Master Thesis

When a virus takes over the whole: will the old way saves an investor portfolio or the new?

Academic research on the ability of bitcoin to absorb the shock on an equity portfolio during a global pandemic

September 2021

Author: Theophile Junior Ekoue Akakpo

MSc. Finance – National College of Ireland

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1. Abstract

My research question for the master's Thesis is to take a specific period of uncertainty that we experienced and assess if Bitcoin offers the same property of safe haven as Gold. This paper will not stop at just look at the effect on two instruments in a portfolio but try to figure out which one of performed better.

Looking at the banking and financial services one thing constant is change. The transformation in the financial industry aims to lower the barrier to entry and increase competition at first then that evolves into redefine the system. With the introduction of Bitcoin and the blockchain technology we experienced a massive impact to the banking industry. While at the beginning it created sensation between the believers and the non-believers with time the acceptance of this new technology is increasing, and more people are starting to give it a chance. Years after its creation Bitcoin was persona not grata with Wall Street banks with even some banning their employees to buy or sell the instrument. However, in 2021, Goldman Sachs Group Inc. after restarting their trading desk introduces new Bitcoin derivatives to its clients as demand for the instruments grew over the year within Institutional investors.

The avalanche of the demand of the cryptocurrency after the period of the Covid-19 shows that there is a shift of the mentality about the asset. Was the pandemic, the perfect period to demonstrate that Bitcoin can be a safe haven asset during a period of uncertainty in the market?

Keywords: Bitcoin, diversifier, hedge, safe haven, Modern Portfolio Theory, diversification, mean-variance, Gold.

2. Introduction

Just as the computer and the internet radically transformed the way people store, process, and share information, Bitcoin radically enhances the ways we can store, process, and exchange value (Beck, 2019). Introduced in 2008 by (Nakamoto, 2009) who was given the surname "father of bitcoin", bitcoin is a purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. The introduction of bitcoin in our society was an aim to provide an alternative payment system that will remove the middleman and its cost during the transaction. Bitcoin can be used in different currencies as mean of payment worldwide without any central banks or sovereign intervention. It became the first decentralized digital currency ever made and the first to be use as a form of transaction. Like gold or other rare commodities, the limitation of the total supply of bitcoin to 21 million of unit makes the instrument more attractive with time.

Today bitcoin is more accepted but the journey to get here was not easy. Looking at the interest and volatility of the instrument, one can say that the story of Bitcoin today can be seen as exceptional and divisive. Since its debut in 2009 when the community started mining the coins, the price has increased from $0.10 to $35,691.39. It was first used as payment in 2010, when the first person use bitcoin to acquire two pizzas for a total of 10,000 BTC. That transaction became the symbol in the history of the blockchain because until that payment Bitcoin was not traded but only mined and did not have any monetary value assigned. While the value of the crypto was lower back then, it evolved over the time to hit the $100 in April 2013 then to reach $1,000 by the end of that year. In 2021, the price hit an historical all time high of $63,3989.48 with a market capitalisation of $667,774,349,858 and 18,727,250.00 BTC in circulation which represents 89% (CoinMarketCap, n.d.).

In the early days of bitcoin, from governments to the financial industry bitcoin faced a big huddle because of its decentralized nature, the high volatility and the consistent pessimism around it. Over the past years, academics have debated whether bitcoin can be used as an alternative asset and become the new gold or if it can be used as currency. Some like (Klein, et al., 2018) concluded that Bitcoin behaves completely different from Gold, in particular in market distress and other like (Yermack, 2013) rejected the consideration of Bitcoin as a currency. At the same time, you have different academics that believe that Bitcoin can

improve the performance of an investment portfolio. (Bouoiyour & Selmi, 2017) conclude that Bitcoin which lives outside the confines of a single country's politics can profit of the ongoing volatility of the market, which in return will provide the crypto an ability to serve as hedger in turbulence time. The same conclusion was drawn by (Brière, et al., 2015) who believe that the low correlation of bitcoin and other assets in a portfolio compensate the high risk that Bitcoin represents due to its high volatility. Including even a small proportion of Bitcoins in a well-diversified portfolio may dramatically improve risk-return characteristics (Brière, et al., 2015).

From the last 10 years alone, Bitcoin price have experience different surges which lead some academics to believe the crypto can be considered as safe haven same as gold. With investors experienced a set back with the financial crisis and loss trust in financial intermediaries, bitcoin has caught the eyes of few of them as a potential investment instrument. That sentiment grew bigger with the shocks that improved the image of the virtual gold during those periods of trouble. The first period where the crypto shinned was the Cypriot's crisis in 2013. During that crisis the world noticed that the price of the crypto surged as reported by different news media like CNN, CNBC and even Forbes. While people were still reluctant to agree on the ability of bitcoin to hold value during time of uncertainty, the same phenomena as the Cyprus crisis happened once again with the coup in Zimbabwe. The Zimbabwean coup d'état led to further speculation of the crypto and increasing the price to another all-time high. As pointed out by (Brière, et al., 2015) Bitcoin deserve to be taken seriously by financial analysts. Hence, the shift in mentality as the world hit another crisis which this time did not start because of a collapse of bank or financial institution but health sector. While previously there were more resistance in the adoption of Bitcoin, people started to see the potential of the coin as a financial asset and a safe haven for investors that seek protection against market uncertainty, downward movements, legislators or inflation.

Local events such as elections have been shown to have a significant impact on both policy uncertainty and financial market uncertainty (Conlon, et al., 2020). Those uncertainty often impact negatively most investors. To negate the risk from such events, investors use different methods such as diversify the portfolio or include a safe haven instrument in the portfolio. While a lot of studies, already discussed the potential attribute of Bitcoin as safe haven, the world lacked a situation to test those arguments. The COVID-19 pandemic provided the first widespread bear market conditions since the inception of cryptocurrencies (Conlon, et al., 2020). Therefore, it provides this paper the perfect opportunity to examine the following

research question: "Can Bitcoin be a hedge or safe haven against a severe hit to the financial market or the global economy?". While the financial markets already give investors different instruments to increase their capital, (Dyhrberg, 2016) affirms that Bitcoin is different from any other asset on the financial market and thereby creates new possibilities for stakeholders with regard to risk management.

3. Literary Review

This section will give a general recapitulation of Bitcoin by giving a quick introduction to the crypto touching quickly on the technology behind and the ecosystem that is supporting it. After the background is established and introduction is done, we will dive into the different literature that have explored the ability of Bitcoin to be a safe haven more than the crypto's ability to hedge. Then the next section will provide a more in depth to the capacity of bitcoin to provide investor a better investment opportunity than Gold in period of uncertainty – which is the main topic of this thesis.

3.1. What is a safe haven?

The growing popularity of cryptocurrencies has inspired numerous studies of their investment benefits, including their safe haven properties (Conlon, et al., 2020). (Klein, et al., 2018) comes up with a way to picture the difference between an instrument that is used for hedging and another that acts like as safe haven. (Klein, et al., 2018)'s paper explores the hedge and safe haven capabilities of cryptocurrencies in comparison to Gold by means of a dynamic correlation analysis. This is not news as there is growing academic and policy interest in so called "safe assets". Safe asset is assets that have stable nominal payoffs, are highly liquid and carry minimal credit risk (Habib, et al., 2020). A safe haven asset can be described as an asset which is uncorrelated or negatively correlated with another asset is defined as a hedge whereas a safe haven asset is uncorrelated or negatively correlated with other assets in distressed markets only (Klein, et al., 2018). A simple way to define safe haven would be an asset that retains its value during extreme market volatility. Same definition is shared by who states:" while most investments are sinking, these assets tend to maintain their value, appreciate, or otherwise outperform during crises". As defined by (Cambridge Dictionary, n.d.), a safe haven is an investment that keeps its value, especially when other investments are falling or may fall in value. (Cheema, et al., 2020) also went in that direction when defining safe haven as assets that should earn positive or, at worst, close to zero returns during financial market turmoil. When there's serious political or geopolitical risk or a

financial crisis, the value of gold rises because it serves as a safe haven asset, as does the Swiss Franc, the Japanese Yen and US Treasuries (Roubini, 2021). In other words, during periods of market stress, "safe haven" assets are supposed to be uncorrelated, or negatively correlated, with large markets slumps experienced by more traditional financial assets (typically stock or bond prices). As (TRONZANO, 2021) affirms since "safe haven" assets are presumed to offer protection against market slumps, one would expect, during each financial crisis, a massive portfolio shift towards these assets with consequent increases in their return co-movements.

3.1.1. Evolution of Safe haven in Society

With their deep history in serving humanity's sense of well-being, there is not surprisingly a long list of safe havens that predate Bitcoin (and other cryptocurrencies) (Financial News Media, 2020). These include commodities, United States Treasury's and select fiat currencies, equity strategies and hedge funds, as well as more tangible assets such as precious metals (gold and silver), real estate and even art (Financial News Media, 2020). (Conlon, et al., 2020) believe the concept of an investment safe haven is motivated by investor loss aversion, where investors are more concerned with avoiding losses than any associated prospective gains. Whether it is the stock market crash (1987), the dotcom bubble (1999 – 2000), or the global financial crisis one is can be noticed the behaviour of most investors in looking for a security asset to amortise the shock received from the crisis. The equity market downturn in 2000 and the low historical correlation of commodities with stocks prompted many investors to view commodities as a desirable alternative asset class (Baur & Glover, 2016).

3.1.2. Gold the ultimate safe haven for investors

All Over history, fiat currencies have been destroyed by hyperinflation, currency wars, imprudent monetary policies and reform, resulting in an average lifespan of roughly thirty years (Beck, 2019). Gold's trading history goes back to ancient times when its beauty and association with nobility meant that it became a natural commodity for transactions (Reynolds, 2018). The same view is shared by (GoldCore, 2014) when they said: "throughout history, from ancient Greek and Roman times to Europe in medieval times to Germany in the 1920s and many other countries in the 20th century, gold has protected people's savings and wealth from the debasement of paper currencies and from the scourge of inflation". Countless nations and currencies have risen and fallen, but gold remains because it possesses the following properties that make it "good money" as store-of-value and medium of-exchange: scarcity, verifiability, durability, portability, divisibility, fungibility and recognizability. Gold

have been continuously used by international investors to shield from macroeconomic variables and stock market losses. 2007 introduced the world to a period of extreme volatility since the great depression of 1930 and also a steep decline in most financial assets such as traditional (Equity and currencies) and freshly introduced assets (mortgage-backed securities). While it was true that some assets experienced some drop in their prices, gold had performed strongly as the price doubled a few months after the crisis started.

During the period of the financial crisis of 2007, the performance of Gold reminded the world of finance why the asset was seen as a hedger and at the same time forced some investors to include it in their portfolios. (Tronzano, 2020) concludes that from early 2009 to November 2011 (when a record peak was reached), gold price replicated a steady and even faster increasing trend, apparently displaying its "safe haven" property during most of the Eurozone debt crisis. Gold is a financial investment that is considered as a store value which is immune to credit default, inflation, financial crises and credit default as we have centuries of history to validate that attribute. The current crisis is the latest test to challenge that statement which the asset has successfully passed as per the graph of the price of the asset.

3.1.3. Proprieties of Gold

Gold's portability has helped people to protect their savings and create new lives for themselves in other regions or countries (GoldCore, 2014). However, it was not only the portability that made the commodity attractive to people there are other proprieties to gold that made it become safe haven. This section will highlight the proprieties that was attributed to Gold and which in turn are used to verify if an asset can be considered as Safe haven.

The ability of an asset to hold value throughout the time is very difficult as time holds in itself a lot of uncertainty which can be detrimental to most assets. In contrast to other commodities, gold does not perish or degrade over time, giving it unique properties as a very long-term store of value. Gold mined today is interchangeable with gold mined many hundreds of years ago (Oxford Economics, 2011). The fungibility of Gold is due to the uniform value of the asset as each unit has the same chemical identity which means a coin of Gold will be worth the same amount as the gold coin that was dig out 50 years.

Gold was acknowledged by as a global monetary asset as it is held by either public or private institutions all over the world. That aspect was only possible by the divisibility of Gold. Like previously explained above the metal was very helpful during time of crisis to communities by helping them moving their wealth from one destination to the another. The portability of

the commodity is only possible because you broke down into small segment Gold. That attribute also makes it easier to transact in different amounts.

Time is the greatest ally for gold, as the asset has a unique chemical component that make it last for generations and confer to it the ability to store value and a physical medium-of-exchange. Adding to time you have the scarcity of gold as total supply of the precious metal is limited on earth. It is estimated that if you were to collect every parcel of gold in the world and melt it down you would be left with one 20-meter cube, or just enough to fit in an Olympic-sized swimming pool (Beck, 2019).

As (Beck, 2019) concludes history reinforces that of all the elements naturally existing in the world and all forms of man-made money created, gold possesses the optimal composition of "good money" qualities. That was indeed true until the introduction of the new digital asset which will start as an idea before becoming a reality and little by little imposing itself as the "Digital Gold".

3.2. Bitcoin: the digital Gold

Dating back to some of the earliest civilizations, trade has been used as a way for people to satisfy basic human needs (Beck, 2019). Same argument was made by (Saboia de Albuquerque & Callado, 2015) when they claimed that the need for exchange is an ancient human characteristic. Since prehistoric times, exchange of goods for another goods, services for goods or services for services was part of human endeavour. That aspect of our society is more present in finance which is a place where buyer and seller meet to exchange depending on the need. To facilitate the exchange between the buyer and seller, the concept of currency was introduced. Gold was the most common type of currency at one period of our society, it was a mean exchange between two persons that have two different products which are not complementary. Instead of exchanging the product, the first buyer would give gold in exchange of the stock of the seller. However, as society progress, we moved from gold to fiat currencies as they gave more flexibility to countries as a medium-of-exchange. But to this day, investors still view gold as the ultimate store-of-value hedge against inflation; and for good reason (Beck, 2019).

Cryptocurrencies such as Bitcoin are establishing themselves as an investment asset and are often named the New Gold. Bitcoin is different from any other asset on the financial market and thereby creates new possibilities for stakeholders with regard to risk management, portfolio analysis and consumer sentiment analysis (Dyhrberg, 2016). Bitcoin use the peer-to-

peer technology that allows transactions to be processed over a distributed network using public-private key technology, where the sender and the receiver of a transaction use a private key and everyone else on the network uses a public key to verify the legitimacy of the transaction. Bitcoin has previously been compared to gold as they have many similarities; the primary value is derived due to scarcity of supply, supply is not controlled by a government but independent agents, both assets have high price volatility and total supply is finite (Dyhrberg, 2016).

3.2.1. Similarities between Bitcoin and Gold

In this subsection let see how the two assets can be similar to each other and how the new asset which is Bitcoin can be seen as the potential digital Gold. Using the criteria to evaluate an asset as safe haven we will be checking if Bitcoin falls into that category of asset.

- ❖ Rarity: Same as gold which is limited in the amount of supply of the asset , Bitcoin also is limited to 21Millions. The total of Bitcoin will be reached by the year 2140, in contrary to gold which it is still unknown where the rest of the commodity is currently to mine it. As of February 24, 2021, 18.638 million bitcoins have been mined, which leaves 2.362 million yet to be introduced into circulation.

- ❖ Safety and transparency of the asset: it is probably impossible to create and transport fake gold, the precious metal has an effective system to be used when it comes to trading the hard or the digital version of the commodity. Bitcoins are unique cryptographic assets that are directly verifiable on the Bitcoin blockchain, in real-time, from anywhere in the world (Beck, 2019). However, the security and safety of Bitcoin should be increased overtime to avoid situation where investors lose their assets without a possibility to track them.

- ❖ Fungibility and recognizability: the value of bitcoin is the same across the network, which matches the same attribute of Gold as 1 oz of gold will have the same value as another one even if there was time difference between the mining. A Bitcoin from 2009 would be worth the same as a bitcoin mined in 2021. Adding to that the crypto has managed to create recognition from the same people that used to ban it at the beginning of its journey. In the U.S. specifically, Bitcoin is classified as a commodity by the CFTC, as a non-security by the SEC11 and as property by the IRS (Beck, 2019). At the same time more private businesses are starting to accept Bitcoin as a form of payment, each day the recognition of the cryptocurrency is expanding to becoming a real monetary asset.

❖ Divisibility: The smallest possible unit, a 'satoshi,' represents 0.00000001 of a single Bitcoin which is allows Bitcoin to facilitate digital micro-payments and financing in ways that other forms of money cannot. (Beck, 2019).

The notion that Bitcoin can replace gold as a hedge against inflation has especially interested people in countries where governments were struggling with hyperinflation.

3.2.2. Old ways were good, but Bitcoin is better?

The value of Gold tends to rise during market turmoil, as we saw during the 2008 – 2009 financial crisis when it offers a return up to 20% to investors. According to the World Gold Council, the investment market for gold has now ballooned to nearly $4 trillion (Beck, 2019). That is a significant increase for financial asset. The reason for such rise of the market of Gold came from the ultimate store-of-value that is rooted in the hard money attributes and in particular scarcity of the instrument.

Figure 1

As an investor, an asset that increase in value when economic is going down and the financial market takes a hit will always be welcomed. Gold in general has given investors opportunity to store the value of their gain during period of uncertainty but with the introduction of the cryptocurrencies and Bitcoin, an extra asset came in the scenario. While results pre-Covid are decidedly mixed, many of these studies found evidence supporting the hypothesis that cryptocurrencies had safe haven properties (Conlon, et al., 2020). The ability of Bitcoin to be safe haven has been increasingly noted by the investment world. Using data spanning from July 18th, 2011 to Dec 22nd 2015, Bouri, et al. (2017) found that Bitcoin can serve as an effective diversifier and that it has safe haven properties in some cases (AlAli, 2020).

3.3. Covid-19 and the world

For the past 50 years we have had many of bubbles and bursts that were local sometimes and global other times. Most of those events had their source or origin the financial sector or banks. But in 2020 the world would face a crisis that will leave a mark in human history. Where in the past the source was a bad corporate governance, too much risk taken by a bank or a financial institution; this time the source was health and decades of bad management of the health sectors that will lead to the crisis. In December 2019, a severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) was reported in Wuhan, a city in China. In a few months, the virus had spread quickly outside the epicentre to reach most countries of the planet. This spread of the virus would have a significant impact on the global health. The majority of patients with SARS-CoV-2 infection remain asymptomatic or have mild symptoms, including fever, cough, anosmia and headache. Adding to that the ageing population of most western developed countries, the COVID19 will bring most country to their knees and lead to unprecedent political decisions to avoid the countries to collapse.

3.3.1. Impact of Covid-19 on the financial market

The COVID-19 pandemic has evolved from a health crisis into a severe economic crisis as countries around the world closed their economies and prevented the movement of, and interaction between, people as a means to slow the spread of the virus (Cheema, et al., 2020). Stocks, bonds (with the exception of U.S Treasuries), gold, commodities and currencies (with the exception of the U.S. dollar) all turned red between February 19 and March 23 as the S&P 500 went from its all-time high to its bear-market nadir after a staggering 34% plunge (SCHLEGEL, 2020). Furthermore, (SCHLEGEL, 2020) argues that when the coronavirus exploded and the stock market imploded in March, there was a brief time—similar to the depths of the Great Recession—when seemingly no financial assets were safe. The economic crisis initially led to a massive selloff in the financial markets as investors transferred risky assets into safe haven assets to protect their wealth (Cheema, et al., 2020)

3.3.2. Bitcoin during Covid19

COVID-19 touched all facets of life, and Bitcoin was not exempted. As highlighted by (Sarkodie, et al., 2021) the COVID-19 pandemic is expected to leave a lasting scar on the world economy—in global value chain systems, investor and consumer confidence, and human capital.

Bitcoin positively influenced social encouragement, cybersecurity, and government regulations, and infrastructural quality support on behavioural intentions. During the COVID-19 pandemic, bitcoin surged by 300% in 2020 amid speculations in the financial market that investors were piling the digital currency (Sarkodie, et al., 2021). At the beginning of the pandemic, Bitcoin which is considered as the world's first cryptocurrency – could be bought for about $7,300. The cryptocurrency then suffered a drop during the first implementation of the pandemic actions by governments to stop the pandemic. (Cheema, et al., 2020) found that investment in Bitcoin has proved to be a high-risk strategy during COVID-19. They argued that losses exceeded stock market losses across all of the ten largest economies in the world (Cheema, et al., 2020). In their paper, we can see that the crypto on 12 March dropped significantly as much as 46.5% when at the same time the other safe haven asset Gold only fell 4.8790% and the S&P 500 only suffer 10% drop. While they believe that this should be considered as failure by the asset to demonstrate the ability to hold value during a period of crisis, they following months prove that their conclusion was inaccurate on long term. The COVID-19 outbreak is reported to have affected the efficiency of cryptocurrencies particularly Bitcoin and Ethereum but recovered faster at the end of March 2020 (Naeem et al., 2021) (Sarkodie, et al., 2021). While on the short run, the asset was heavily affected by the decision of tackle the pandemic, as shown by the impressive jump by the end of the year of the crypto, the long run is beneficial to the crypto. The empirical evidence of (Sarkodie, et al., 2021) shows 1% increase in COVID-19 confirmed cases spur Litecoin, Bitcoin, Ethereum, and Bitcoin cash market price by 3.20%, 2.71%, 1.43%, and 1.34%, respectively. Likewise, 1% growth in COVID-19 deaths spurs Litecoin, Bitcoin, Ethereum, and Bitcoin cash market price by 3.84%, 3.27%, 1.75%, and 1.62% (Sarkodie, et al., 2021).

The upward gains were partly influenced by financial market investors who saw the potential of using bitcoin to hedge against recent inflation due to the global pandemic—although inflation in countries like the U.S. was fairly stable (Sarkodie, et al., 2021). One of the reasons for the high demand for the cryptocurrencies during the pandemic was the fact that they could be traded anywhere in the world. In case of Bitcoin the attractiveness of the crypto was boosted by the excellent rise that it experienced shortly after the drop in the month of March. With growing lockdowns and social distancing measures disrupting traditional in-person goods and services, investors increase demand for digital goods that act as safe-haven over uncertainties with traditional regularized-systems, hence, increasing circulation of cryptocurrencies—due to spike in investments and market capitalization.

4. Data & Methodology

While the previous section explored the research question for this thesis, this section will discuss the data and methodology used to answer the research questions. This section is divided between the first part which will explore the data used for the paper and the second section which explain the methodology for each steps taken.

4.1. Data

This thesis is constructed using the dataset of the daily return in US dollar for bitcoin and ten other assets. The data covers a period of two years from the 20 May 2019 to 19 May 2021. However, due to the fact that bitcoin trades even during the weekends we will remove observations that fall on holidays, Saturdays and Sundays. Closing spot prices for all stocks are obtained from Thomson Reuters DataStream. The Bitcoin closing price in US dollar is downloaded from CoinDesk, which is a news site specializing in bitcoin and digital currencies.

The stocks in the portfolio can be grouped into consumer cyclicals, consumer non-cyclicals, Financials, Technology, and a group that will include Gold and 2 ETFs. The pick of the stock was based on the categories they fall into: Growth or Value. Growth stocks tend to have higher risk levels, but the potential returns can be extremely attractive. In the portfolio, Tesla and Netflix can be considered as growth stocks.

Value stocks, on the other hand, are seen as being more conservative investments. Companies like Microsoft, Apple, JPMorgan, Amazon and PepsiCo are value stock as they are mature, well-known companies that already became leaders in their industry.

While stock like Ali Baba are both a value and growth stock. The stock has been growing with the company being more dominant in the Asian market and getting more market shares globally.

Then you have two ETFs: iShares MSCI Emerging Markets ETF and Vanguard S&P 500 ETF (VOO). They were selected based on the investment objectives that they offer to the investors. From their investment object:

"The iShares MSCI Emerging Markets ETF seeks to track the investment results of an index composed of large- and mid-capitalization emerging market equities."

"Vanguard S&P 500 ETF seeks to track the performance of a benchmark index that measures the investment return of large-capitalization stocks." Vanguard S&P 500 ETF invests in stocks in the S&P 500 Index, representing 500 of the largest U.S. companies (Vanguard, n.d.). Bonds were not used in this case because of the current situation of the market and the use of negative rates on some governments' bonds.

With a common denomination in US dollar, it is easier for the paper to conduct the research and achieve the result without the burden of using different real time currency exchange rates.

4.2. Methodology

This section explains the approach taken by this paper to determine the validity of the researched question. The paper relied on a quantitative type of approach to come up with a conclusion to the questions that were highlighted in the previous sections. The quantitative approach was chosen because of the style of the paper and the research conducted, which does not require a human questionnaire. To find an answer to the questions that were introduced by this paper, we adopted the Mean-variance portfolio methodology that was introduced by Harry Markowitz in 1952, which later received a Nobel prize for his work in 1990.

There have been a number of efforts to identify the best combinations of financial assets, but the most popular one, Modern Portfolio Theory (MPT), is based on the seminal work of Markowitz (Quintana & Moreno, 2021). Before the MPT we had traditional portfolio management which is a different approach using a nonquantitative model to balance the assets in a portfolio using different investment products like equity and bonds from different companies and sectors to reduce the overall risk that the portfolio faces. In contrary, we have the MPT which uses a statistical technique to quantify the proportion of diversification that is required using the expected returns of the assets for a period of time, the standard deviation to check the risk, and the correlation between the assets. Markowitz (1952) first described the efficient frontier of the portfolios of risky assets (Chen, 2020). The mean-variance portfolio selection is one of the foundations of modern portfolio theory. According to this framework, the problem can be modelled as a multi objective optimization problem where the decision-maker tries to identify the best portfolios according to two competing dimensions: risk and

return (Quintana & Moreno, 2021).

Higher

Expect Return

The line represents The Efficient Frontier,
the optimal combination of risk and return

Lower

Each dot represents a portfolio. Those closest to
The Efficient Frontier have the potential to produce
the greatest return with the lowest degree of risk.

Lower   Risk/Volatility   Higher
                         (Standard Deviation)
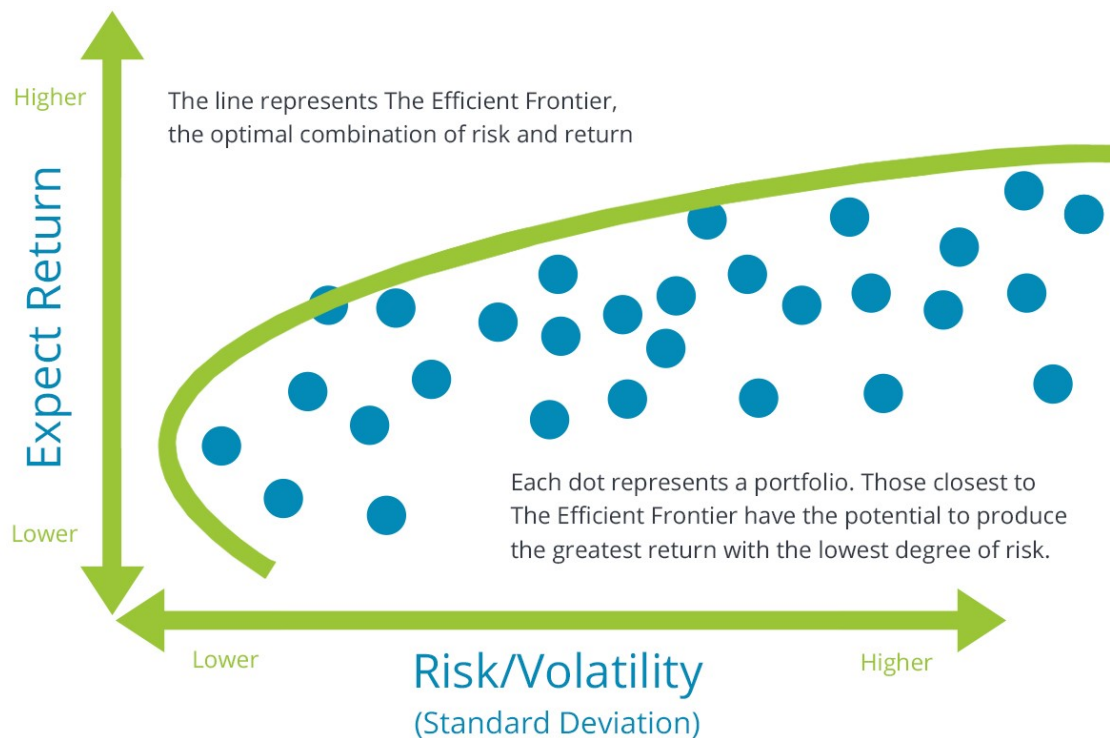
Figure 2

The idea behind the theory is to maximize the expected return of a portfolio provided with a certain level of portfolio risk. Another way of putting that statement would be the investor seeks to reduce the portfolio's risk when he is given a certain level of expected return. The mean-variance portfolio aims to reduce the risk of the portfolio by diversifying the group of assets instead of investing individual in each asset. The portfolios that comprise this efficient frontier are equally good, in the sense that none of them dominates any of the rest (Quintana & Moreno, 2021).

4.2.1. Return of an Investment

In the investment world, the main purpose of an investor to buy a corporation stock is to increase the value of his funds. The appreciation of the investment is done in two ways: increase in the value of the company which is reflected in the share price or by receiving dividends monthly, quarterly, semi-annually or annually depend on the company's dividend policy. Let's define R as the total return of a common stock, for a period of holding the stock:

$$R = \frac{P_1 - P_0 + D_1}{P_0}$$

In the formula above, P_0 is the price of the stock at the start of the period, P_1 is the price at the end and D_1 is the dividend that is paid out by the company during at the end of the period. The formula gives you the historical return or ex post return of the investment. With the returns over a period n express as R_1, R_2, R_3… we can deduct the mean of the returns by adding them for each period and divide by the sum of the number of periods. That will give us the arithmetic mean which is computed as:

$$\text{AM(R)} = \frac{1}{n} \sum_{i=1}^{n} Ri$$

Some argued that the arithmetic mean does not give a fair representation of the mean, the believes that the returns have a significant effect on the final value of the investment. The geometric mean was introduced to compensate where the arithmetic was failing.

However, for this paper we will use a different calculation of the return based on the idea that the actual return of a stock follows is random and can be positive or negative. If we observe the price of a non-dividend paying stock for a number of days, as P1, P2, p3… we will notice that the results seen can be described as normally distributed. To compute the return we will use:

$$R = \ln(\frac{Pi + 1}{Pi})$$

In the formula, Pi is price of the stock on a today, Pi+1 is the price of the security the next trading day, and we consider R in this situation as the continuously compounded rate of return per day (can be per month but daily return gives a better result which is why we will use that for this paper) on the security we invested in.

4.2.2. Risk of an Investment

The concept of risk in our society has always been there since the dawn of human evolution. In the past people were making decision and doing trades without a real good understanding of risk and its impact based on their decisions. The human society evolved from using superstition and tradition to make decisions to using probability to evaluate the risk in our decision thanks to Pascal and Fermat.

From the earlier Italian *risicare,* risk was defined as "dare". It was not regard as fate driven but rather choice that the individual would take. People would dare to take actions out of free will, and that that is all risk is all about. In finance, the concept of risk has always been present, especially true when we look at most portfolio theories. Where some instruments can offer the investors a risk-free investment, for equity investment there is no such a thing as riskless investment. Even the most balanced portfolio will carry a certain level of risk when the investor constructs it. For example, if we look at the equity market, the retail investor that purchase a stock expects to make a return on the investment by the next year or at the end of the year. He might calculate a rate that he would expect by that time, but there is no guarantee that the company will meet his expectation and his will see his investment achieves that rate of return. The company might experience an exception year and record a profit that will drive the share price to be above the investor's predictions. At the same time, the sector of the company might be hit by a crisis and that will affect all the participants like we experienced in the financial crisis of 2007 -2008. Or even more drastic will be the global economy that will be hit by something unexpected like the Covid-19 pandemic and that will affect any sectors of the country. The Modern portfolio Theory uses volatility of returns indicated by market price vacillations as the composite of risks.

4.2.3. Portfolio Formation

We call portfolio a group of securities, or investment products that are put together as a bundle. For this paper we will construct an envelope portfolio. An envelope portfolio is the portfolio of risky assets that gives the lowest variance of return of all portfolios having the same expected return. The envelope of this paper is consisted of 8 equity stocks and 2 Exchange-traded funds (ETFs). As we will be analysing the impact of the uncertainty on the portfolio, using equity seems to be the best approach as they are the investment instruments that will be affected by such situation. The impact of the ETFs would be middle as they are already asset that as constructed as pool of securities.

As we will be using real life situation for this paper, we would assume the investor would take a margin account from its broker which will be offering the investor the possibility to buy securities with borrowed money. We will add to that assumption that the client portfolio would have long and short securities. The idea behind constructing a portfolio is "diversification" of the risk that you face. As an investor you do not want to put your "eggs in one basket" as the quote said. Having all your funds that you might take from your savings or collect from friends in one stock expecting the return to be positive all the time, would be a foolish thinking. You always need to

diversify the risk you are taking, if in the portfolio one of your stocks is underperforming the other will balance the shock by supporting the nonperforming stock.

4.2.4. Risk and Return of a Portfolio

Based on the Markovitz's Modern Portfolio theory the return is measured using the probability distribution of the expected return, and the risk is the standard deviation around the expected value of the probability distribution of the return. In an envelope portfolio each asset possesses its own return and standard deviation, and as we pooled the assets together, we achieve a portfolio that offers to the investor diversification.

(Sharpe , 2000) defines a portfolio's expected return as the weighted average of the expected return of the individual assets. The impact of an asset on the portfolio will depend on the weight of that asset in the portfolio. Adding the weight, volatility of the stock will also have an impact on the return of the portfolio. The volatility is associated with "risk", measuring how much worse than average an investment's bad years are likely to be. The expect return of the portfolio is calculated by using the weighted average of the assets included in the portfolio:

$$E\left(r_p\right) = \sum_{i=1}^{n} w_i E(r_i)$$

The formula is made up on the left side by the $E\left(r_p\right)$ which is the expected return of the portfolio, and the right side is made up of $\sum_{i=1}^{n} w_i$ which is equal to 1 and the weight of the funds (w_i) that are invested in the assets i multiply by the expected return of asset i.

$$Var(rp) = \sum_{i=1}^{n}\sum_{j=1}^{n} wiwjpij\sigma i\sigma j$$

The return and risk of the portfolio can change by altering the weights of the assets comprised in the portfolio. The probability of building portfolios by shifting the asset ratios allows for different portfolio returns and risk at the same time as having the similar asset types in each

portfolio. By doing so, investors can reduce their exposure to individual asset risk, while hoping to achieve a desired expected return.

pij is the correlation coefficient between asset i and j. The coefficient of correlation indicates the relationship between two securities and also determines the variation of security x and

security y which helps in finding out the kind of proportion which can be combined and measured. The correlation of two assets can be calculated in order to see the degree to which two assets move all together. Correlations reveal an easier way to gauge behaviours. Correlations range from +1.0 to -1.0. A correlation of +1.0 implies that there is perfect movement of the return of two assets in the same direction, while a correlation of -1.0 indicates a perfect movement in the inverse directions. And finally, when we get a correlation of zero, that simple suggests that the returns are uncorrelated.

wi and wj represent the proportions that the investor put in each of the asset, and $\sigma i \sigma j$ represent the standard deviation of each asset. The standard deviation is the measurement of uncertainty associated with the asset, a measure of the dispersion of a set of data from its mean. The more spread the data is, the higher is the deviation (Sharpe , 2000)

Under the MPT or mean-variance analysis—an investor can hold a high-risk asset, mutual fund, or security, so long as this high-risk investment is minimized by all underlying assets. According to MPT, there are two components of risk for individual stock return: Systematic and Unsystematic Risk.

MPT defines Systematic Risk as the market risk that investor cannot reduced by using diversification, this type of risk affects the market as a whole or a segment of the market. On the other hand, Unsystematic Risk only affects a specific product or asset and can be reduced by increasing the position the investor holds in the assets.

5. Findings

This section will resume our findings from the construction of the portfolio. To be able to create the portfolio, we acknowledge the assumptions that were introduced by Markowitz:

- ❖ All investors take a position on the efficient frontier, where all investments are maximizing utility. Investors are risk averse, utility maximizing and focus only on their return (mean) and the related risk (variance). The exact location on the efficient frontier which investors take and the portfolio they select will depend on their utility function and the trade-off between risk and return.
- ❖ Investors can borrow or lend any funds at the risk-free rate of return (RFR).

- ❖ All investors have homogenous expectations which mean that they estimate the same distributions for the future rates of return.

- ❖ All investors hold investments for the same one-period of time.

- ❖ Investors are able to buy or sell portions from their shares of any security or a portfolio they hold.

- ❖ There are no taxes or transaction costs on purchasing or selling assets.

- ❖ There is no inflation or any change in interest rates.

- ❖ Capital markets are in equilibrium, and all investments are fairly priced. Investors can not affect prices (Reilly & Brown, 2003).

A portfolio of assets which is constructed based on the above assumptions is considered efficient. The reason is no other or portfolio of assets will offer a higher expected return with the same or lower risk or the inverse. This portfolio theory is ideal for the different style of portfolio that we encounter in the financial market.

5.1. Performance for the Gold Portfolio

Empirical analysis starts with calculating daily returns for each asset in the portfolio for a period of 5/20/2019 to 5/19/2021. In practice, we do not know the returns and standard deviations of individual assets, but we can approximate these values using the historical values of the assets. To start the process of constructing this efficient front, we make a strong assumption that the data collected for this paper would give us a fair representation of how the stock would behave in the future.

Table 1

	Gold	MISC	Apple	Amazon	VOO	JPM	BABA	Tesla	Netflix	Pepsi	Microsoft
Mean	0.0768%	0.0706%	0.1991%	0.1097%	0.0735%	0.0733%	0.0555%	0.5196%	0.0669%	0.0223%	0.1301%
St dev	1.1695%	1.7064%	3.4221%	1.9739%	1.6508%	2.5862%	2.3594%	4.6990%	2.6260%	1.7716%	2.1695%
Variance	0.0137%	0.0291%	0.1171%	0.0390%	0.0273%	0.0669%	0.0557%	0.2208%	0.0690%	0.0314%	0.0471%

Using the formula of the compound return we calculate the daily return of each asset of the portfolio. Then we move to calculate the mean of each asset, to calculate the mean we add up the observed values and divide by the number of them. However, for this paper the average function of Excel was used to derive the Mean of each asset; Tesla stock displayed the highest Mean (0.52%) in our group of Asset and Pepsi had the lowest (0.02%) among the group. Once we calculate the mean, we use the excel function Stdev.s to calculate the standard deviation of each asset. The standard deviation is a statistic that measures the dispersion of a dataset relative to its mean. The standard deviation is an important tool in the

world of finance as it helps investors in planning their trading strategies by measuring the market and the volatility of an asset and also help determinate performance trends. The standard deviation for an Index Fund would be relatively low for example compared to a benchmark index, or higher for a growth stock than a mature stock. From the table, during the period used for this paper, we notice that Tesla displayed the highest standard deviation 4.6990% where at the same time Gold has the lowest 1.1695%. this is not surprise as we already confirm the safe haven ability of the instrument throughout the centuries.

The last row is the calculation of the variance of the assets. Levels of variance translate directly with levels of risk; higher variance suggests higher levels of risk and vice versa. The variance of portfolio return is greater when the covariance of the two assets is positive, and less when negative. Diversification is a technique that minimizes portfolio risk by investing in assets with low or negative covariance. To calculate the variance of the assets in the portfolio the choice of using the Var.s instead of Var.p (population variance) function in Excel was made. The reason for that choice is because in the case of portfolio return statistics, an investor will almost always be dealing with a sample rather than the whole population.

Table 2- Correlation matrix

	Gold	MISC	Apple	Amazon	VOO	JPM	BABA	Tesla	Netflix	Pepsi	Microsoft
Gold	1										
MISC	0.119283	1									
Apple	0.103157	0.428674	1								
Amazon	0.124161	0.569205	0.491723	1							
VOO	0.123151	0.697408	0.56769	0.616859	1						
JPM	-0.03564	0.476857	0.344892	0.257057	0.791352	1					
BABA	0.004969	0.791902	0.315929	0.498785	0.482984	0.282522	1				
Tesla	0.136528	0.463173	0.32663	0.463313	0.47008	0.283874	0.345456	1			
Netflix	0.145225	0.446476	0.365465	0.636876	0.466037	0.177738	0.388672	0.368163	1		
Pepsi	0.216473	0.482744	0.43842	0.467457	0.795527	0.554983	0.302039	0.277201	0.383906	1	
Microsoft	0.106499	0.669469	0.56996	0.737389	0.859424	0.531082	0.515484	0.49854	0.567578	0.696451	1

The table above illustrates the correlative relationships between Gold and the equities in the portfolio constructed. Gold maintains its low correlation to long exposure of global assets with all correlations ranging between -0.04 to 0.2. Since the correlation coefficients are low in absolute terms, Gold remains uncorrelated and a portfolio diversifier in conjunction with portfolios that are short global assets.

Var-Cov, S											
	Gold	MISC	Apple	Amazon	VOO	JPM	BABA	Tesla	Netflix	Pepsi	Microsoft
Gold	**0.0137%**	0.0024%	0.0041%	0.0029%	0.0024%	-0.0011%	0.0001%	0.0075%	0.0045%	0.0045%	0.0027%
MISC	0.0024%	**0.0291%**	0.0250%	0.0192%	0.0196%	0.0210%	0.0319%	0.0371%	0.0200%	0.0146%	0.0248%
Apple	0.0041%	0.0250%	**0.1171%**	0.0332%	0.0321%	0.0305%	0.0255%	0.0525%	0.0328%	0.0266%	0.0423%
Amazon	0.0029%	0.0192%	0.0332%	**0.0390%**	0.0201%	0.0131%	0.0232%	0.0430%	0.0330%	0.0163%	0.0316%
VOO	0.0024%	0.0196%	0.0321%	0.0201%	**0.0273%**	0.0338%	0.0188%	0.0365%	0.0202%	0.0233%	0.0308%
JPM	-0.0011%	0.0210%	0.0305%	0.0131%	0.0338%	**0.0669%**	0.0172%	0.0345%	0.0121%	0.0254%	0.0298%
BABA	0.0001%	0.0319%	0.0255%	0.0232%	0.0188%	0.0172%	**0.0557%**	0.0383%	0.0241%	0.0126%	0.0264%
Tesla	0.0075%	0.0371%	0.0525%	0.0430%	0.0365%	0.0345%	0.0383%	**0.2208%**	0.0454%	0.0231%	0.0508%
Netflix	0.0045%	0.0200%	0.0328%	0.0330%	0.0202%	0.0121%	0.0241%	0.0454%	**0.0690%**	0.0179%	0.0323%
Pepsi	0.0045%	0.0146%	0.0266%	0.0163%	0.0233%	0.0254%	0.0126%	0.0231%	0.0179%	**0.0314%**	0.0268%
Microsoft	0.0027%	0.0248%	0.0423%	0.0316%	0.0308%	0.0298%	0.0264%	0.0508%	0.0323%	0.0268%	**0.0471%**

A market participant faces two types of risk when he buys a stock, the first is systematic risk and the second is unsystematic risk. From a portfolio perspective, there are two important concepts that help investors manage those risks. The first concept is the variance which can be defined as the deviation of a stock's return with its own average returns and the covariance which is the variance of a stock with another stock's return and also the second concept. We use the matrix algebra to evaluate the variance co variance and the correlation of a portfolio that is built with multiple stocks.

The variance – covariance matrix will then be used to calculate the key components of the paper that will help us drawing a successful conclusion.

To proceed to the calculation on the allocation to each assets, we will be using a constant ratio for each portfolio.

A constant ratio plan (also known as "constant mix" or "constant weighting" investing) is a strategic asset allocation strategy, or investment formula, which keeps the aggressive and conservative portions of a portfolio set at a fixed ratio (Hayes, 2021).

Computing an envelope portfolio x, with c = 0.002		
c =	0.0020%	
	z	x
Gold	555.75%	111.44%
MISC	-71.96%	-14.43%
Apple	105.10%	21.08%
Amazon	92.19%	18.49%
VOO	-506.04%	-101.47%
JPM	193.67%	38.84%
BABA	-44.47%	-8.92%

Tesla	216.34%	43.38%
Netflix	-128.18%	-25.70%
Pepsi	-285.53%	-57.25%
Microsoft	371.81%	74.56%

The same calculation will be done for the portfolio Y to find the possible allocation for the assets based on a different constant as for portfolio X. using the MMULT (MINVERSE (B6:L16), M6:M16-B21) formula in Excel, we used the matrix and the mean from which we subtracted the constant to find the allocation Z for each asset. Once the find Z, we then use the information to calculate the proportion of funds that will go into each asset to have a total of 1 or 100%. As short selling is allowed for this portfolio, we can see that some of the positions will have a negative proportion. The proportion of investing in Gold is the highest in the portfolio at 111.44%, which is at the opposition of VOO with -101.47%.

Computing an envelope portfolio y, with c = 0.05		
c =	5.00%	
	z	y
Gold	-33877.52%	60.30%
MISC	-5853.91%	10.42%
Apple	1840.23%	-3.28%
Amazon	-8131.87%	14.48%
VOO	-18745.47%	33.37%
JPM	-858.73%	1.53%
BABA	-2907.45%	5.18%
Tesla	2658.47%	-4.73%
Netflix	-84.07%	0.15%
Pepsi	-739.07%	1.32%
Microsoft	10521.72%	-18.73%

The key finding from the table above is that some assets would be shorted in the portfolio irrespective of their type of assets. However, with the new constant we can see a different from the portfolio X. Gold still has the higher proportion of the funds with 60.30%, but VOO

in this portfolio is positive which mean we are long, and Microsoft is negative at -18.73% where previously we were long in the stock for Portfolio X

Portfolio's statistics		
	Portfolio x	Portfolio y
Mean	0.379%	0.043%
Variance	0.076%	0.009%
St. Deviation	2.75%	0.94%
Covariance	0.0082%	
Correlation	31.85%	

Using the new set of data, which is the proportion we can then calculate the mean of each portfolio. Then the variance of the portfolios which will give us the standard deviation by using the Sqrt function of Excel. The covariance is calculated using the proportion of both portfolio and the variance – covariance matrix. We then finish with the correlation of the envelope portfolio by using the covariance and the standard deviation. The correlation of the portfolio is at 31.85%, which can be considered as moderate association between each assets.

If a portfolio's strategic asset allocation is set to be 60% stocks and 40% bonds, a constant ratio plan will ensure that, as markets move, that 60/40 ratio is preserved over time (Hayes, 2021). In this paper, we will opt for a proportion of 30% in portfolio X and 70% in the other portfolio.

Proportion in Port x	30%
Proportion in Port y	70%
Mean	0.14%
Variance	0.01%
St. Deviation	1.21%

We then use the two mean that we multiply by each proportion to calculate the portfolio mean and then use the variance formula that we describe in the methodology to calculate the variance of the portfolio which we square rooted to find the standard deviation of the portfolio that amount of return. The result simple means that for an investor that wanted to have a return of 0.14%, he would be willing to take on a risk of 1.21%.

From the data function we simulated the data to find more set of returns and risks to create the efficient frontier for the envelope portfolio.

Data table: varying the proportion invested in Port x		
% Port x	Portfolio st.dev.	Portfolio mean
	1.21%	0.14%
-80%	2.31%	-0.23%
-70%	2.07%	-0.19%
-60%	1.84%	-0.16%
-50%	1.63%	-0.13%
-40%	1.42%	-0.09%
-30%	1.24%	-0.06%
-20%	1.09%	-0.02%
-10%	0.98%	0.01%
0%	0.94%	0.04%
10%	0.97%	0.08%
20%	1.06%	0.11%
30%	1.21%	0.14%
40%	1.39%	0.18%
50%	1.59%	0.21%
60%	1.81%	0.24%
70%	2.03%	0.28%
80%	2.27%	0.31%
90%	2.506%	0.345%
100%	2.750%	0.379%
110%	2.996%	0.413%
120%	3.245%	0.446%
130%	3.495%	0.480%
140%	3.747%	0.514%
150%	4.000%	0.547%
160%	4.254%	0.581%

170%	4.509%	0.614%
180%	4.764%	0.648%
190%	5.020%	0.682%
200%	5.276%	0.715%
210%	5.533%	0.749%
220%	5.790%	0.782%
230%	6.047%	0.816%
240%	6.305%	0.850%
250%	6.563%	0.883%
260%	6.821%	0.917%

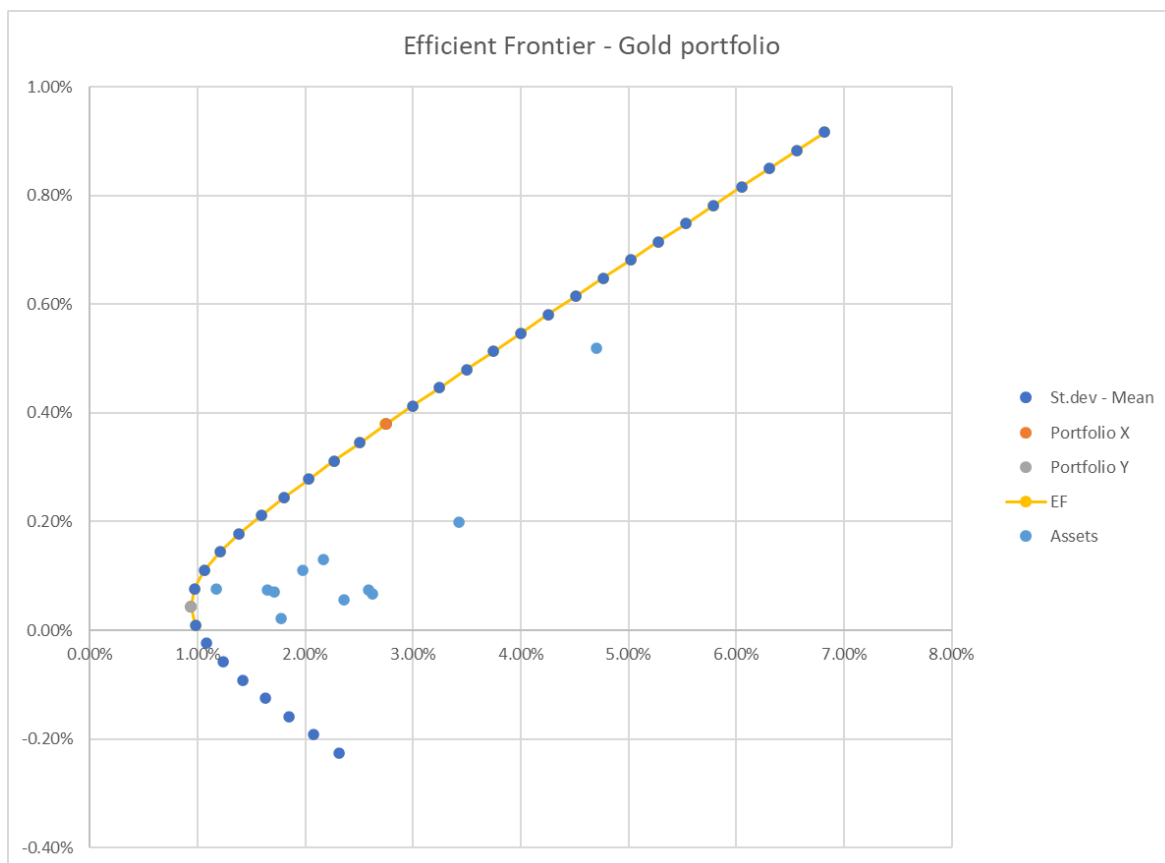The graph below shows the data above in a better visual:

Figure 3

As per the figure 3, we can the efficient frontier for the portfolio that has Gold as a safe haven asset. Both portfolio X and Y are on the positive side of the curve. Any investment risk is the unpredictability of return on a stock, assets or a portfolio.

Now that we have an idea on how the portfolio would be when using Gold to take the shock on the shock of the event experienced in 2020, we will replicate the same but changing the asset Gold to Bitcoin, the very first crypto currency.

5.2. Performance for the Bitcoin Portfolio

The same experiment as the previous paragraph was conducted with Bitcoin to see the impact of the asset in the portfolio during the period of time we use for the paper. We construct the variance – covariance matrix for the portfolio and from there calculate the mean and standard deviation of the envelope portfolio.

Table 4 - variance-covariance matrix

| | Var-Cov, S | | | | | | | | | | | |
	Bitcoin	MISC	Apple	Amazon	VOO	JPM	BABA	Tesla	Netflix	Pepsi	Microsoft	Mean
Bitcoin	**0.21151%**	0.01400%	0.01758%	0.01159%	0.01543%	0.01812%	0.01308%	0.03168%	0.01284%	0.01387%	0.01524%	0.32917%
MISC	0.01400%	**0.02900%**	0.02493%	0.01910%	0.01957%	0.02096%	0.03176%	0.03699%	0.01993%	0.01454%	0.02469%	0.07061%
Apple	0.01758%	0.02493%	**0.11664%**	0.03308%	0.03194%	0.03040%	0.02541%	0.05232%	0.03271%	0.02647%	0.04215%	0.19909%
Amazon	0.01159%	0.01910%	0.03308%	**0.03881%**	0.02002%	0.01307%	0.02314%	0.04281%	0.03288%	0.01628%	0.03145%	0.10973%
VOO	0.01543%	0.01957%	0.03194%	0.02002%	**0.02714%**	0.03365%	0.01874%	0.03632%	0.02012%	0.02317%	0.03066%	0.07348%
JPM	0.01812%	0.02096%	0.03040%	0.01307%	0.03365%	**0.06662%**	0.01717%	0.03436%	0.01202%	0.02533%	0.02968%	0.07330%
BABA	0.01308%	0.03176%	0.02541%	0.02314%	0.01874%	0.01717%	**0.05545%**	0.03815%	0.02399%	0.01258%	0.02628%	0.05554%
Tesla	0.03168%	0.03699%	0.05232%	0.04281%	0.03632%	0.03436%	0.03815%	**0.21994%**	0.04525%	0.02299%	0.05062%	0.51960%
Netflix	0.01284%	0.01993%	0.03271%	0.03288%	0.02012%	0.01202%	0.02399%	0.04525%	**0.06868%**	0.01779%	0.03221%	0.06690%
Pepsi	0.01387%	0.01454%	0.02647%	0.01628%	0.02317%	0.02533%	0.01258%	0.02299%	0.01779%	**0.03126%**	0.02666%	0.02227%
Microsoft	0.01524%	0.02469%	0.04215%	0.03145%	0.03066%	0.02968%	0.02628%	0.05062%	0.03221%	0.02666%	**0.04688%**	0.13007%

We use the same constants 0.02% and 5% as the previous envelope which has Gold.

Table 5

Computing an envelope portfolio x, with c = 0.002		
c =	0.002%	
	z	x
Bitcoin	1.364741751	157.65%
MISC	-0.080747953	-9.33%
Apple	1.092206768	126.17%
Amazon	0.886555023	102.41%
VOO	-4.905573526	-566.66%
JPM	1.124346987	129.88%
BABA	-1.044308681	-120.63%
Tesla	2.225482094	257.08%
Netflix	-1.150141217	-132.86%
Pepsi	-2.016053868	-232.88%
Microsoft	3.369185179	389.19%

Surprisingly, we do see the same data as previously with the Gold's portfolio. the highest proportion went to Microsoft in this experimentation and the lowest was VOO. When we increase the constant, we notice a shift in the output from highest Microsoft which turns

negative and VOO which becomes positive. The proportion that is allocated to Bitcoin falls drastically to 2.20% which is far from the proportion of Gold at that constant.

Computing an envelope portfolio y, with c = 0.05		
c =	5.0%	
	z	y
Bitcoin	-6.335548256	2.20%
MISC	-115.5645087	40.15%
Apple	16.52821227	-5.74%
Amazon	-80.07168512	27.82%
VOO	-249.6430525	86.73%
JPM	46.51198354	-16.16%
BABA	9.38857421	-3.26%
Tesla	18.01710019	-6.26%
Netflix	-11.07206741	3.85%
Pepsi	-70.01052374	24.32%
Microsoft	154.4101201	-53.64%

Once we calculate the proportion of each asset in the portfolio X and Y at the respective constant of 0.002% and 5%, the paper then calculate the means, variance, and covariances of the two portfolios.

Portfolio's statistics		
	Portfolio x	Portfolio y
Mean	2.189%	0.010%
Variance	2.526%	0.017%
St. Deviation	15.89%	1.32%
Covariance	0.010%	
Correlation	4.67%	

With the information we found in the above table, the next step would be to calculate the standard deviation and return of the combinations of portfolio X and Y.

Proportion in Port x	0.3
Proportion in Port y	0.7
Mean	0.664%
Variance	0.236%
St. Deviation	4.86%

We allocate a proportion of funds in the portfolio, for this paper we use 30% for the portfolio X and 70% for the portfolio Y. This gives us a level of risk 4.86% for the portfolio and a return of 0.664%.

The data table and the graph of the simulation of the risk and return of the portfolio gives us the below:

% Port x	Portfolio st.dev.	Portfolio mean
	4.86%	0.66%
-80%	12.75%	-1.74%
-70%	11.16%	-1.52%
-60%	9.58%	-1.31%
-50%	8.00%	-1.09%
-40%	6.42%	-0.87%
-30%	4.86%	-0.65%
-20%	3.31%	-0.43%
-10%	1.84%	-0.21%
0%	0.92%	0.01%
10%	1.84%	0.23%
20%	3.31%	0.45%
30%	4.86%	0.66%
40%	6.42%	0.88%
50%	8.00%	1.10%
60%	9.58%	1.32%
70%	11.16%	1.54%
80%	12.75%	1.76%
90%	14.33%	1.98%
100%	15.92%	2.20%
110%	17.51%	2.42%
120%	19.10%	2.63%
130%	20.68%	2.85%
140%	22.27%	3.07%
150%	23.86%	3.29%

160%	25.45%	3.51%
170%	27.04%	3.73%
180%	28.62%	3.95%
190%	30.21%	4.17%
200%	31.80%	4.39%
210%	33.39%	4.60%
220%	34.98%	4.82%
230%	36.57%	5.04%
240%	38.16%	5.26%
250%	39.75%	5.48%
260%	41.33%	5.70%
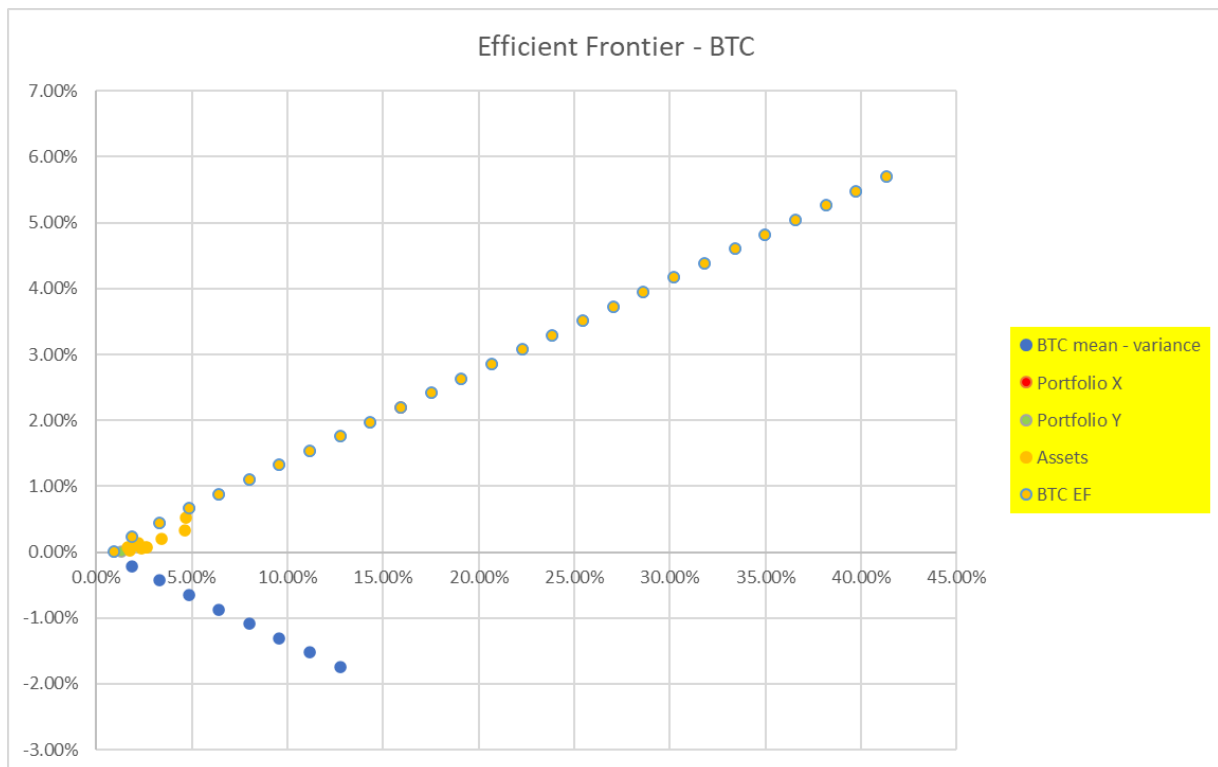
Figure 4

Table 6

	Bitcoin	MISC	Apple	Amazon	VOO	JPM	BABA	Tesla	Netflix	Pepsi	Microsoft
Bitcoin	1										
MISC	0.178744	1									
Apple	0.11194	0.428674	1								
Amazon	0.127952	0.569205	0.491723	1							
VOO	0.203592	0.697408	0.56769	0.616859	1						
JPM	0.152643	0.476857	0.344892	0.257057	0.791352	1					
BABA	0.120747	0.791902	0.315929	0.498785	0.482984	0.282522	1				
Tesla	0.146902	0.463173	0.32663	0.463313	0.47008	0.283874	0.345456	1			
Netflix	0.106523	0.446476	0.365465	0.636876	0.466037	0.177738	0.388672	0.368163	1		
Pepsi	0.170608	0.482744	0.43842	0.467457	0.795527	0.554983	0.302039	0.277201	0.383906	1	
Microsoft	0.153027	0.669469	0.56996	0.737389	0.859424	0.531082	0.515484	0.49854	0.567578	0.696451	1

The table 6 above illustrates the correlative relationships between Bitcoin and the multiples assets in the portfolio. Bitcoin maintains its low correlation to long exposure of global assets with all correlations ranging between 0.11 to 0.2. Since the correlation coefficients are low in absolute terms, Bitcoin remains uncorrelated and a portfolio diversifier in conjunction with portfolios that are short global assets.

5.3. Summary

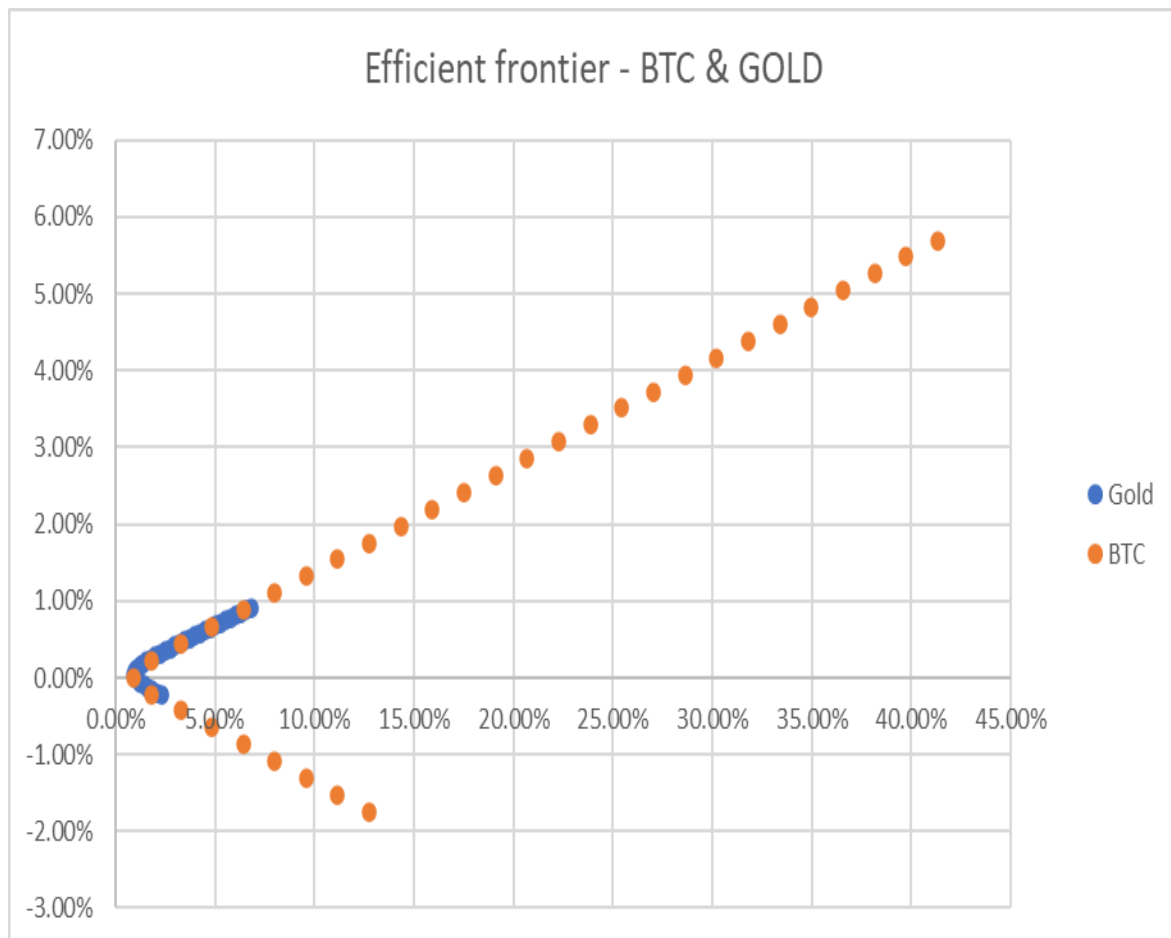Efficient frontier - BTC & GOLD

Figure 8 illustrates two efficient frontiers. A red efficient frontier represents an efficient frontier of a portfolio that includes BITCOIN as a financial asset. The blue efficient frontier does not incorporate the specified cryptocurrency but has Gold instead. The result we can see from the graph is that an efficient frontier with Bitcoin as asset is above an efficient frontier without BITCOIN included but Gold another safe haven asset. For example, as comparison we can see that at 6.42% risk level, a portfolio with the cryptocurrency delivers a return of 0.88% which can be considered decent with the time period of the study. At the same, when we compare this result to the other portfolio which has Gold instead of Bitcoin, we first do the average to two risk level to have a fair representation of the return. Using the average function in excel we get the mean of the two risk levels 6.305% and 6.563% as 6.434% which is the closest to the risk we pick from the Bitcoin's portfolio. Same process was done for the return's levels at that percentage, and we have as return 0.866%. Provided that for the same level of risk, from time to time, even when the risk level is lower, a portfolio with BITCOIN delivers a higher return. This leads us to conclude that a portfolio that includes Bitcoin as a safe haven asset instead of Gold, would produce a higher level of return even during period of turmoil of the market or the economy.

6. Conclusion

The introduction of Bitcoin in 2009 marked a paradigm shift in the evolution of our global financial infrastructure, monetary systems, and the economic opportunities afforded by them (Beck, 2019). (Nakamoto, 2009) have proposed a system for electronic transactions without relying on trust. As fully explained, they started with the usual framework of coins made from digital signatures, which provides strong control of ownership, combined with a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU power (Nakamoto, 2009). Despite its popularity and gradual worldwide acceptance, most people are still confused as to what a Bitcoin actually is. The status of Bitcoin as an alternative currency, transactions tool or a speculative bubble is still subject to on-going debate (Bouoiyour & Selmi, 2017). The debate mostly comes from the high volatility of the instrument. (Shahzad, et al., 2019) conclude in their paper that Bitcoin, gold, and commodities have a similarity in their weak safe-haven properties for the world stock market index, which is not the case for the developed, emerging, US, and Chinese stock markets. (Smales, 2019) on the other hand, argues that while other research in cryptofinance has continued to consider whether Bitcoin possesses a safe haven property as traditionally

defined by its correlation with other assets during times of market stress, it ignores the attribute of assets that are important to investors. Bitcoin is more volatile and less liquid than other assets – including traditional safe havens such as gold. Furthermore, Bitcoin should not currently be considered as a safe haven, even if it were to meet the existing criteria related to return correlation (Smales, 2019). But like (Shahzad, et al., 2019), many academics believe in the ability of the crypto to reach the same level of Gold and other safe haven instruments in the future. (Baur & Glover, 2016) think despite its high historical volatility compared to major currencies, Bitcoin may evolve as a store of value and an alternative to other stores of value such as gold.

Numerous studies prove that gold reduces overall risk and improves performance by enhancing returns (GoldCore, 2014). However, (Cheema, et al., 2020) conclude in their paper that traditional assets such as gold and silver failed to protect investors' wealth during days when they needed it the most. All safe haven assets are not necessarily safe by default during a stock market crisis (Cheema, et al., 2020). And that is the reason why some investors might want to go away from the traditional way to embrace something different.

It appears that the high volatility period caused by the COVID-19 pandemic is normal in a Bitcoin context as the volatility did not significantly increase in that period despite the 50% drop in prices in March 2020 and the subsequent rise of more than 100%. To check the robustness of this finding, we also use March 31, 2020, as the end of the COVID-19 crisis, and the results are qualitatively identical; the parameter for the COVID-19 crisis never turns out statistically significant (Baur & Glover, 2016). Same conclusion was done previously by (Klein, et al., 2018) as their correlation modelling provides evidence that Bitcoin behaves completely different from Gold, in market distress.

Overall, the evidence from this paper points to the conclusion that investors who seeks protection from the uncertainty of the equity market can use Bitcoin as safe haven. The comparison with gold in the portfolio demonstrates that Bitcoin offers to the investors more benefice during the period of the pandemic. This can be useful not just to investors but institutional investors, governments in terms of the usage of Bitcoin.

On a final note, the results with the portfolio including Bitcoin as asset seem interesting but investors must be caution in regard to the instrument due to the volatility. While on the long run it is offset by the asset's ability to bounce back, on the short run and for a trader that want

to take advantage of the market it might work as a double edge sword. In the history of financial asset, Bitcoin is most volatile asset in the portfolio and for investor that are looking for a safe haven it might be a big decision, but they can take advantage of the long run aspect and recover above their expectation. The time will tell us if the digital Gold will be able to replicate the same level of trust as the traditional Gold.

7. Final Discussion

This section will be the closure of a long journey that was this dissertation on a topic I found interesting and fascinating. The cryptocurrency introduction from 2009 to today shows that the world of finance can be expanded further in the future. As we have seen countless of time, the financial world is not static and has been constantly changed over the years through different approach but mostly with the innovation that was done with technology. The disruption that was created because of the improvement in the way we use technology was quickly accepted by major players.

7.1. Reflections and Criticism

While the dissertation focuses on the trying to see the impact of Bitcoin as a safe haven for an investor during time on uncertainty, there are currently a few flaws in the work overall. The environment set ups for the paper was designed to only see an aspect of the equation which is the impact of the financial instrument in a portfolio essentially constructed with equity. However, in the real world a portfolio is constructed with different type of financial instruments. The reason I chose only stocks or equities was because I knew the impact of the pandemic on the stock market and was targeting that exact shock received by that financial instrument.

7.1.1. Asset's selection

As already pointed out, a real-life portfolio is constructed using different financial instruments. The allocation is done by dividing the capital between the financial assets. The asset allocation most of the time will be based on the risk profile of the investor. A young investor of 20 years of age will be more willing to take on risk than an investor that is over 50 years. The more risk an investor can take the more aggressive the portfolio would be. On the efficient frontier of the Bitcoin that was produce for this paper, you will see them from the 10% above. While the more conservative investor would be less willing to go above the 10% and even select the Gold's portfolio as it is more protective.

After the allocation you need to decide the financial instruments. Once the select the appropriate asset classes are selected, those might be split even more in subclasses. For example, an investor might divide the portfolio's equity portion between different industrial sectors and companies of different market capitalizations, and between domestic and foreign stocks. The bond portion might be allocated between those that are short-term and long-term, government debt versus corporate debt and so forth (Gallant, 2021).

The selection of assets is key as the different asset classes that the financial market offers to investors do not offer the same returns and face the same risk. The financial instruments are divided in three categories: Money market, Capital Market and Hybrid instruments.

❖ The money market is an organized exchange market where participants can lend and borrow short-term, high-quality debt securities with average maturities of one year or less. It enables governments, banks, and other large institutions to sell short-term securities to fund their short-term cash flow needs (Corporate Finance Institute, n.d.).

❖ A capital market is a place that allows the trading of funding instruments such as shares, debentures, debt instruments, bonds, ETFs, etc. It is a source for raising funds for individuals, firms and governments (Thakur, n.d.).

❖ Hybrid financial instruments are a type of financial instrument that possess features of both debt and equity. These instruments help provide a greater degree of flexibility for both the business receiving the investment as well as for the investors that are financing it (Department Of Finance, n.d.).

All those financial instruments offer to the investors a different risk and return; and adding them in a portfolio provide a different advantages and disadvantages. The portfolio in the paper would be accurate to the real world if the selection was more diverse, and we use more instruments.

7.1.2. Limitation of the tool

Apart from the assets use another criticism would be the tool use to evaluate the paper. While the efficient front is a useful tool that has helped investors for so many years in investigating the risk and return of their portfolio, it still needs other risk metric to valid the finds. While the efficient frontier is good in theory, replicating in real life has been proven to be impossible. The assumption that the portfolio's asset returns follow a normal distribution is considered by some academics as one of the biggest limitations of the

theory. Studies has demonstrated that the returns on assets follow a heavy-tailed distribution and not normal.

Furthermore, upon reflecting on the about we notice that the assumption that investors are rational when making their investment decision and their willingness to avoid risk has been proven false or debatable so far. As we have seen countless of time the irrationality of a lot of investors, even the most experienced investors.

7.2. Suggestions for Further Research

While the adaption of bitcoin has been very slow in the society, more financial companies have started to embrace the use of the cryptocurrency for various purpose. The phenomena do not stop to financial companies, but some governments and more retail investors are ready to embrace the cryptocurrency even with the high volatility that the instrument displayed so far. Global adoption of cryptocurrency has taken off in the last year, up 881%, with Vietnam, India and Pakistan firmly in the lead, according to new data from Chainalysis (Pérez & Ostroff, 2021). At the end of the August 2021, tiny and impoverished El Salvador's move to become the first country in the world to adopt bitcoin as legal tender got off to a bumpy start, as the government tok its bitcoin e-wallet offline for several hours after tens of thousands of people tried to download the app, overloading servers (Sigalos, 2021). With more roles being enabled for the crypto currency, the journey for the cryptocurrency to embrace more role has started. Will it succeed? Only the time will tell us.

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