies, only 2 of them have the same "flatter" distribution, but not so well expressed as the one presented with gold, being Bitcoin SV with an excess kurtosis of -0,13 and Monero with a value of -0,08, both of them, and specially Monero, coming very close to the level of excess kurtosis of the idealized normal distribution.
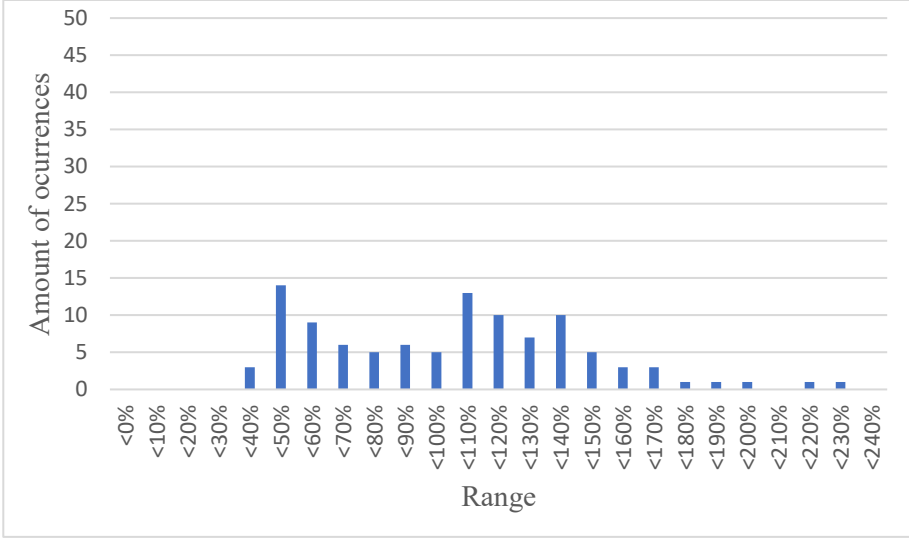


Figure 5.2 BitcoinSV Prices (average = 100%)
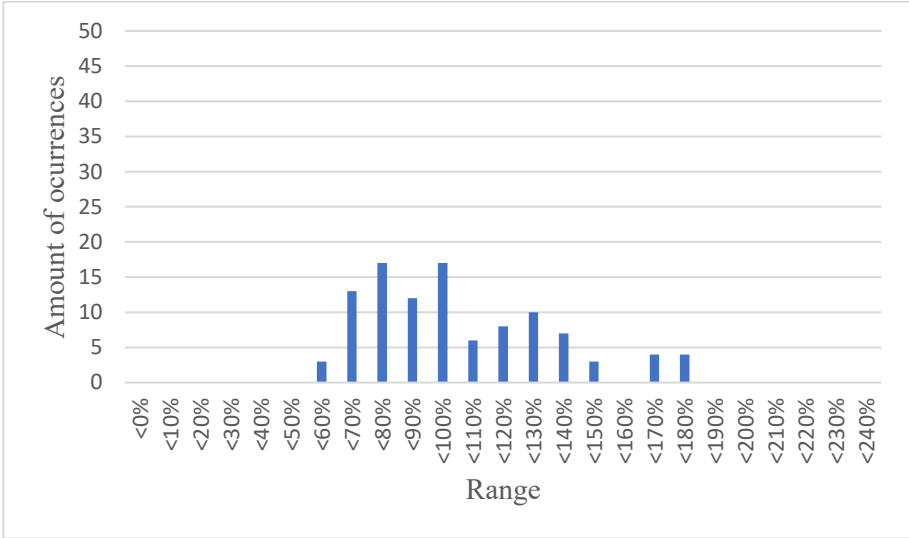


Figure 5.3 Monero Prices (average = 100%)

For the rest of the possible currencies, the one that has the most well-expressed leptokurtic distribution is Litecoin, at a value of 2 of excess kurtosis and followed by Dash (1,17) and Zcash (1,02).
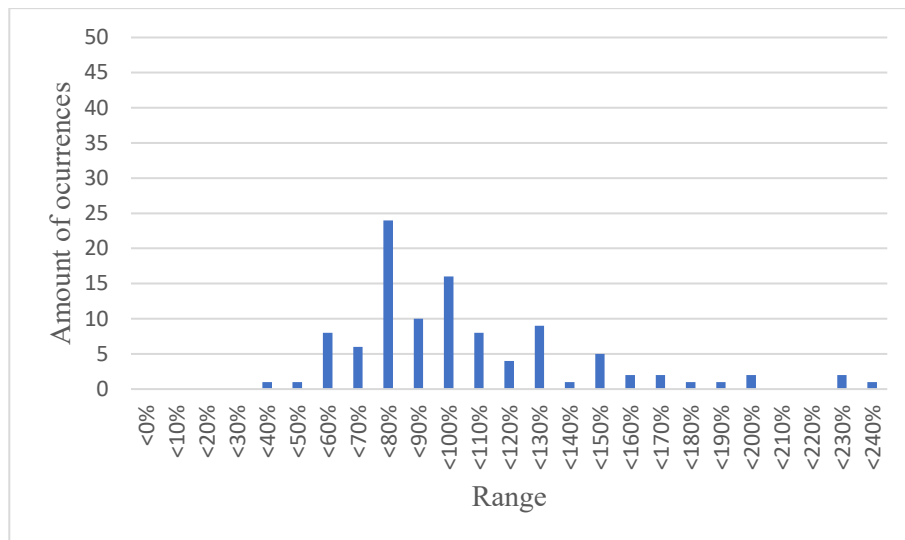
Figure 5.4 Litecoin Prices (average = 100%)
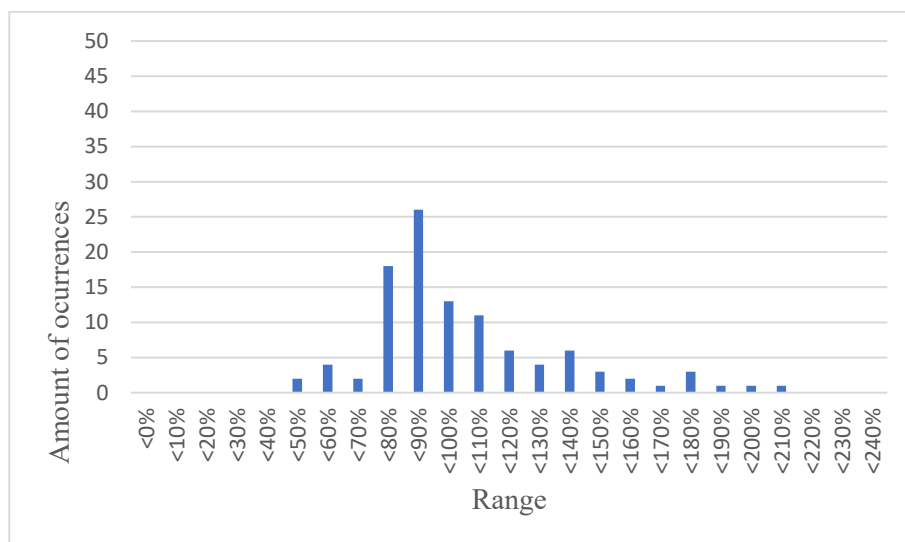


Figure 5.5 Dash Prices (average = 100%)
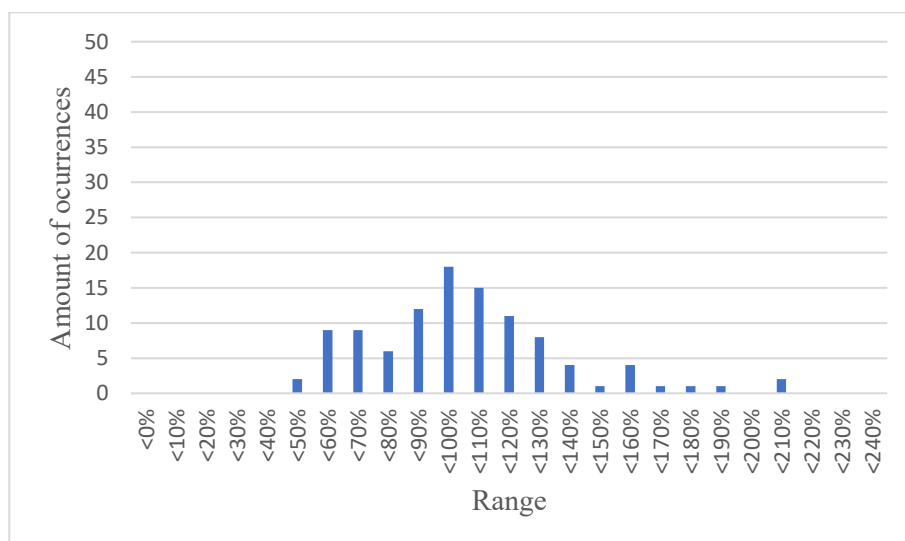


Figure 5.6 Zcash Prices (average = 100%)

Curiously, Silver presents a higher level of excess Kurtosis of 0,8 than Bitcoin (0,79), being followed by Platinum at 0,69 and Nano at 0,62 to the closer to 0, Bitcoin Cash at 0,17.
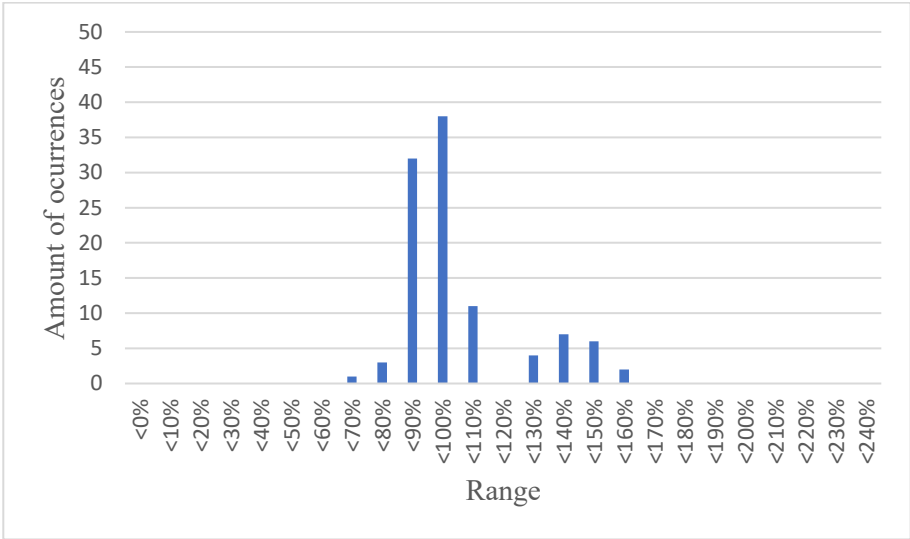


Figure 5.7 Silver Futures Prices (average = 100%)
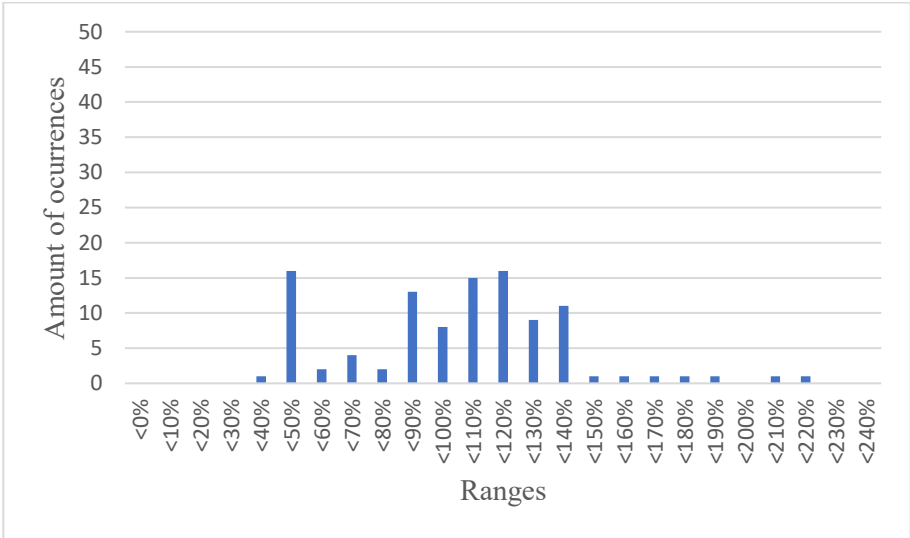


Figure 5.8 Bitcoin Prices (average = 100%)
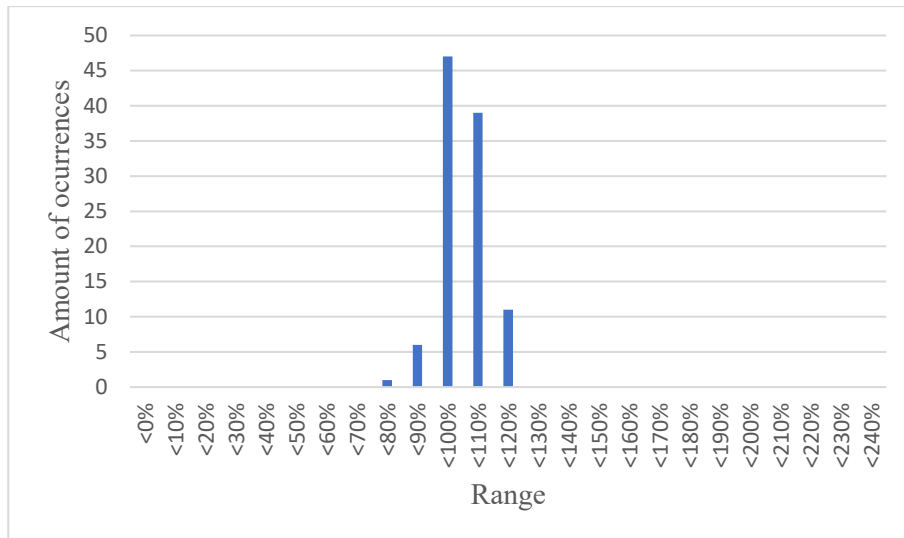
Figure 5.9 Platinum Futures Prices (average = 100%)
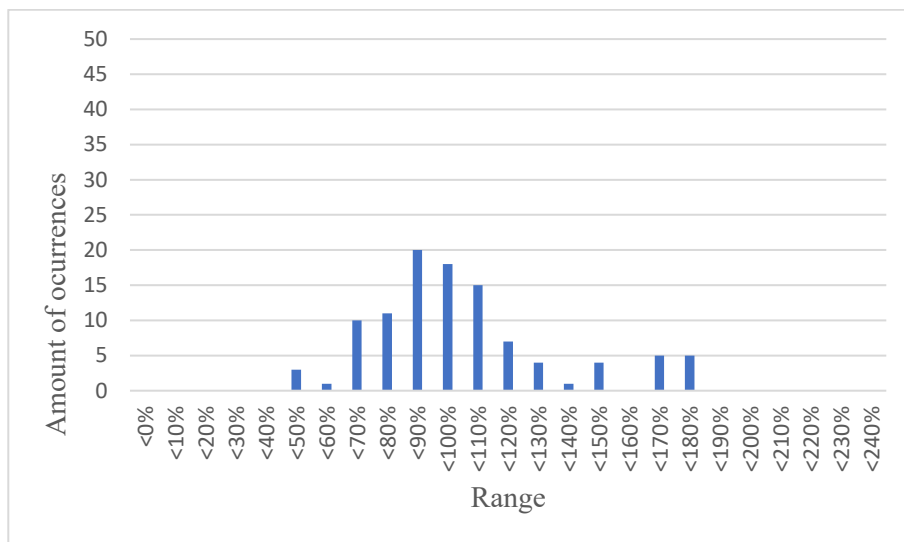


Figure 5.10 Nano Prices (average = 100%)
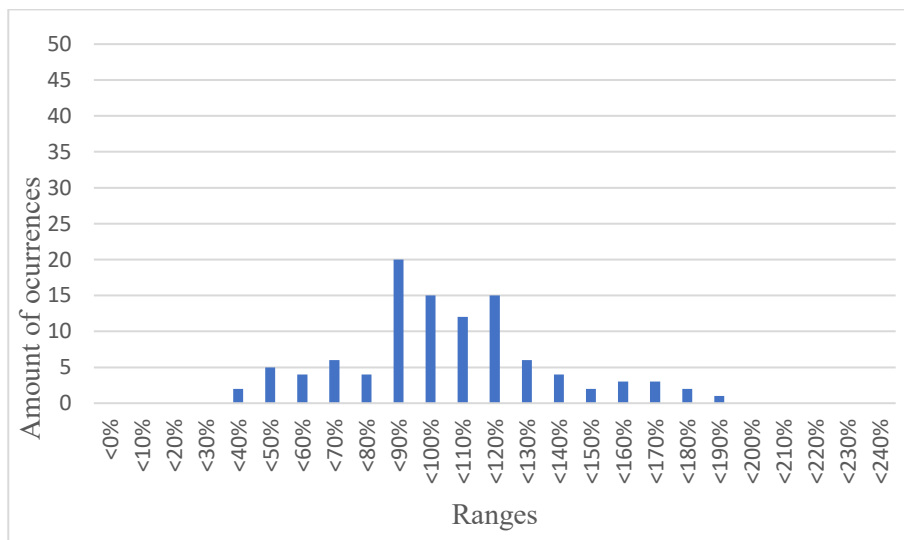


Figure 5.11 Bitcoin Cash Prices (average = 100%)

Considering that normal distributions with a leptokurtic type of variant present "larger tails" and so, more extreme values in their distribution, gold is clearly the asset that presents the greatest stability with this very important part of the study, specifically because it is precisely the opposite, a platykurtic distribution which has a "fatter distribution" and so, one with much less extreme values for its past prices over the two year gap studied.

If the analysis started from some years earlier with the cryptocurrencies that already existed at that time, the distributions of these currencies would probably be a lot more leptokurtic. After some time of existence, it is interesting the way that some of them have such close values to 0, the reference of excess kurtosis for the perfect normal distribution.

Besides that, precious metals, regarded has more stable and with less extreme values in the general populous mind and in the literature are not represented in this way with the data for this specific occasion.

Gold obviously stands out in this way, besides the fact that Silver and Platinum are leptokurtic and so have more extreme values even than some cryptocurrencies pointed out before.

Table 5.1 Excess Kurtosis Distribution

|  | Excess Kurtosis | Distribution |
|---|---|---|
| Bitcoin | 0,79 | Leptokurtic |
| Bitcoin Cash | 0,17 | Leptokurtic |
| Bitcoin SV | -0,13 | Platykurtic |
| Nano | 0,62 | Leptokurtic |
| Litecoin | 2,00 | Leptokurtic |
| Monero | -0,08 | Platykurtic |
| Dash | 1,17 | Leptokurtic |
| Zcash | 1,02 | Leptokurtic |
| Gold | -1,04 | Platykurtic |
| Silver | 0,80 | Leptokurtic |
| Platinum | 0,69 | Leptokurtic |

Commonly, the values or the skewness in finance representing different assets are positive and for the ones taken in consideration in this study, the tendency is the same with only Platinum futures having a negative value of -0,32, all the others present values above 0, which means that only Platinum has "the tail" of the distribution on the left side.

With this said, Platinum is the exception on the analysis and an exception that does not seem to distribute its various prices over the 2-year period in a good light because it has the

tendency to place its extremes in values below the mean. When fluctuating, the price of Platinum is the only one that when gets very far from the mean, has a negative tendency to it.

With the same logic, Silver futures prices are the ones with the most obvious tendency for extremes above the average values among the precious metals taken in account, having a skewness of 1,36 and only being surpassed by Litecoin with a skewness of 1,38, the cryptocurrency with the greatest tendency for extremes and for extremes on the above level of the mean represented in simultaneous. A very curious fact about this is that Litecoin, as a cryptocurrency project was and is regarded sometimes as the possible "Silver of Bitcoin", proposing itself to do the same as Bitcoin in its essence just like Silver satisfies the same type of need when complementing Gold in previous economies in the bimetallic currency system.

Dash with a skewness of 1,17 is the only other currency that has a higher value than 1 with Nano getting very close to that reference with 0,93.

Table 5.2 Distribution of Extremes

|             | Skewness | Side of the tail |
|-------------|----------|------------------|
| Bitcoin     | 0,38     | Right            |
| Bitcoin Cash | 0,35    | Right            |
| Bitcoin SV  | 0,45     | Right            |
| Nano        | 0,93     | Right            |
| Litecoin    | 1,38     | Right            |
| Monero      | 0,76     | Right            |
| Dash        | 1,17     | Right            |
| Zcash       | 0,81     | Right            |
| Gold        | 0,45     | Right            |
| Silver      | 1,36     | Right            |
| Platinum    | -0,32    | Left             |

No doubt that the excess kurtosis analysis and the skewness tell us about the past values in the market and how the distributions might mean that one of the assets taken into account is more or less suitable for it to be adopted as a currency, but besides stability and predictiveness asserted with these two ways of looking at the data gathered, the reserve of value property of an asset will be analyzed in one more way.

If wanting to guarantee that the people and companies that transact in a specific currency do not lose their wealth within the context of fluctuations in the economy in general, the next step taken is the correlation calculation in regard to the S&P 500 in order to know the correlation between the price of these proposed currencies in relation to the increases and decreases in the stock market, a major indicator for economic predictions and general economic welfare.

Starting with Gold futures, it is known that Gold is distinguished among many options as a "safe haven", one of the most recognized ways of resisting the fluctuations of the general economy and overall inflation, normally with the intention of resisting economic breakdown and depression too. It is known that Gold, normally shows a negative correlation near 0, because it has valuations normally stable or contrary to the ones that are presented within the stock markets and other assets. In this case, for the 2-year period, Gold futures have a correlation of 0,29, having an increase in its value when S&P 500 has it but at a lower rate.

Curiously, maybe due to the bull market frenzy of the last few years, Gold, because in this period was not subject to a context of a depression, might have behaved as another asset that respects the tendency of the other markets. If confronted with an economic downturn, it would probably have the same contrary tendency that it always has had previously.

Silver and Platinum, in this regard, show a tendency of almost equal correlation to the stock market, presenting values of 0,83 and 0,93 respectively, being considered as profitable assets due to the constant growth of the S&P 500 in the period taken in consideration. Because of the fluctuations in the American stock market, Silver and Platinum might not be the most efficient reserves of value.

But in relation to cryptocurrencies, there seems to be some alternative directions within them in relation to the stock market starting with Bitcoin Cash with a value of -066, Bitcoin SV with -0,4 and Dash with -0,16.

At least for the period analyzed, we can assert that there is a great variety in the way the prices of these various financial assets and/or proposed currencies act in relation to the stock market. This doesn´t mean that these specific currencies are the best to accomplish the condition of reserve of value with the correlation analysis only. Just because they correlate contrarily to the fluctuations of the stock market, it does not mean that they do that well regarding this fundamental characteristic or currencies to be adopted and be efficient.

At this point, quantitatively, all the three main focuses have been explored, the excess kurtosis analysis, the skewness analysis, and the correlation with the stock market analysis. From all of this, I draw the following aggregate:

With the 2-year period taken in consideration, Gold, as predicted initially and by most metrics of comparison in price stability like the attraction that its reputation commands, mainly based upon the fact that its distribution predominantly is almost exempt from having extreme values out of the norm or too much apart from the mean. After all, the platykurtic distribution is more favorable for a possible currency to be adopted since it translates into a more stable range of values. Besides the confirmation of the initial suspicions about the advantages of gold,

in the period studied, it did not reveal itself as a "contrary force" to the general economy represented in the stock market valuations, nonetheless, besides not having a negative correlation with it, it presented a value of close to 0 correlation in comparison to a lot of other possible currencies, being at least somewhat resistant to the fluctuations referenced.

On the other hand, Platinum showed itself as the most fallible commodity once it has a leptokurtic distribution for its prices, it is the only one that has a negative skewness value, which means that its extreme values tend to be occur below its mean and it has an almost perfect correlation with the variations in the stock market, which in practice makes of , not a reserve against the fluctuations of the economy, but one asset that values and devalues in a direct line with it.

Silver, having more extreme values than Platinum, has a greater tendency to have those extreme values above the mean, being the second currency in the analysis with the highest skewness. But, once more, in terms of reserve of value, the tendency to follow the S&P 500 fluctuations is very high with a value of 0,83.

Regarding cryptocurrencies, there is an interesting case to be made with Litecoin. In terms of its correlation with the stock market, there are no important conclusions that can be drawn besides the fact that it has a positive response in relation to it with a correlation coefficient of 0,33. The values of kurtosis and skewness on the other hand, for the case of Litecoin, it presents a lot of extreme values and a very positive value for the tendency for those extremes to be on the positive side. For a currency, the quantitative analysis does not support a very strong case for Litecoin as a currency of mass adoption.

In general terms, the quantitative analysis does not give us a clear alternative to the already established fiat currencies for the time-period taken in consideration, but a currency to be viewed further might be Bitcoin SV, which presents us with a platykurtic distribution and its extreme values are in its majority above the average. Yet, the negative correlation with the stock market is not ideal because it goes beyond what would be desired. The ideal case for a feasible alternative would be, again, a "low negative" and Bitcoin SV doesn't have it, going to much against the tendency of the market to be considered stable in correlation to it.

From all the other cryptocurrencies available, Bitcoin Cash and Dash are the only two left with negative correlation but both have leptokurtic distributions which as seen before, are not the best type of distribution to have in a guarantor of value, even so, Dash has what can be considered the best value of correlation with the stock market considering the reference of the "low negative" with a -0.16 value for it, again, not being ideal, but it is the one that gets it the closest.

Monero is a case where the distribution is slightly platykurtic and has an even lower value of correlation in comparison to the value that Gold presents. In that sense, it is a strong candidate in the quantitative analysis to be adopted as a currency but one that still mingles the results of gold for the excess kurtosis analysis, a difference so big that it cannot be ignored at all.

In summary, quantitatively and within the 2-year period studied, it can be concluded that Platinum and Litecoin have been the ones that performed the worse when the objective is to know if these could be currencies adopted in the larger scale based upon their past prices only. Gold clearly takes the lead in terms of the way it is the asset with the shorter amount of extreme values by a large margin and in such a clear way.

Zcash and Nano didn´t have the spotlight because they do not show values as extreme and as "bad" for currency adoption when comparing to previous examples, but the prices these cryptocurrencies have had in those two years are not stable enough and do not present a true alternative to the stock market to accomplish its reserve of value function, presenting both leptokurtic distributions and having positive correlations to the S&P 500, besides the fact that those same values are not as extreme as the ones for Platinum or Silver.

Table 5.3 Correlation to S&P 500

|              | Correlation S&P 500 |
| --- | --- |
| Bitcoin | 0,08 |
| Bitcoin Cash | -0,65 |
| Bitcoin SV | -0,40 |
| Nano | 0,37 |
| Litecoin | 0,33 |
| Monero | 0,24 |
| Dash | -0,16 |
| Zcash | 0,28 |
| Gold | 0,29 |
| Silver | 0,83 |
| Platinum | 0,93 |

**5.2 Qualitative analysis:**

With the objective of being clear, simple and straightforward in the analysis, I'm going to divide it into three different sections:

Firstly, for a term of comparison and for the line of argument to be logical and more interesting, I am going to submit the fiat currencies to the criteria and analysis that I'm submitting the cryptocurrencies and precious metals.

The second will be focused on going for each characteristic specified in the methodology section, explaining in a detailed manner how does each cryptocurrency perform on the "purpose of being money".

The third and final section will be focused on the precious metals taken in consideration, an analysis that, because of the nature of precious metals, will be much different from the second one, mainly because of the physical substance that cryptocurrencies do not have.

**First Part – Fiat Currencies**

Without a gold standard (as argued throughout the literature review and the rest of the study), fiat currency does fail on having a system in place that controls the scarcity of the currency.

The euro and the dollar for example do have their institutional "checks and balances" in order to be reproduced and issued but the reality is that, at least for the dollar, the last 120 years have been harsh on its value and capacity to store wealth. A reserve of dollars made in the year 1900 could buy a lot more than it can buy today, exemplifying with gold, $20.67 could buy an ounce. To buy an ounce of gold in 2020, $1955 were needed, that is an increase of the value of gold facing the dollar of 9458% in the last 120 years and it is mainly due to the fact that the Federal Reserve, since its creation, has been a factor for the massive expansion of currency in circulation.

In that aspect, whether institutionally guaranteeing the value of fiat currencies or not, governments and the state in general do not give a guarantee to "keep the currency scarce". This is evident when comparing the 7 billion dollars that were in circulation around 1900 compared to the 13291 billion in the money supply today.

In terms of durability, it may depend if it is a coin or a paper note we are referring to. Being used countless times throughout the economy every second, paper notes do last less but the cost of maintenance is small and bearable for the modern central banks, being a disadvantage in relation to precious metals or cryptocurrencies, but not the most significant disadvantage, especially in an era where fiat money is becoming more and more digitalized and so, enjoying the same benefits cryptocurrencies have in that regard.

Portability is an interesting case because it was one of the main arguments made for the initial adoption of Bitcoin and for it to replace "traditional currencies". Because fiat money uses the central bank and the banking system established in general to validate transactions, there is a degree of inefficiency associated with transaction fees and the time needed to validate those transactions centrally (mainly when the transactions are international). The multiple variables at play with fiat currencies for transactions make the whole process of moving money slow and costly beyond borders.

Two characteristics that do not have greater further implications with fiat is divisibility and fungibility, only under certain very specific conditions would a note not be capable of being divided correctly, probably in the case that a paper note would be so badly damaged that it wouldn´t be accepted as a currency of payment anymore, after a lot of transactions back and forth. That puts the fungibility aspect of the currency in check too, by not keeping its value at full after a long period of time. Nonetheless, it is a disadvantage of fiat currencies, but it´s not one of its main problems once again.

The last and one of the soundest criticisms to fiat currencies is their inability to be hidden and/or removed from observation, the so called concealability. Every bank account is registered and monitored by the banking system independently from the specific institution where the money is, this centralization, despite the legal limitations to state authorities that are applied in developed countries can change depending on the type of government elected or in office at the time. The fact that accounts are registered with names and addresses associated to them, makes it even more problematic once hackers and other criminal attacks may put everyone with an account at risk.

In summary, fiat currency is especially problematic with providing scarcity, portability and concealability to its user. Durability, divisibility and fungibility are characteristics that might not be fully satisfied, nonetheless, the physical characteristics still present in them make it more difficult to eliminate these same limitations.

**Second part - Cryptocurrencies**

For the cryptocurrencies discussed here, scarcity is one of the most important characteristics in which cryptocurrency developers and enthusiasts are focused on. Because of the already mentioned flaws of fiat currencies, it is crucial for alternative currencies to succeed at providing real scarcity in their quantities in circulation to the ones that use them.

Most cryptocurrencies work on the basis of "mining", a term used to describe the way one can put a certain currency into circulation by "making more of it" through solving complex problems and equations to be rewarded with new units of that same currency. This problem-solving gives the network a way of guaranteeing the validity of other transactions between users of the network and that´s why in the beginning of a cryptocurrency like this, the rewards are much higher than later "down the road". The closer one gets to the maximum limit of currency in circulation mined, the harder and more costly it gets to mine it (this is the basis for Bitcoin and the ones that followed it).

Starting by the most debated cryptocurrency, the protocol of Bitcoin establishes a maximum limit of 21 million Bitcoins into existence (Nakamoto, 2008). For the case of Bitcoin

Cash, the limits are the same as well as for Bitcoin SV, another "fork" from the original Bitcoin, this time, an internal division between developers and investors inside Bitcoin Cash itself, already a (previous) "fork" itself.

In this regard, Litecoin has a maximum limit of 84 million Litecoins in circulation, Dash 18 million (Duffield and Hagan, 2014), Zcash 21 million (in reference to Bitcoin, Bewn-Sasson, 2014) and Nano approximately (133 248 290)133 million (Lemahieu, 2014). Monero is the exception here because, besides having a maximum limit of 18,4 million in circulation initially, the mining continues indefinably but at a fixed rate of 0,6 XMR (Monero) per block to reward miners keeping the network working (Van Saberhagen, 2013). Nonetheless, this fixed rate, in the grand scheme of things is almost irrelevant. A rate like that, can still be argued as scarce in the same way we would say that gold is scarce besides more quantities always coming into the market indefinitely and with no established limit in the future to it, in the case of Monero, being predictable and by knowing exactly what new quantities will come into existence at what rate, makes it accomplish scarcity in a more peculiar but very effective way.

The maximum limit established in every crypto analyzed is what grants it the satisfaction of the scarcity characteristic and it is not difficult to understand why once after the limit is reached, there will be no more coins of that specific crypto being created (exception to the situation with Monero), this causes the cryptocurrencies in analysis to have a deflationary tendency by default, which is something beneficial for its value and for the people who hold it (if this tendency is too strong, the deflationary default might put in check the incentives to use the currencies at all and to spend it, but because it will merely be backed by the loss of units over time, it will probably be at a bearable rate).

But there are fundamental differences in the way scarcity is achieved throughout these cryptos, apart from Nano, all of the others are not yet all in circulation because they are submitted to the mining process in order for it to be at the hands of users.

It is, nonetheless, one of the pillars of cryptocurrencies and mining differs from cryptocurrency to cryptocurrency, for in the case of Monero, as stated before, the mining process tries to "correct" the deficiencies that Bitcoin, Litecoin and others have with the rampant centralization of miners into the hands of a restricted number of corporations with enough capital to invest in "mining factories". Large warehouses of computers to achieve economies of scale with mining are common, being a reality now that around 60% of the mining of Bitcoin is in the hands of a very small group of companies while for Litecoin mining, the scenario is even worst at about 70% of it.

Despite the differences, Nano is the only one in the list of this study that does not have a mining process built into it. The amount of Nano in existence was established with the beginning of the project and it was distributed throughout the solving of "captchas", with the easiness of this process of distribution, and without an initial coin offering (ICO), the developers of the Nano project achieved a more equal and decentralized way of putting Nano in circulation for the general public, everyone that has a laptop or a desktop can solve captchas while at the same time there is no real way of scaling a process like this besides going into their platform and personally solving them.

But in this respect, independently of the specific process used in the crypto in analysis, the main aspect that must be stated is that the limits are set with a maximum fixed number which addresses and adequately satisfies the "scarcity problem" that currencies need to have to be more efficient as money.

Durability, at this point, is a settled characteristic for every currency that might want to be used for the public and especially as a reserve of value. Cryptocurrencies, because they are digital, are fully durable for as much time as the Internet still functions somewhere around the world.

Portability is one of the most emphasized arguments in favor of cryptocurrencies, Bitcoin was created in part because of its usability throughout borders and other bureaucratic processes that make it more difficult for mainstream currencies (fiat) to be fully used internationally functional.

But this is a topic of great discussion around the differences between cryptocurrencies, Bitcoin has been considered "useless" for the large population in the foreseeable future because of the overloading of its system of transactions. Being a currency that validates transactions based upon the "hashing power" of its network and its users, it has been common for the past three years to have situations where Bitcoin takes up massive amounts of fees and immense "waiting lists" to validate transactions that in this fashion can wait for more than half an hour to be verified.

But to make the direct comparison between the cryptos in analysis, Bitcoin can process 7 transactions per second (TPS). Assuming everything equal, Bitcoin Cash can process 8 times the number of transactions per second when comparing it to Bitcoin. This is because it has 8 times the size of the blocks processed on it.

Just like other improvements in this regard comparing Bitcoin and Bitcoin Cash, Bitcoin SV tests show that it can handle 9000 TPS. Unfortunately for the project, because the size of the blocks are much bigger than Bitcoin and Bitcoin Cash, to have full security that there is no

double spending, waiting 10 minutes wouldn't be uncommon to be sure of it and so, the metric of TPS in Bitcoin SV do not correspond to that first initial claim at all. Independently from all others who have been tested in the past months and years, Nano is by far the most ambitious project with a proposal of "unlimited number of transactions", having no fees and less than a second on average to confirm transactions made.

The problem discussing this characteristic on cryptos is that it is normally related to the TPS measurement mentioned before, but it can only be certain that a specific cryptocurrency has a determined amount of transactions per second once the system and the network has been tested to the new limits established. That is how we know that Monero can handle 1700 transactions per second and Dash only between 30 and 56, etc.

Obviously, portability is one of the most important criteria for the usage of currency and in this regard, Nano has the "upper hand", either from the fees perspective, it is feeless, either from the scalability it can achieve without having its network slowed down or massively overwhelmed by the amount of transactions made, proposing itself to be "infinitely scalable" with 1000x transactions per second more compared to Bitcoin and with a less than 1 second time to confirm transactions on average.

In terms of a currency that can be used at a global scale and in the regular life of people, from the analysis, Bitcoin has failed intensively to achieve the scalability needed for a truly global system of transactions. Just to put in comparison, Visa alone makes 4000 TPS normally while having the capacity to handle 24000 transactions per second and credit cards normally make 5000 TPS all over the US. With this reference, nothing can be called "global" if it cannot achieve similar results and standards.

Even with the "Lightning Network", a project being conceived to solve some of the scalability problems of Bitcoin, the usage of the most popular cryptocurrency in a regular basis payment is almost unfathomable to imagine being put in place.

For the characteristic of divisibility, every cryptocurrency in existence has no problem with it. It is evaluated here because it is normally a differentiator factor within physical currencies once ones are easily divisible when compared to others.

The last two characteristics are curiously intertwined and especially for the case of cryptocurrencies.

Fungibility does not seem to be a problem at the first glance for cryptocurrencies, but the fact that some "can be hidden" more effectively than others, creates some difficulties in keeping the currency fungible in comparison.

The specific case that represents this situation very well is exposed by the way Bitcoin works (for it to be clearer).

Every time a transaction is made, the blockchain registers it publicly so everyone knows that wallet x transferred funds to wallet y. In its core, because there is no name associated to the wallet, neither an address or any personal information, concealability is in large granted and as a consequence, every unit of a specific currency is equal to every other unity of that same specific currency in any other moment.

The problem with privacy started largely because of the role exchanges started to play in the cryptocurrency market, its rising importance started to attract the attention of governments and state agencies and soon, regulation was put into place.

The type of regulation governments can most effectively put in practice is directly demanding that registered people in exchanges give more information about themselves, in the last couple of years, working with Coinbase or Binance, for example, went from registering a card from where to make purchases and then registering some way of getting back money from these platforms in order to convert cryptocurrencies to fiat currencies and then transferring them to a normal bank account of a bank deposit, to now having to register legal identity documents demanded by a lot of countries and registering addresses, not having any chance of getting into the cryptocurrency market without first having the confirmation of legal demands made by the state authorities in the majority of Western countries.

In this context, once Bitcoin for example registers in public domain all the transactions between wallets, even if these wallets have no link between the identity of the people who use them, authorities only need to cross information between the names of the wallets in the exchanges accounts and the identification of the wallets in the blockchain.

With this said, it is obvious that concealability is not granted for Bitcoin at this point, at least not in full and the same problem applies to most other cryptocurrencies that cannot be identified as "privacy coins". Because they register everything for the public and in order to avoid "double spending", every currency with this process is at risk of being traceable and so, concealability and fungibility are put in check.

"Privacy coins" in large are coins that propose themselves to have a functionality similar to the one that Bitcoin had proposed itself from the beginning, to be a "Peer-to-peer electronic cash system".

It is in this scenario that fungibility is put in check too, once privacy is not fully granted, there starts to be a difference between coins being transitioned within exchange wallets and coins outside of that environment. That is exactly what happened to Bitcoin at a certain day and

age, having Bitcoin outside exchanges being traded at a more expensive rate when comparing to the ones that could be traced back to trade on the exchanges.

It is in this regard that Monero and Zcash make a big difference, being considered the main "privacy coins" mentioned and traded in exchanges, they have been the ones that regulators seem to be more worried and focused about, but even between privacy coins there are major differences, besides their mining process and "proof of work" rules, in terms of privacy, Zcash, just like Dash, largely give the option for their users to "hide" their transactions. Monero, in this regard, does not have the option of going public, as a consequence, it is generally the one cryptocurrency regarded has "the best privacy coin".

It is important to make a disclaimer here, I mentioned the option of making transactions private for Dash, but the development team and the heads of the project refuse the idea that Dash is a privacy coin. Only 0,7% of transactions with Dash are made with the privacy option and the project has been evolving to put privacy claims as almost non existing, a "sacrifice" made for the purpose of avoiding harsher rules and less attention from regulators in great part. This distance from the privacy coin market is well expressed by the fact that Dash was previously called Darkcoin…

**Third part – Precious Metals:**

Scarcity has largely been accepted has one of the characteristics that precious metals achieved better through the evolution of human society. No doubt that "precious metals" or "rare metals" is a name directly given because of their scarcity in our world, even with this fact in mind, they do not achieve total scarcity because of the fact that there is no maximum limit established on their existence, but in general, it is well known that they are limited by the quantities available in nature.

In that sense and historically now, especially gold has been contrasted with fiat currencies for achieving limits to its mining strongly established in comparison to the rules that dictate fiat printing and mechanisms to put in circulation.

Nonetheless, historically, gold, as well as silver, have suffered from great volatility regarding their price, mainly because of large quantities being found in a short amount of time, so even if we can consider them scarce, it is in the molds of a general statement, having specific periods of time where this same scarcity is put in check in the short-term.

What makes the bigger difference between the 3 precious metals in analysis regarding scarcity is not just their quantity in circulation (if there is great quantity of a commodity or asset but its quantity in circulation is stable, we can say that scarcity has been generally achieved, with some limitations of course).

Silver is the most common of the 3, that´s mainly why its price is the cheapest. The once called "coin of the people" gained its connotations because it was the most used by the lower classes, even in France, the term for money is "argent", the same word that is used for silver.

But for precious metals, the term of comparison for scarcity is in the mining process (just like for the majority of cryptocurrencies that picked the term because of their older precious metals counterparts), and it is here that gold beats both of its competitors.

Platinum has a big problem related to its scarcity, and that is centralization. Mining of platinum is mainly coming from South Africa and the country alone extracts more of it than the rest of the world all together. With this said, it means that its scarcity might be put in question because it is in the hands of so few and at any time those few might easily manipulate its quantity in the market (the same happens and happened with diamonds coming from South Africa at the end of the 19th century).

Silver does not have this same problem at this scale, but it has that same problem in different terms, a few countries control the whole supply, having in its core the same possible danger regarding its supply.

Gold is favored in this regard because the top countries on the mining and exploration of gold mines can exceed the extraction made from the rest of the world only taken together. Being very limited but sparse around the globe makes its quantity flooding into the market more controlled and more equally distributed, being difficult to manipulate its flow into the market by one or few entities.

In terms of their durability, precious metals have always been associated to the higher classes of society when being driven to concepts like "immortality" and "eternity" partially because they work very well in the realm of longevity. If it were for bronze and iron coins like some of the ones that existed in ancient times, it would be difficult for them not to deteriorate over time, for the 3 in this study, it is not a real problem to be overcome.

The same can be stated in large for the question of fungibility, one ton of gold will be equal to one ton of gold on the other side of the world, this is true for silver and platinum too. The differences might occur like they occurred in some historical contexts where "currency debasement" happened by "lashing out" parts of coins and making them less rich then what is stipulated, even so, that is not a problem of the metal in itself but a problem between what is the value established by the ones that put coins in circulation and the fact that parts of that metal can be extracted out of the coins themselves.

But this begs the question, what about divisibility? Not that today it is a big problem to divide precious metals into relation to their weight, but the way things have been done in the

past, precious metals are divided into coins and joined together with other metals to make them easy to transport and trade. In this regard, we can say that precious metals will go as far as fiat currency can go, by having physical content associated to them, it limits their ability to be more efficient at some point. On the other side, having physical substance has been considered "a security" for the ones that possess their wealth in the currency/commodity in question.

But the major points of stress when regarding to precious metals and their characteristics are portability and concealability, both related to one another and almost interchangeable.

It is by now clear that to transport great quantities of wealth from one place to another, two things are very important. On one hand, how much bureaucracy must be endured to transfer that amount from point A to point B? Secondly, in practical terms, how much does volume and weight make it more difficult to do so?

The first point can even be answered for some situations with total impossibility of transactions, just like fiat currencies, precious metals must be deposited in a centralized bank, part of a broader international system to be transported internationally. If it is the decision of the government to freeze transactions for bank accounts or to make some new legislation regarding what can be done when making specific transactions, precious metals have the same problem as any other mainstream currency. But additionally, because of its physical substance, it must be stored somewhere in the vaults of a bank and registered by authorities as an immediate consequence. Clearly, in terms of concealability, precious metals do lack ways of being hidden as well as problems of transportation, especially for silver, which needs a lot more quantities of it to be transported to represent the same amount of wealth and value stored.

Historically, nonetheless, the alternative that precious metal users found for both portability and concealability was with diamonds and other precious stones. Weighting a lot less and representing huge quantities of value in small objects that can be at the same time hidden in an easier fashion and transported, they are not being considered as part of precious metals in the analysis but they cannot be ignored for the fact that during so much time they were seen as "complements" to the use of precious metals.

Having two precious metals in circulation at the same time is too a form of conceiving and making possible the use of them in an easier way. The study analysis them separately, but it must not be forgotten that to solve problems of one precious metal, others might play a part of their role like they used to years ago.

Because there is a well-tested market with precious metal adoption as currency, these complementary solutions between various precious metals and precious stones is a reality and a solution that must not be ignored.

### 6. Limitations of the research

Before conclusions are drawn, it is good practice that limitations of the research are stated and taken in consideration.

The 2-year period taken in consideration is within the context of one of the historically biggest bull markets that has ever existed, while at the same time and influenced by some of the lowest interest rate levels ever recorded. Because cryptocurrency is as recent as 2008, its "track record" in relevant terms, has always been in this context, making the conclusions drawn out of a situation where there is no way to know how would cryptocurrencies adapt and react in the situation of a bear market and an economy of higher interest rates.

It is a reality that for the conceptualization of hypothesis, it is taken for granted that the currencies/commodities with the best characteristics are the ones that will prevail in the future. Although evolutionary theory has the weight to make such an assumption, it is very difficult to measure the amount of time that is needed for this "natural equilibrium of Darwinism" to become a reality. Fiat currency performs poorly, but it has the weight of the law behind it. Legal requirements and obligations play a difficult role to measure in these types of situations.

Finally, in order to capture a better picture of the volatility in cryptocurrencies, one can speculate towards taking in consideration the daily prices instead of the weekly ones and having a better notion of the small adjustments in price one may find from week to week. If confirmed, this speculation could have made the statistical analysis even more positive to precious metals and gold specifically, while at the same time making it worst for every other specific cryptocurrency analyzed.

### 7. Conclusions

**H1 – Precious metals are more stable than cryptocurrencies overall**

**H1.1 – The most unstable precious metal is more stable than the most stable cryptocurrency in analysis**

Overall, looking at the distribution of its prices, precious metals seem more stable for the 2-year period in analysis than the cryptocurrencies put forward. Silver, which is the precious metal with the most leptokurtic distribution falls still far behind the distributions of Zcash, Dash and Litecoin.

Surprisingly, a lot of cryptocurrencies perform better than Silver and Platinum futures, by having less extreme distributions and by not being so much influenced by the fluctuations in the stock market, those are: Bitcoin Cash, Bitcoin SV, Nano and Monero. Bitcoin still performs better in both when comparing to Silver. Gold clearly has the better well expressed platykurtic distribution in its values by far, which makes it very good as a stable commodity.

Taking in account both analysis, (mainly excess kurtosis and correlation to the S&P 500, but the skewness and where the extreme values appear too), we cannot positively confirm either H1 or H1.1. Because there is no clear superiority on the first one and the second one because of the worst performing precious metal (Platinum in this case and because of the skewness analysis to make a difference from the performance of Silver), performs much poorly when comparing it Monero or to Bitcoin SV.

**H2 – Gold is the most stable precious metal;**

**H2.1 – Gold is the most stable currency.**

From H2, there is no doubt that Gold futures are the ones performing the best when comparing it directly to the other two precious metals. It has the only platykurtic distribution with the less extreme values and it has the lowest value of correlation to the stock market, besides the fact that this value is neither negative or low enough. The skewness analysis becomes almost irrelevant when the extreme cases and values are redundant as it is the case with Gold futures. H2 is correct.

H2.1 is a more difficult one but still, because Gold futures perform so well in terms of presenting almost no extreme values, this is something only Bitcoin SV and Monero can argue at their favor. Even though they have platykurtic distributions, Gold's is much more well behaved and no doubt its biggest advantage when compared to every other one in the analysis.

Without ignoring the relevance of the rest of the comparisons, Gold underperforms with what was expected and established before the analysis and in that regard, H2.1 is still acceptable but because of a manner of having no other clear rival in that sense. Monero posts a platykurtic

distribution and a very close value of correlation to the S&P 500 to the one of gold, but it is a distribution that almost fits in the perfect normal distribution, being very far from the levels that Gold presents.

Bitcoin SV has that same distribution and better behaved than Monero but offers no resistance to the stock market, not verifying the "low and negative" spot that a reserve of value should have and acting in a well-expressed contrary tendency to S&P 500. Bitcoin Cash in that sense is even worst by not even having the desired type of distribution and Dash, beyond the fact that has the best performing correlation to the S&P 500 needed in comparison, has a very well expressed distribution full of extremes.

In this question, Gold is the most stable currency, H2.1 is true.

## H3 – Bitcoin is not the most stable among cryptocurrencies.

Bitcoin is more stable than some cryptocurrencies in the research, even so, having a very well-behaved leptokurtic distribution for its prices sets it as more stable than a lot of the others. The strongest point Bitcoin has is its correlation to the S&P 500, not being ideal for the purpose, it is the one from all the currencies nearest to 0, almost having no correlation to it (which is not ideal, but it is better in comparison than having a very strong negative of positive correlation).

But by having so much extreme values, it performs worst than at least 4 other cryptocurrencies in terms of its distribution, being those, Bitcoin Cash, Bitcoin SV, Nano and Monero.

With this, H3 is true and Bitcoin is not the most stable among the cryptocurrencies, especially because of its poor performance in the distribution of prices analysis besides the fact that it is the one performing the closest to the ideal value of correlation needed (Dash is more or less as close in this regard but on the other end of the spectrum, still having a more well behaved group of tails than Bitcoin on the first analysis).

## H4 – Gold has the best characteristics as a currency in comparison to other precious metals.

Gold is still today a very important reserve asset. Silver played a very important role too in history but the magnitude to which gold can be used in a context where physical money is losing popularity really demonstrates that its achievements fulfilling the characteristics of money are like none other in the "precious metal group".

Platinum has a lot of scarcity, even in absolute terms, its circulation in the world is close to the one that gold has and there is no vision in the foreseeable future that this scarcity will be put in question. But scarcity, even for silver that exists in larger quantities can be easily achieved

for precious metals, new precious metals require great amounts of investments and its flux into the market is predictable from year to year.

For portability and divisibility, silver is more easily divisible because of the fact that it is more abundant, not necessarily something we can call a truly differentiator factor. Same thing for portability in general, greater quantities of wealth would be more easily transported by gold or platinum, smaller ones with silver certainly.

For concealability, normally required for greater amounts of wealth, of course the more wealth that can be stored in a smaller object the easier it is to do it.

With no further difficulties, the hypothesis H4 is accepted, in what makes a real difference, gold beats silver and platinum.

## H5 – One of the cryptocurrencies in analysis is the currency with the best characteristics overall.

In the overall "currency characteristics" between the groups "fiat currencies", "precious metals" and "cryptocurrencies", the ones that performed the worst in the qualitative analysis were fiat currencies for the reasons explored before, with a special focus on the lack of scarcity, deficiencies in portability and the almost impossible concealability.

Gold could possibly be considered the best potential currency in the analysis, nonetheless, some of the problems it may face are present because those are problems that fiat currency suffers from too and in a more general way, because of the way physical substance is a tradeoff, posing it as a security for the general population but at the same time, a limitation to better fulfill the characteristics of money, starting with the possibility of "black swan events" to put the scarcity of gold in check (its quantity is dependent on what can be found in nature), the general problem with portability, being dependent on a structure like the traditional banking system to move substantial quantities across borders and from one place to another. Concealability can be achieved if outside of the banking system in vaults or other places to hide it. Even so, the physical substance of it makes hiding from outside looks and attention very difficult.

It is with this said that cryptocurrencies seem to be better and represent alternatives that solve these kinds of issues and that is why, after the analysis, the group of currencies with the best characteristics can be summarized into a clash between Nano and Monero.

Bitcoin, as well as Bitcoin Cash and Bitcoin SV fail to achieve the scalability needed to be adopted as currencies for the future mainstream system of payments. Besides the improvements the forks of Bitcoin have, they still suffer from the same basic principles Bitcoin cannot surpass, using bigger blocks to process more transactions but not being at all the solutions that they

propose to be. In the process of complementing or having the same purpose as Bitcoin, Litecoin fails too, showing even worst problems of mining centralization and still implying fees and transaction confirmation times that are not the best in comparison to some alternatives presented.

For scalability and transaction purposes, Dash is a good option when comparing it to the other alternatives already viewed here, having 2 second transactions and much lower fees, but when comparing it to Nano, none of these can work without fees and at such a quick confirmation time.

The one characteristic Nano doesn't satisfy is privacy, in the research, the characteristic of concealability proposed by Monero and the Zcash projects and from those two projects, Monero clearly has a much bigger scalability and because it is not optional if the privacy of transactions is kept or not, it is the one that better satisfies it. Dash was at a time considered a privacy coin, but the project and the developers took another approach to it, only 0,7% of transactions with Dash were private, with Zcash, the scenario is around 4%.

Between Monero and Nano it is a question of priorities, Monero still has fees and confirmation times when in comparison much higher than Nano, nonetheless, it has total privacy, one thing Nano doesn't achieve at all.

Independently of what is the cryptocurrency with the best characteristics at the end, it is a cryptocurrency that has the best characteristic among all of the included in the study.

H5 is accepted because of these arguments, where fiat fails in every one of the most important characteristics and where gold completely fails at achieving some of them, Monero fails at total portability and Nano at total concealability.

**H6 – In the long-term, cryptocurrencies will overthrow precious metals.**

Because of the more speculative nature of this last hypothesis, it needs a broader and more robust approach to it.

The main argument for gold, as well as the one for cryptocurrency is one of direct opposition to fiat currencies. In large, advocates of gold do not propose to the use of gold coins in the general economy, what is proposed is the reestablishment of the link between paper money and precious metals once again (I say gold because it is the most voiced and serious one), e.g., the gold standard

In the last decades, the opposition between gold and fiat currencies has been made thru legal procedures, once the gold standard was over legally, the utility for gold as a currency in the general economy became inexistent. With this observation made, gold and precious metals have become consensual only as reserves of value, something fiat currency fails tremendously

to do so and that is the characteristic and purpose they are fulfilling right now besides anything else they were totally replaced by paper money.

An analysis like the one I did here makes it clear that if is to be a reserve of value, no cryptocurrency can satisfy that need like gold does in the present. At least for the moment, gold still has the stability needed to resist fluctuations of the general economy and its price volatility almost doesn't change throughout time. Like it or not, gold is the only precious metal in the analysis still fulfilling this purpose of reserve of value and the scenario being put in question is one where cryptocurrencies in the future become the new reserves of value.

In order to be reserves of value, a commodity must have the stability in prices needed, to do so, the market capitalization of cryptocurrencies must increase in the future, something that is not so radical or "outside of the box" to see happening in the long-run. In a different way to answer this hypothesis it could be asked, can cryptocurrencies become reserves of value? That is the last hill precious metals are still fighting for and with only one soldier, gold.

Once again, I believe the stage is set, scarcity is achieved by all the cryptocurrencies in the analysis and for most relevant crypto projects, that is a reality. Besides the fact that scarcity is achieved in a lot of different ways in the ones analyzed, scarcity in gold is its main characteristic and almost all of its fame comes from it, being a "rare metal".

Therefore, H6 has a very high likelihood of being true, past prices being almost irrelevant for this statement, the characteristics achieved by crypto are the characteristics needed for it to become a reserve. Directly against gold, the scarcity in crypto has no secrets and does not suffer from the unlikely possibility of somehow flooding the market. In the short-term might not be noticed, but looking more into a distant future, reserves of value will always be considered for their characteristics and that is how we get to the conclusion that gold and the other precious metals will be replaced by cryptocurrencies.

## 8. Recommendations for future research

Despite my best efforts to make the best analysis I could, some points might be considered for further research.

Starting by other metrics that can be taken in consideration to measure and quantify the stability of the currencies. To make a more robust and complex analysis, taken in consideration what was done in the quantitative analysis is a good start, but there are a lot more ways stability can be measured. For the further scientific research on the topic, to broaden and to expand the methods of analysis will only make the conclusions drawn more reliable and truthful.

The cryptocurrency market is still dominated by Bitcoin largely, taking this in consideration and until this dominance changes, it would be interesting to know what is the impact that the variation in the Bitcoin price has on the other cryptocurrencies. In this research I did a correlation between each individual currency/commodity and S&P 500, and so I will make 2 suggestions: 1 – Correlation between each specific cryptocurrency and Bitcoin; 2 – Correlation between the overall market of cryptocurrencies and S&P 500 in order to than compare if a certain crypto is above or below what is happening in the market as a whole.

If further research analyzes a smaller group of cryptocurrencies, expanding the time frame available for the analysis is always good, taking in consideration that most of the projects in the beginning will have more extreme values and extreme fluctuations.

Finally, and more related to characteristic/qualitative types of analysis, in this research I tried to avoid the most technical parts of cryptocurrencies but for future studies, analyzing more of the effective implementation of the technology and not relying so much on the claims and face value affirmations of whitepapers and development team statements would always be a plus in order to be more scientific and closer to what reality unravels and is based upon. Besides that, updates are made constantly to the networks and usability of cryptocurrencies, as a consequence, it is important to update from time to time a study like this in order to know if the characteristic functionality of these varied projects has changed or not.

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**Annexes**

Annex A - Bitcoin Price

| | |
|---|---|
| Mean | 8 496,76 |
| Standard Error | 304,26 |
| Median | 8 902,05 |
| Standard Deviation | 3 102,90 |
| Kurtosis | 0,79 |
| Skewness | 0,38 |
| Range | 15 458,50 |
| Minimum | 3 228,70 |
| Maximum | 18 687,20 |
| Count | 104 |

Annex B – Bitcoin Cash Price

| | |
|---|---|
| Mean | 259,12 |
| Standard Error | 8,03 |
| Median | 252,67 |
| Standard Deviation | 81,87 |
| Kurtosis | 0,17 |
| Skewness | 0,35 |
| Range | 401,79 |
| Minimum | 78,35 |
| Maximum | 480,14 |
| Count | 104 |

Annex C – Bitcoin SV Price

| | |
|---|---|
| Mean | 147,52 |
| Standard Error | 6,14 |
| Median | 155,18 |
| Standard Deviation | 62,59 |
| Kurtosis | -0,13 |
| Skewness | 0,45 |
| Range | 283,75 |
| Minimum | 53,71 |
| Maximum | 337,46 |
| Count | 104 |

Annex D - Nano Price

| | |
|---|---|
| Mean | 0,97 |
| Standard Error | 0,03 |
| Median | 0,91 |
| Standard Deviation | 0,29 |
| Kurtosis | 0,62 |
| Skewness | 0,93 |
| Range | 1,31 |
| Minimum | 0,39 |
| Maximum | 1,70 |
| Count | 104 |

Annex E - Litecoin Price

| | |
|---|---|
| Mean | 60,42 |
| Standard Error | 2,35 |
| Median | 55,73 |
| Standard Deviation | 24 |
| Kurtosis | 2 |
| Skewness | 1,38 |
| Range | 118,60 |
| Minimum | 23,65 |
| Maximum | 142,26 |
| Count | 104 |

Annex F - Monero Price

| | |
|---|---|
| Mean | 71,24 |
| Standard Error | 2,13 |
| Median | 66,29 |
| Standard Deviation | 21,71 |
| Kurtosis | -0,08 |
| Skewness | 0,76 |
| Range | 91,29 |
| Minimum | 36,15 |
| Maximum | 127,44 |
| Count | 104 |

Annex G - Dash Price

| Mean | 88,17 |
|---|---|
| Standard Error | 2,76 |
| Median | 79,46 |
| Standard Deviation | 28,17 |
| Kurtosis | 1,17 |
| Skewness | 1,17 |
| Range | 134,54 |
| Minimum | 41,85 |
| Maximum | 176,39 |
| Count | 104 |

Annex H - Zcash Price

| Mean | 56,42 |
|---|---|
| Standard Error | 1,78 |
| Median | 54,85 |
| Standard Deviation | 18,18 |
| Kurtosis | 1,02 |
| Skewness | 0,81 |
| Range | 88,98 |
| Minimum | 25,05 |
| Maximum | 114,03 |
| Count | 104 |

Annex I - Gold Futures Price

| | |
|---|---|
| Mean | 1 591,16 |
| Standard Error | 20,52 |
| Median | 1 542,30 |
| Standard Deviation | 209,27 |
| Kurtosis | -1,04 |
| Skewness | 0,45 |
| Range | 721 |
| Minimum | 1 307 |
| Maximum | 2 028 |
| Count | 104 |

Annex J - Silver Futures Price

| | |
|---|---|
| Mean | 18,26 |
| Standard Error | 0,35 |
| Median | 17,30 |
| Standard Deviation | 3,55 |
| Kurtosis | 0,80 |
| Skewness | 1,36 |
| Range | 15,19 |
| Minimum | 12,43 |
| Maximum | 27,61 |
| Count | 104 |

Annex K - Platinum Futures Price

| | |
|---|---|
| Mean | 869,96 |
| Standard Error | 6,84 |
| Median | 867,05 |
| Standard Deviation | 69,77 |
| Kurtosis | 0,69 |
| Skewness | -0,32 |
| Range | 415,65 |
| Minimum | 611,40 |
| Maximum | 1 027,05 |
| Count | 104 |