Project Dissertation Report on

CRYPTOCURRENCY; IS AN ALTERNATIVE HIGH RISK, HIGH RETURN INVESTMENT?

Submitted By

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Declaration

I Maryam Mohebbe, daughter of Habibullah Roll No.2K19/DMBA/121 student of Master of Business Administration at Delhi School of Management of Delhi Technological University, where I declared the project report as titled;

CRYPTOCURRENCY; ALTERNATIVE AND HIGH RISK, HIGH RETURN INVESTMENT

"Submitted by me in partial fulfillment of the requirement for the award of the degree of Master of Business Administration." "It is my work and has not been submitted or published earlier. Solemnly I declare that in the future, it shall not be submitted by me to this or any other university or institution for obtaining any other academic credit"

Maryam Mohebbe

MBA (2019-2021)

Acknowledgment

“All praise and appreciation to Almighty Allah, the source of mankind's knowledge and wisdom, who bestowed upon me mental power and the ability to contribute materially to already existent knowledge.” “All respect and love to him, who serves as an everlasting example of wisdom for all of humanity.”

" with offering my heartfelt gratitude to" our Professor. “for encouraged me in writing this Major Project [CRYPTOCURRENCY; IS AN ALTERNATIVE HIGH RISK, HIGH RETURN INVESTMENT?] with the substance of genius and attitude, she consistently and effectively imparted a spirit of adventure accordingly,” said Head of DELHI SCHOOL OF MANAGEMENT(DSM) DELHI TECNOLOGICAL UNIVERSITY , Dr. “ARCHANA SINGH,”.

In addition, I express my gratitude and best wishes to Assistant Prof. Dr. "Abhinav Chaudhary," faculty coordinator, for sharing the best of his knowledge with me. “I am very grateful to him and the other members of the team for providing me with regular advice, motivation, and inspiration as I worked on my Major Project Report.”

And by using this opportunity I like to convey my gratitude and appreciation to all the people who helped me in this area” “I'm also grateful to my family and coworkers for continually encouraging me to finish the project and providing me with a learning environment.”

Maryam Mohebbe

Executive Summary

Cryptocurrency and blockchain are attractive and important topics in today's world. This technology has emerged as one of the significant financial software platforms. This platform is relying on the secure data structure which is distributed and one of the key components of this system is mining. Mining with combining the recorded past transaction with blockchain (distributed ledger), permit customer for secure access, and robust consensus for each of the transaction. The important attribute of this system is that investors can trade in the blockchain without any intermediaries. Risk and return are the most important attribute of assets for investing.

Cryptocurrency as an alternative investment is predicted to find a significant place in the portfolio and will decrease the investment in the other assets, in this study we want analysis that it can be a choice for future investments with high returns and low risk, as a viable investment. For this analysis needs to find the correlation between the cryptocurrency and after that analysis, the volatility and return of that in the portfolio with other assets such as real estate, property, treasury bills and others, analysis of this project have done through the python for getting the accurate answer of this analysis. because of the increase in cryptocurrency finding the price of cryptocurrency is easy from a website like a yahoo, Quandl, and another source.

The result of this study shows that it is no difference in the correlation on the price of cryptocurrency and This study explain that almost all the cryptocurrency has correlation with each other's. and behalf of the cryptocurrency, bitcoin was involved in the portfolio analysis. This analysis explore that cryptocurrency can be a suitable and good option in the diversification of portfolio, due to low correlations among the traditional asset and cryptocurrencies, and higher return of average daily return of most cryptocurrencies than other traditional investments. Also plots of the efficient frontier explain that investor have to be aware about the danger of cryptocurrency for having high return and high risk ,

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CHAPTER ONE

INTRODUCTION

1. INTRODUCTION

1.2 Background

Throughout a brief history of cryptocurrency, erratically this industry has grown at an unparalleled rate. Since the public release of the first anarchic cryptocurrency, Bitcoin, in January 2009, more than 550cryptocurrencies have been created which majority of them has only a sliver of success. (Aung & Tantidham, 2017). There is also the scarcity of research in this market and the most focus of this researches is on the bitcoin rather than the other coins, and it is rapidly being outpaced by industry innovations such as new coins, technical advancements, and increased government regulation.

Digital forms of currency, such as Bitcoin and Ethereum, have risen quickly and unexpectedly in recent years. Digital types of finance are increasingly being used in government money owes and the exchange of goods and projects. As a result of this, the cryptocurrency industry has grown tremendously, with more than a great many digital currencies on the market.

With the increasing ubiquity of digital forms of currency, a growing number of businesspeople and speculators are investing in this new resource class. They are common among young investors who want to benefit quickly, but money earned quickly is also lost quickly because of their high risk. However, the high risk means something else: there would be extraordinary yield. Cryptocurrency speculation is high risk because the valuations of cryptographic types of money are extremely volatile, with daily fluctuations of more than 20%. Regardless of this fact, digital forms of money have made a solid step in the last two years, and some long-haul speculators regard them as important. Young financial professionals are profiting handsomely from investment, which has attracted significantly more seasoned speculators. Cryptocurrency contribution is becoming increasingly common as a result of its high yield.

Digital resource which is meant to be used as a medium of exchange for goods and services is called cryptocurrency. It makes use of strong cryptography to manage the creation of new units, secure monetary transactions, and monitor the exchange of benefits. This current trade medium is a type of virtual currency, digital cash, or elective

money. Decentralized control is used instead of centralized control in digital forms of currency for Managing an accounting system and gathering electronic cash. (Jayadas, n.d.).

1.1.1 Blockchain:

Blockchain is a digital ledger for making a transaction on the bitcoin or other cryptocurrency which are recorded chronological order and publicity and through that can have access on the all of information related to the transaction such as the amount of money. Whit launching the Bitcoin cryptocurrency for the first time, blockchain technology was used for the first time also. Today one of the most widely used framework based on Blockchain technology is still bitcoin. (Yli-Huumo et al., 2016)

The public transaction ledger of the bitcoin is a blockchain. bitcoin is one of decentralized digital currency which its essential characteristic is marinating the currency value without the intervention of any company or government. The Bitcoin network's number of transactions and users is continuously growing. Furthermore, conventional currency conversions, such as KRW, EUR, and USD, occur frequently in currency exchange markets [Bitcoin has thus attracted the attention of numerous societies and is currently the most popular digital currency based on Blockchain technology. (Farell, 2015)

Public key infrastructure (KPI) which is used by bitcoin for enhancing security and communication is one of the standard base technology, the user in PKI only has one set of public and private keys. In the user’s bitcoin wallet address, while the private key is used to authenticate the public key. Bitcoin transaction was made up by the sender's public key, several receiver's public keys, and the value transferred. The transaction will be written in a block in about ten minutes. A previously written block is then connected to this new block. All of the blocks, including information about each transaction, are saved in the users' disc storage, which is referred to as nodes. Each node stores information about all Bitcoin network transactions and uses previous blocks to verify the correctness of each new transaction. Checking the correctness of transactions rewards the nodes. Mining is the term for this process, which is supported by Proof-of-Work, it is one of the significant concepts in technology of block chain. All of them are aligned

in a continued chain in which the new blocks are connected to the previous blocks. Block chain which is used by bitcoin a public ledger technique, and it consists of a series of blocks. (Yli-Huumo et al., 2016)

The block chain of Bitcoin, is used for issuing and exchanging money for Bitcoin currency users knows as a decentralized management strategy. With this method without requiring the involvement of a third party, able to endorse a public ledger of all Bitcoin transactions that have ever been completed.

According to Swan .M (2015) in blockchain technology, there are some drawbacks and technological obstacles that have been found, and he was able to identifies seven barriers and technological obstacles and to the potential adoption of Blockchain technology:

- Security: possibility of 51% attack, which a single entity can manipulate and full of control on the majority of hash rate
- Latency: bitcoin block needs more than 10 minutes for creating sufficient security and more time to outweigh spending more money in once (double-spending attack)
- Throughput: maximum of 7tps transaction per second is the throughput potential of issue
- Usability: bitcoin API is difficult to use for developing service and needs to develop more API
- Wasted resource: its mining waste the almost $15 million per day which is a huge amount of energy is caused by proof of effort in the work.
- Hard forks, Versioning, multiple resources: A narrow chain with small number of nodes are in the dominant of 51 percent attack which is more likely to occur because in the time of chains, broken for administrative or versioning purposes, another problem will arise.
- Size and hand width: In the bitcoin network, the scale of a Blockchain is currently over 50,000MB (February 2016). As throughput reaches VISA levels, Blockchain could expand by 214 billion dollars per year. According to assumption of The Bitcoin community, each block is 1MB in size and in every 10 minute a new block is created.

On the whole, a technology blockchain can transform the way people do business in the real world. Furthermore, Blockchain implementations are not restricted to cryptocurrencies; the system could be used in a variety of settings where certain types of transactions are carried out.

1.1 .2 Industry Overview

Electric currency was initiated after the 1980s, and bitcoin was the first decentralized cryptocurrency launched in 2009 by Satoshi Nakamoto a pseudonymous creator. cryptocurrency is a decentralized coinage scheme that works similarly to a traditional currency and allowing users to make virtual payments for products and services without relying on a central authority. Relying on the digital information transmission and for legitimate ensuring and unique transaction can utilize the cryptographic method. Bitcoin was an innovation in this market that decentralize the currency and release it from the structure of hierarchical power then individuals and businesses can transact on peer to peer network through electric currency. The other cryptocurrency which was appeared early after bitcoin is called Altcoin (Alternative Coin) the beginning of 2011.in the fall of 2011 lite coin was released and very soon it became the most popular coin after bitcoin, till 2013 which it was overtaken by Ripple. Litecoin was the best modifier of the protocol along with increasing the speed of transaction which was predicted as an appropriate protocol for daily transactions. ripple which was introduced as a unique entirely model and today is the third highest market capitalization with more than $ 171billion. the other important coin which was emerged in this market was Peercoin in august 2014 (Farell, 2015) while today this cryptocurrency has less market capitalization and other currencies such as Etherem and Binance coin which emerged after that has the big market cap in the world.

1.1.3 Investment in cryptocurrency

There is a lot of interest in the cryptocurrency market right now, but there is also a lot of vulnerability, perplexity, and confusion. Digital money is one of the most volatile resource classes, if not the most volatile, Financial experts will benefit or lose everything they own. The potential for spectacular returns is the most appealing feature of digital forms of money for speculators. Currently, alternative speculations are widely found in

portfolio administration and include property, objects, multifaceted assets, private value, works of art, and others. Typically, elective projects have a lower historical relationship to traditional capital groups, for example, shares, securities, and money equivalents, and as a result, they provide significant enhancement to the portfolio. (Pope et al., 1995)

Regardless of whether digital forms of money will become a part of the traditional fiscal system, the global day-by-day trade traded value of bitcoin in 2016 was over 1 billion dollars, demonstrating abundant liquidity. Furthermore, Bitcoin experts show that the price of Bitcoin does not fluctuate in the same way as money markets, as shown by low return connections. Even some of the experts believe in the limitation of the number of bitcoin which can be produced within 21000000, but they should consider the altcoin that can use as their subtitle. Ever, the valuation of digital currencies differs significantly from that of previously used traditional securities, and different cryptographic types of currency, such as Bitcoin, have a fixed supply, so the value of fiat money with an unrestricted supply cannot be linked because of digital forms of money. Furthermore, unlike bonds and values, digital monetary standards do not generate revenue, so the reduced income valuation does not apply to cryptographic types of currency. Because of this stumbling block, financial experts are granted cryptocurrency tokens in exchange for some promise of future profits, possible future trade installments, and the right to take an interest, create parts, and vote. (Xi et al., 2020)

1.2 Problem Statement

Cryptocurrency investment is increasing today world due to the attraction of people for using trustable transactions without any intermediaries. There is a lot of interest in the cryptocurrency market right now, but there is also a lot of vulnerability, perplexity, and confusion. Digital money is one of the most volatile resource classes, if not the most volatile, Financial experts will benefit or lose everything they own. The potential for spectacular returns is the most appealing feature of digital forms of money for speculators. Currently, alternative speculations are widely found in portfolio administration and include property, objects, multifaceted assets, private value, works of art, and others, but which all of these asset investors are interested to invest in cryptocurrency widely, and expecting the high return with low risk in this market.

1.3 Purpose of This Study

In the 21-century blockchain with cryptocurrency is an interesting topic which most experts expect the highest growth in this market and predict as an end for the traditional transaction and banking system, and this new technology will change the way of using money and political and governmental legal and economic framework in this area. Therefore, for gaining the best profit from this market it is required to know the answer to some questions, will face it such as definition and usage of blockchain and cryptocurrency, the relationship between these two, revolutionize of cryptocurrency and blockchain in the financial market, and for investing in this market needs to be aware of the risk and return on this market cause the most desirable asset for the investor is an asset with high return and low risk.

1.4 Significant of This Study:

This study enables the investors in deciding on investing in this market, and elaborate the correlation between different kinds of cryptocurrency, with significant analysis on the portfolio with different securities from the well-established company of the world, in addition to cryptocurrency this study will help in decision making for investment in other assets also.

CHAPTER TWO

LITTERATURE REVEIW

2.Literature review

2.1 What is cryptocurrency

Trade of goods and service have been used as the exact meaning of exchange, Since the dawn of time. Currency was invented over a thousand years ago since become the dominant exchange medium in today's world means, that invention of fiat currency, such as the US Dollar or Euro was not one end for the history of money. Cryptocurrency is a relatively new development. It is neither a trade good nor a form of fiat money, it is completely a new experiment of money exchange. (Phillip et al., 2018)

A digital asset that employs strong cryptography and is designed to serve as a medium of transaction known as cryptocurrency. Its operating network controls its creation for securing the transactional flow and controlling the creation of additional units of the currency. Chen (2018) believes that Blockchain protocols are used by cryptocurrencies like altcoins and Bitcoin. For being agree on a set of new transactions regularly, and the protocol's popularity reflects its features such as security, anonymity, and data integrity this platform provides a mechanism for a distributed network of computational nodes. Yli-Huumo(2016) Phillip ,(2018) believe in the complexity of cryptocurrency and explained they have a wide range of characteristics to discover while there is no full investigation on the complex structure of cryptocurrency. One of the most important characteristics of cryptocurrencies is their decentralization. In the innovative technology bitcoin is one of the new type of digital currency which made a new digitalization movement in the payments sector and, is based on decentralization (Glaser & Bezzenberger, 2015). Other critical feature of cryptocurrency is immutability according to (Brauneis & Mestel, 2019) and means the immutability and publicity of the transactions. The important feature of cryptocurrency can add a trustless factor, which indicates no requirement trust on anybody or any authority in the network and blockchain function among the players in the blockchain.

2.2 different type of cryptocurrency

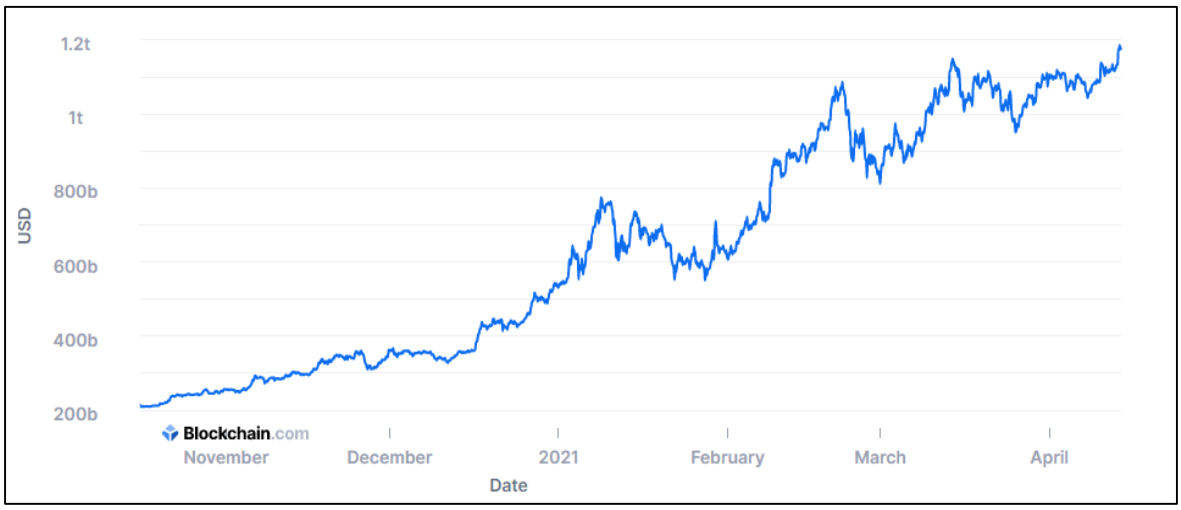
After the bit gold, the first decentralized cryptocurrency is bitcoin which is used in the blockchain technology which is launched in 2009 and since now is the leader of the cryptocurrency market. It allows to be sent directly from one party to another without using any financial institution in the online payment and this feature is called peer to peer version of electronic cash. (Berentsen & Schär, 2018)the other type of cryptocurrency was created after the bitcoin and mostly survived to data. Smolinsky &Zohar (2013) explained Bitcoin is based on a decentralized and open-source, network whose characteristics appear to be disruptive, but they are the source of the network's popularity. Bitcoin is widely regarded as the world's most successful cryptographic currency. The total value of its existence within two years of its launch reached billions of dollars with considering all of its faults in system design. (Bonneau et al., 2015)

Following the launch of Bitcoin in 2009, the market has seen the emergence altcoin as many alternative types of cryptocurrencies. it is becoming increasingly difficult for investors to assess the potential of each altcoin because , altcoins claiming to offer investors many different and distinct features,. (Ong et al., 2015)

Iwamura, Kitamura, and Matsmoto (2014) stated that all cryptocurrencies except bitcoin are referred to as altcoins, and altcoin is an abbreviation for alternative coin or alternative to bitcoin. Bitcoin was the first widely traded cryptocurrency and knows as market leader, by considering that it emerged after competing with others and some of cryptocurrency are catching up to it's popularity.

According to White (2015) by June 2017, the cryptocurrency market had grown steadily to a market capitalization of more than $100billion. This demonstrates the growing importance of cryptocurrencies in the financial world. Bitcoin and other cryptocurrencies compete for market share. Bitcoin's market value increased fourfold between March 2013 and December 2014, while altcoins increased twelvefold, and caused the reduction (95-84) % in the bitcoin market share. Meanwhile, the current market share of bitcoin is 56.38 and descending and 43.62 is the altcoin market share. The below graph shows the market share of the bitcoin.

Figure 2.1 (market capitalization of bitcoin)



source (http;//www.blockchain.con/)

The below can see some of the altcoins;

1. ETHEREUM(ETH): This cryptocurrency which is created by Joseph Lubin in 2014, with more than $270 billion is the second most popular platform in this market, and expect to get more market share in the future than bitcoin refers to blockchain.com. The possibility of running the written program through the Ether network shows the strength of this cryptocurrency, and this possibility is not limited to all needs.
2. RIPPLE (XRP): Third popular cryptocurrency in the market with more than $171billion market cap which is created by Chris Larsen for the first time in 2012. the inverse of Ethereum which is not similar to Bitcoin is similar to bitcoin with excellent mathematical modeling.
3. BINANCE COIN (BNB): It is founded by Changpeng Zhao in 2017, this platform is used for trading various coins. in terms of trading volume by 2018, this coin becomes the largest in the market and with a market cap of more than $90 billion is the fourth popular cryptocurrency in the world.(bonhouse.com ,2020)
4. TETHR (USDT): With an AI-driven communications intelligence platform that listens to and analyses every customer conversation and surfaces contextual understanding and insights from the data, Tethr enables the enterprise to make smarter business decisions based on the true Voice of the Customer. this coin with more than a $47.8 billion market cap is the 5th largest platform in this market. (crunchbase.com ,2020)

5. CARDANO(ADA): a cryptocurrency network and open source project whose goal is running a public blockchain platform for smart contracts called Cardano. Ada is the name of Cardano's internal cryptocurrency. The Cardano Foundation, based in Zug, Switzerland, oversees and supervises the project's development. And this cryptocurrency with a market cap of more than $ 45 billion has the 6th position in the market. (cradona.org,2020)
6. POLKADOT(DOT): a heterogeneous multi-chain interchange for translation architecture that allows customized sidechains to communicate with public blockchains called polkadot. Gavin Wood, a co-founder of Ethereum, created this protocol which with a market cap of 50.03 is the 7th popular coin in the market. (polkadot. network,2018)
7. DOGECOIN (DOGE): a cryptocurrency with Shiba Inu dog logo from the “Doge” Internet meme. Dogecoin, which was introduced as a "joke currency" on December 6, 2013, quickly developed its online community and reached a capitalization of US$60 million in January 2014. today its capitalization is more than $37 billion. (dogecoin.com)
8. LITECOIN (LTC): by considering the attribute of this currency which can etching with a normal desktop computer when bitcoin mining needs a lot of computer power, seems to be one of the bitcoin competitors. furthermore, this cryptocurrency with a market cap of $18.7billion is the 9th largest coin in this market.
9. BITCOIN CASH (BTC): bitcoin cash which is called bitcoin’s sub currency with a market cap of more than $94 billion is the 10th popular cryptocurrency in the market.
10. STELLER (XLM): refer to Steller. org (2018) can define this platform as the connection between banks, the system of payment, and customers. the base of this cryptocurrency is ripple, in addition to ripple, its goals are being in development and well-structured financial market and institutions (STELLER News, 2018). This cryptocurrency with having $ 30 billion market cap is the 11th in the market
11. EOS: this cryptocurrency is similar to Ethereum in function which is a blockchain platform for decentralized application development. Furthermore, with more than $7.9 billion is the 12th place in the cryptocurrency ranking.

Among all of these coins Focus on the bitcoin is more than others, however, there is no comprehensive analysis in the whole of this system, and also there is no comprehensive analysis on this system.

(ElBahrawy et al., 2017) conducted a study on the history of the entire market and behavior of introduced cryptocurrency between 2013 April and 2017 June. according to this study, the new appearance of cryptocurrency or disappearing of that have a positive market capitalization and several statistical properties of the market will be stable for one year. the finding of this study shows a formal link between ecological modeling and cryptocurrency growth.

In 2018 David Roubaud, Elie Bouri, Syed Jawad Hussain Shahzad have done a study on the Co-Explosivity between the cryptocurrency in this market, according to their result, this behavior is not necessary for this market from the bigger to younger or smaller. Particularly long-live Explosivity is related to bitcoin and their logistic regression analysis shows that if the explosive period of cryptocurrency depends on each other's but it is not necessary to depend on the size of others.

2.3 Centralization and decentralization of cryptocurrency

According to Ben S. C. Fung and Hanna Halaburda in 2016 High transaction fees and a long settlement, period are two major drawbacks of the conventional fiat currency payment system, which has prompted people to seek out alternative currencies system which can use without any intermediaries for faster peer-to-peer (P2P) processing, resulting in a flourishing market for digital currencies with lower settlement danger. Before the creation of cryptocurrency, there were several different forms of digital currencies such as digital currency which developed by an institution and transacted on a network is the most popular example. They are using Loyalty points which produced by businesses or digital coins created by Internet-based platforms are examples of such currencies.

Pak Nian Lam and David K.C.Lee in 2015 have done a study on the evaluation of bitcoin and they believe These centralized digital currencies are used to conduct business. They are created for working k with a specific platform to help the issuing institutions'

business. This digital currency is difficult for using as a substitute of fiat money because of their illegal tender.

. As a result, decentralized digital currencies appear to be a promising option. Since there is no central authority, there is no need for fiat money. required to double-check the transactions However, with no use of central authority or any intermediary, there are still many challenges to address. The problem of double-spending is one of the most significant roadblocks: can in the multiple time, spend the same digital coin. This issue has persisted, as a mystery which for a long time has remained unanswered, discouraging the use of decentralized coins. To avoid double-spending, a trusted ledger without a central authority is required to ensure about the correctly representation of every transaction in the account balance for digital currencies.

E-Cash, the first cryptocurrency, was a centralized system developed by Digi -Cash, Inc. and later E-Cash Technologies. The cryptographic protocols it used to prevent double-spending were phased out in the late 1990s.For protecting users' privacy, a blind signature was used and it chose as a good model for future growth. The digital gold currency became common shortly after cryptography protocols were discovered, with e-Gold being the most widely used. It had been The first popular online micropayment scheme, which spawned a slew of inventions aimed at making transactions more convenient and safe. With an annual transaction volume of over US$2 billion, it was eventually liquidated in 2008 due to a failure to resolve enforcement issues.

Satoshi Nakamoto 2008 published a ground-breaking white paper on the internet after the global financial crisis that year, which was exacerbated by a lack of faith in the financial system, which was sparked by Bitcoin has sparked a lot of interest. This anonymous individual or individuals emerged a digital currency which is called as bitcoin in the article. Bitcoin is based on blockchain technology. as a scheme and a public ledger for all transactions to eliminate central server for timestamp of transactions a trustworthy authority, the protocol is known as a prisoner of war (pow). The double-spending problem is solved by blockchain, as a distributed and transparent ledger which is able to records all transactions in an accurate and stable manner.

CHAPTER THREE

METHODOLOGY OF RESEARCH

3. Methodology of Research

3.1: Methodology

Here firstly we have analyzed the impact of integrating cryptocurrency in a regular stock portfolio from a mean-variance standpoint. The goal of this analysis is to provide investment advice or forecast the future, along with showing why integrating an alternative asset class, such as cryptocurrencies, in a portfolio alongside stocks could be a valuable exercise.

Return and volatility are the two most important metrics in the time of referring the stock price. which return means the rate of return and it is used mostly in two common forms such as simple rate and logarithmic.

The standard deviation of the return, or the square root of the variation of the return, is referred to as volatility. The variance is a measure of how evenly distributed the returns are in the data collection. The variance does not have the same unit of measurement as the original data because it is calculated using squared deviations. With Taking the square root, can determining the standard deviation, transforms this statistic into the same units, making it easier to understand and compare across data sets. The reason behind using the standard deviation as a risk indicator is more spread suggests more up and down oscillations.

The idea behind reducing the risk of whole portfolio and diversification, with investing in multiple equities, is to pick stocks whose prices, and so returns, do not tend to move in lockstep. Therefore, if one falls, the other is more likely to stay the same or rise. This might be thought of as a "balancing out" process. A better-balanced portfolio is achieved by including stocks that have not traditionally moved in lockstep. A better-balanced portfolio is achieved by including stocks that have not traditionally moved in lockstep.

In analyzing a portfolio of numerous stocks, it is required to be able to compute the total portfolio's anticipated return and variance rather than the individual stocks'. To do so, one needs to know one of two metrics about the stocks in the portfolio, in addition to their average return and standard deviation: covariance or correlation.

Covariance and correlation both are for measuring how closely two variables are related and how dependent they are on each other. Correlation is essentially a standardized version of covariance, which assesses the degree and direction of a linear relationship between two variables. A correlation can have values ranging from -1 to 1. A positive correlation indicates that two variables move in the same direction, a negative correlation indicates that two variables move in opposing directions, and a zero correlation indicates that the variables have no relationship. As a result, combining stocks with low or negative correlations is the ideal strategy for portfolio diversification.

For the time being, all we need to know is that the whole portfolio's expected return is the weighted average of the individual stocks' projected returns. The portfolio's predicted variance is a little more difficult, but it's essentially a product of the individual stocks' variance, their respective weights in the total portfolio, and the correlation between each pair of stocks.

In this analysis is required to use Portfolio analysis which is used for selecting the securities with high returns and low risk for investing.

There are two types of approaches for portfolio analysis; traditional approaches, modern portfolio theory traditional approaches have three theories; Dow theory, random walk theory, and formula plan which anyone is using respectively for the situation of no random move on stock price, no relation between the future and current price of the stock and for minimal loss instead of maximizing return.

Modern portfolio theory as a mathematical program and statistical analysis was used by Harry Markowitz in 1952 (variance, correlation) to determine the best asset distribution within portfolios. “It is possible to create an efficient frontier of optimal portfolios providing the highest possible expected return for a given level of risk,” according to this theory. The other part with help of the CAPM model can analyze the risk and return of the portfolio.

3.2 data of this study

This analysis has two-part in the first part is analysis among the cryptocurrency which have analyzed the correlation of their trading price from 2017 to 2021, here we tried to get the famous cryptocurrency with a large market cap in the world. all of them are contained in the following table 1.1. In this analysis, we focused on 30 stocks that involve the S&P 500 also. And needs to have 15 and 30 stocks in the portfolio for better analysis because of the reason that stocks from the same industries tend to be highly correlated than different industries we chose the stocks from different industries. The period for this analysis is the 5 years of stock data from 2017 up to May of 2021. the below-plotting graph shows the time series of stock price data which plotted in a normalized fashion results.

Table 3-1 (cryptocurrency characteristics)

Name	symbol	Capitalization in market	Price	Circulating supply	Volume
Ethereum	ETH	$316,327,093,482	$2,728.37	115,939,767 ETH	$76,081,227,984
Ripple	XRP	$42,484,880,360	$1.21	35,108,326,973 XRP	$20,300,135,013
Ethereum Classic	ETC	$7,935,801,671	$68.23	116,313,299 ETC	$9,467,323,983
Lite coin	LTC	$13,903,967,713	$208.29	66,752,415 LTC	$10,210,875,902
Bitcoin	BTC	$710,169,231,729	$37,949.16	18,713,700 BTC	$111,499,352,365
Monero	XMR	$4,253,695,000	$243.43	17,912,977 XMR	$614,168,151
Dash	Dash	$2,350,968,883	$233.99	10,137,997 DASH	$1,468,599,054
NEM	XEM	$2,025,543,035	$0.2215	8,999,999,999 XEM	$299,606,569
Siacoin	SC	$982,528,623	$0.02051	47,812,582,992 SC	$220,155,748
Stacks	STX	$1,171,186,418	$1.06	1,120,206,745 STX	$34,706,024

Source; coin market website

CHAPTER FOUR

ANALYSIS AND FINDINGS

4.Analysis and Finding

capitalization in the world and is increasing due to people's interest in investing in this market. Cryptocurrency is one of desirable investment in today's world here in two separate parts of analysis we want to analysis the cryptocurrency 1- among them 2- with other assets;

4.2 Alternative of cryptocurrency

Commodities, real estate, private equity (PE), hedge funds, and other alternative assets, such as artworks, are currently popular in portfolio management. Alternative assets, on average, have a weaker historical connection to traditional asset classes like equities, bonds, and cash equivalents, and hence provide superior portfolio diversity. Despite the ongoing debate over whether cryptocurrencies can be integrated into the mainstream financial system, bitcoin's global daily exchange-traded volume averaged over $1 billion in 2016, indicating significant liquidity. (Corbet et al., 2020) Furthermore, bitcoin research indicates that the price of bitcoin does not swing in the same direction as the stock market, as seen by low return correlations. Although some may claim that the number of bitcoins that may be generated is set at 21 million, potentially limiting future supply, we must remember that there are many viable altcoins already in place, and their number is continually growing. according to bitcoin research, the price of bitcoin does not move in lockstep with the stock market, as seen by low return correlations. Although some argue that the maximum amount of bitcoins that may be generated is fixed at 21 million, potentially limiting future supply, we must remember that there are already many viable altcoins in place, and their number is growing. (Corbet et al., 2018)

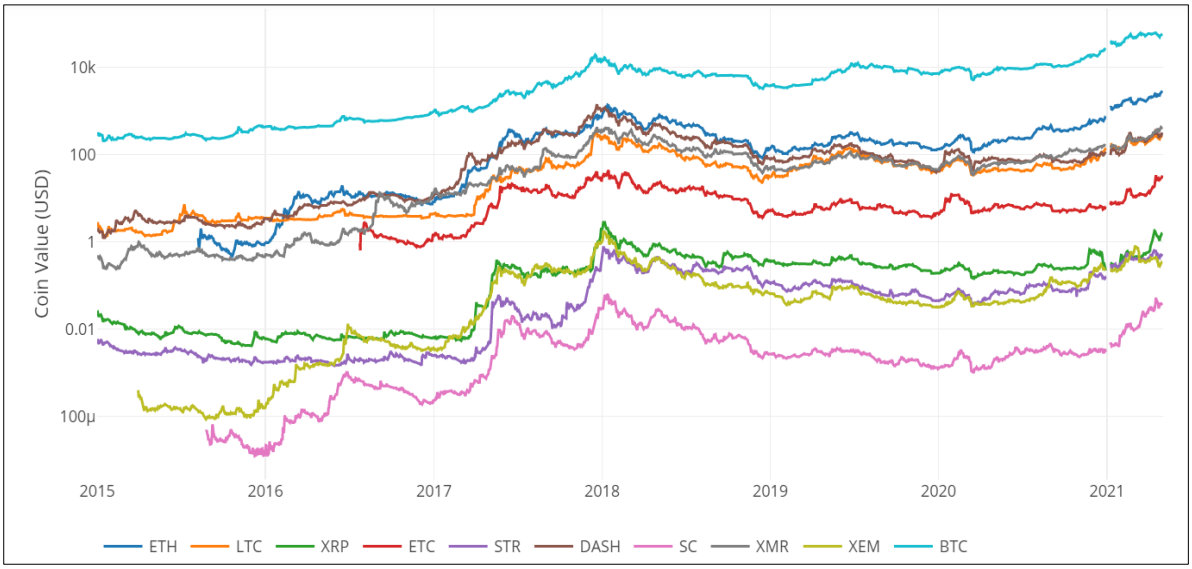
Cryptocurrencies, on the other hand, are valued considerably different than traditional assets. Because many cryptocurrencies, such as Bitcoin, have a finite supply, they cannot be valued in the same way that fiat money with an unlimited quantity can. Furthermore, unlike stocks and bonds, digital currencies do not create cash flow, rendering discounted cash flow value useless. Rather, investors are given cryptocurrency tokens as proof of future cash flow, payments, potential future exchange, and the opportunity to participate, vote, build blocks, or buy. Aside from the future cryptocurrency benefits, the network

effect of cryptocurrency may be a critical aspect in its price for the linked technology and public perception of its value.

4.3 Cryptocurrency Market Analysis

this analysis is based on the trading price of ten famous cryptocurrencies with a large market cap in the USD which is showing in the below graph;

figure 4-1 (cryptocurrency price in USD)



In the exchange rate of cryptocurrency, there is a wide difference in the volatility and volume and shows the correlation between them. And here for testing the correlation between them we have analyzed from 2017-2020 with correlation coefficient analysis and this analysis is done based on absolute price value to a daily percentage of return. Concerning the below table can clarify that coefficient close to 1 or -1 represents the strong correlation or inversely correlated and zero means that there is no correlation between them and the result shows that their strong correlation between this series and all the data is close to 1 table 4.1 is the result of analysis in the 2020 and the following heat map chart from the year 2017 – 2020 explain clearly the correlation of them through colors which dark red colors represent the strong correlation of the serious and dark blue represent the strong inversely correlation.

Table 4-1(coefficient correlation of 2020)

	ETH	LTC	XRP	ETC	STR	DASH	SC	XMR	XEM	BTC
ETH	1.000000	0.816778	0.652744	0.679207	0.517359	0.657670	0.584627	0.760093	0.537515	0.822554
LTC	0.816778	1.000000	0.615413	0.706074	0.485645	0.665195	0.523616	0.741774	0.507355	0.825937
XRP	0.652744	0.615413	1.000000	0.584924	0.652519	0.567327	0.520332	0.517791	0.512610	0.541799
ETC	0.679207	0.706074	0.584924	1.000000	0.560642	0.679165	0.456855	0.648682	0.473644	0.656281
STR	0.517359	0.485645	0.652519	0.560642	1.000000	0.485983	0.452502	0.481139	0.442311	0.440162
DASH	0.657670	0.665195	0.567327	0.679165	0.485983	1.000000	0.465230	0.665365	0.480535	0.642804
SC	0.584627	0.523616	0.520332	0.456855	0.452502	0.465230	1.000000	0.529474	0.534502	0.554800
XMR	0.760093	0.741774	0.517791	0.648682	0.481139	0.665365	0.529474	1.000000	0.510144	0.765235
XEM	0.537515	0.507355	0.512610	0.473644	0.442311	0.480535	0.534502	0.510144	1.000000	0.471840
BTC	0.822554	0.825937	0.541799	0.656281	0.440162	0.642804	0.554800	0.765235	0.471840	1.000000

Figure4.2 (heat map of 2020)

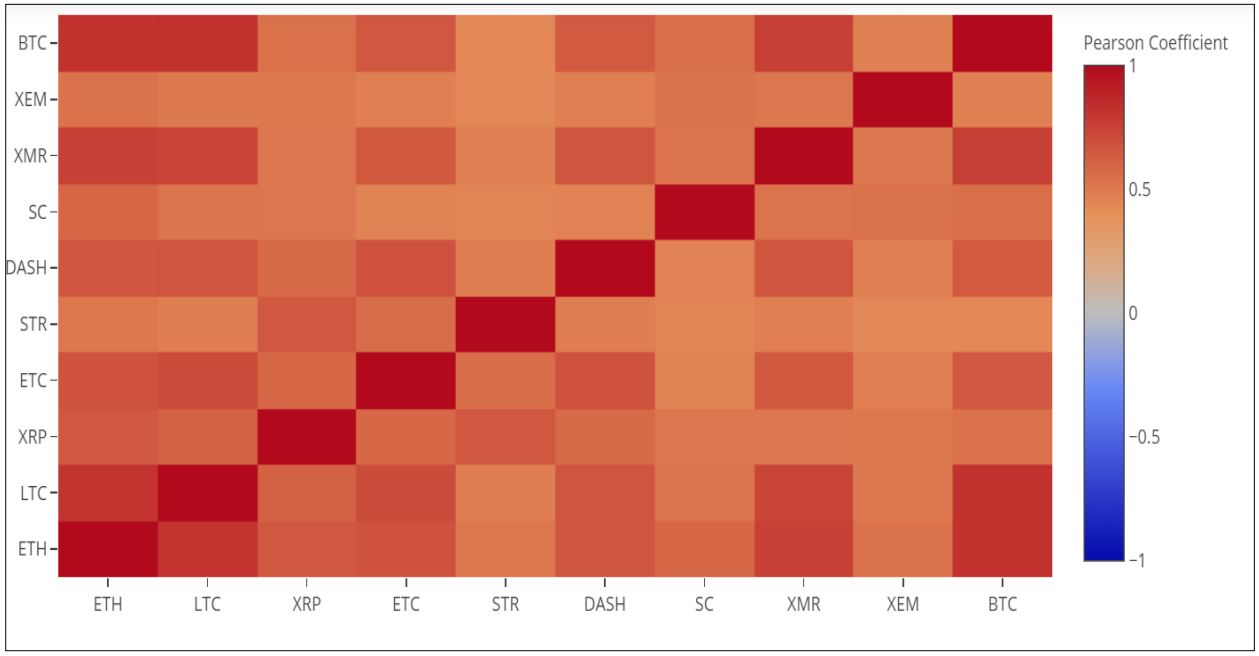


Figure 4.3 (cryptocurrency correlation in 2019)

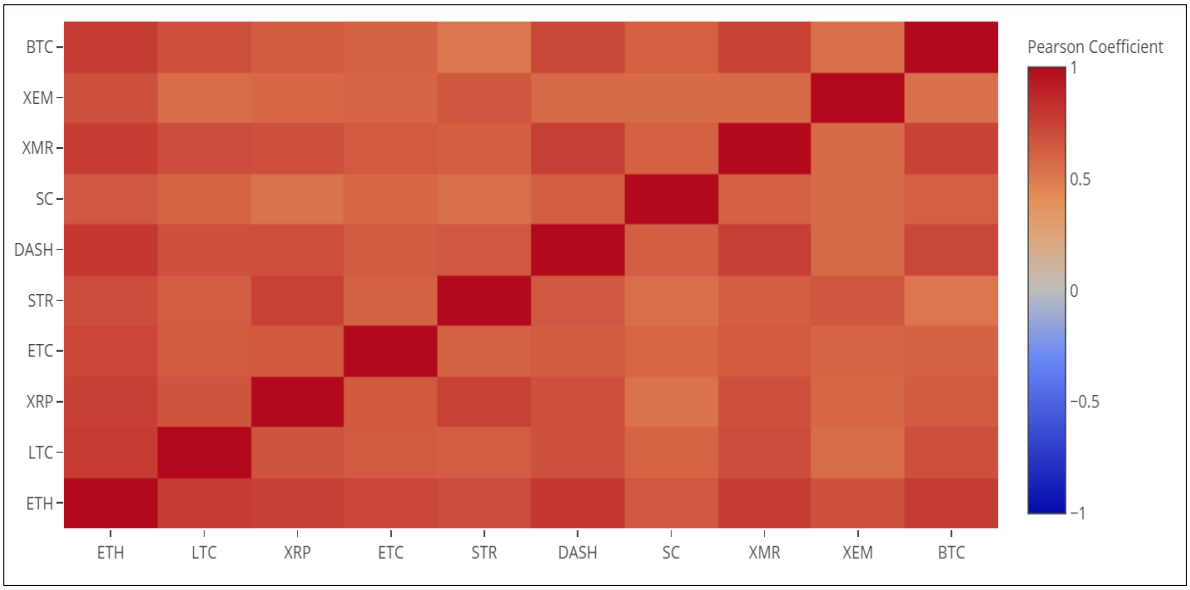
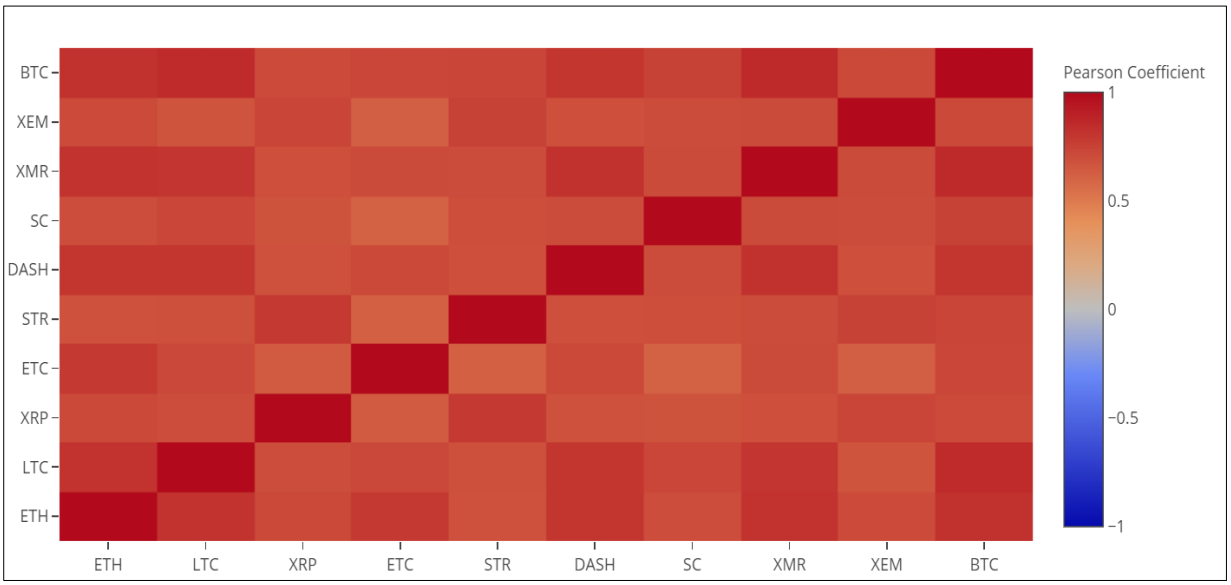


Figure4.4(heat map of correlation of 2018)



4.4 Portfolio analysis

Portfolio analysis is used for selecting securities with high returns and low risk for investing.

$$portfolio = portfolio\ [min(risk), max(return)] \quad \text{..... } \textit{Equation 4-1}$$

There are two types of approaches for portfolio analysis; traditional approaches, modern portfolio theory traditional approaches have three theories; Dow theory, random walk theory, and formula plan which anyone is using respectively for the situation of no random move on stock price, no relation between the future and current price of the stock and for minimal loss instead of maximizing return.

Modern portfolio theory as a mathematical program and statistical analysis was used by Harry Markowitz in 1952 (variance, correlation) to determine the best asset distribution within portfolios. “It is possible to create an efficient frontier of optimal portfolios providing the highest possible expected return for a given level of risk,” according to this theory.

Under CAPM, "Efficient Portfolios" for the accepted risk can produce the highest return and with considering a one-period market with the same estimated returns E [R i] and variances Var(R i). The fraction of wealth invested in the i-th securities is also denoted as w i.

$$\begin{cases} instruuments\ (n) \\ E[R_i = \mu \\ Var(R_i = \sigma^2 \\ Cov(R_i, R_i) = 0\ for\ i = 1, \dots\dots, n \end{cases} \quad \text{.....} \textit{Equation 4-2}$$

$$\begin{cases} \frac{portfolio\ (1)}{E[R_p] = \sum_{i=1}^{n} \omega_i . E[R_i]} \\ Var(R_p) = \sigma_p^2 = \omega^T \sum \omega = \sum_{i=1}^{n} \omega_i^2 \sigma^2 + \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \omega_i \omega_j cov(R_j, R_j) \cdot \\ \sum_{i=1}^{n} \omega_i = 1 \end{cases} \quad \textit{Equation4-3}$$

According to the below equation If we consider two portfolios (A) 100% investing in securities #1 and (B) a portfolio with equal-weighted stocks.

$$E[R_A] = E[R_B] = \mu \quad \text{…….. } \textit{Equation 4-4}$$

$$Var(R_A) = \sigma^2 \quad \text{…….. } \textit{Equation 4-5}$$

$$Var(R_B = {\sigma^2}/{n} \quad \text{……. } \textit{Equation 4-6}$$

With having the same expected return in two portfolios it is not expected to have the same variances, the investor who wants to averse to the risk will consider portfolio B due to its diversification among the n different securities which they will not get the lower returns. Markowitz believes investors are searching for minimizing the variance in the given rate of return which is expected and this is called the center point of Markowitz. the below there is some assumption of modern portfolio theory:

- Investor's decisions based on the variance of return and expected return only
- Estimate the risk based on the expected return's variability
- Returns of securities are random variables following with normal distribution
- Efficient market
- Due to the given level of risk, the investor is expected high returns and the same in the expected level of return rate investor is expected the less risk than the others.

4.4.1 Assessment process

Assessing the current situation needs Define goals, values, and beliefs along with Knowing what exists now in terms of assets, liabilities, and cash flows. Furthermore, it is required to define growth objectives such that any discrepancies between them and your current investment plan can be identified. After this, for required to identify the investors' profile in risk-return for finding the objective and constraint for analysis through a questionnaire

This analysis is based on investing in;

1. large-capital stocks which established from the well-established companies with minimum risk of failure,

2. bonds for balancing the portfolio
3. commodities for diversifying the portfolio
4. T-bills or risk-free assets for 3months

Table 4.2 (percentage of equities)

Stocks	*Bonds*	*Commodities*	*T-bills*
45%	35 %	10 %	10%

Source; central bank website

All the observation for the commodities and companies come under the respective ticker

Table 4.3 (observation of project)

Stocks		*Bonds*		*Commodities*	
Name	*Ticker*	*Name*	*Ticker*	*Name*	*Ticker*
Apple	AAPL	HCA Heatlhcare	HCA	Bitcoin	BTC-USD
Microsoft	MSFT	Vertex Pharmaceuticals Inc	VRTX	Palladium	PA=F
Amazon	AMZN				
Google	GOOG				
Facebook	FB				
Netflix	NFLX				
NVIDIA	NVDA				

Data time series for this analysis is exploring in appendix A according to their n high price, low price, open price, close price, volume, and adjusted close price.

Here the high price is the highest in the trading day, low price is the lowest price on that day, the open price is the price at the beginning of the trading day, the close price is the ending price of that day, and adjusted close price is the adjusting price for corporate action reflecting the dividend and split and volume is the number of share of securities that were traded among its close and open price .due to distributing. In the time of declaring a dividend by a company, the price of its stock is decreased by the sum of the dividend per share, since the company is distributing a portion of its profits. Table 4.3 shows the total trading days of stocks and bonds and table 3.4 shows the trading days of these stocks in one year;

Table 4.4(trading day)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	ALGT	BTC-USD	PA=F
Trading Days	1089	1089	1089	1089	1089	1089	1089	1089	1089	1581	1066

Table 4..5 (trading days in a year)

Date	2016	2017	2018	2019	2020	2021
Stocks	NaN	251.0	251.0	252.0	253.0	82.0
Bitcoin	1.0	365.0	365.0	365.0	362.0	123.0
Palladium	NaN	249.0	243.0	248.0	251.0	75.0

These data are from 2017/01/01 to 2021/04/24 used for calculation of trading days and the formula for calculating the trading day is;

$$Trading\ Days\ a\ year\ = average\ days\ per\ years\ * {}^{5}/_{7}\ (portion\ of\ working\ day\ per\ years\ ) - (holiday\ days\ in\ week) - 3 * 5/7\ (fixed\ holidays\ date \quad \text{..... Equation 4-7}$$

Visualizing the adjusted close price of all securities will give graph 4.5 which shows the big change in the price of bitcoin in January 2021 because of the increase in the investment of this currency. Although absolute price is relevant when investing, we are more concerned with a securities' relative change (and its volatility — risk) than its price.

Figure 4.5 adjusted close price

4.4.1.1 Risk and return analysis

The main pillars in portfolio analysis are risk and return analysis. The below formula is used for the calculation of risk and return;

$$risk = Var(R) = \sigma^2 \qquad \text{..... } \textit{Equation 4-8}$$

$$return = E[R] \qquad \text{..... } \textit{Equation 4-9}$$

Return analysis: change in the price of securities and combination in the dividend has been presented by securities' return as loose and gain in the investment, then for mostly annual return is been using for the portfolio analysis for comparing different securities in the portfolio. this method is an estimation base on the expected return. Using data for this analysis is daily, then needs the daily return calculation before the annual calculation of the rate of return. The below table shows the two methods which are used for this calculation and equation 4.10 shows the relationship between these two methods;

Table 4.7 (APR vs APY method)

	Nominal Rate $r_{nominal}$	**Effective Rate $r_{effective}$**
Other Terminaology?	**Annual Percentage Rate (APR)**	**Annual Percentage Yield (APY)**
What?	The simple. Not taking inflation into account. Not taking compounding into account.	The complex. Taking inflation into account. Taking compounding into account. Giving **higher** rate.

Source; https://www.nadiacvanderhall.com/articles/2020/7/7/difference-apr-x-apy

$$R_{effective} = (1 + {}^{R_{nominal}}/_{N})^{N}\text{-}1 \qquad \text{..... Equation 4-10}$$

$$R_{nominal} = ?$$

$$N = \{1,2,3, \dots \dots ,365\}$$

Here requires the nominal rate calculation for every year, along with nominal and effective rate there are two other kinds of returns such as simple and log returns, the sum of log returns differences interpret as total change percentage over the sum of the period.

Table 4.8(simple return VS log return)

	Simple Return	**Log Return**
Daily r_t	$r_t = \frac{P_t}{p_0} - 1$	$r_t = ln\left(\frac{P_t}{P_0}\right)$
Annual $r_{nominal}$ where $t = N$	$r_{nominal} = \frac{P_N}{p_0} - 1$	$r_{nominal} = ln\left(\frac{P_N}{P_0}\right) = ln\left(\frac{P_N}{P_{N-1}} \cdot \frac{P_{N-1}}{P_{N-2}} \cdot \dots \cdot \frac{P_1}{P_0}\right) = lnP_N - lnP_0$
Advantages	• Check the profitability of an instrument since the beginning of the year. • Check the correlations among instruments while only the prices were not useful	• The difference can be interpreted as the percentage change in an instrument, without depending on the denominator of a fraction • The difference more cleanly show how instruments are modeled in **continuous time**

Source; https://medium.com/@huangchingchiu/analysis-on-stocks-log-1-return-or-simple-return

In appendix B shows the daily log-returns of these securities and the below figure shows the log difference of the securities, in the below visualization shows that returns are quite volatile for most of them due to their movement among +/- 10% solely on any of the given day. An advanced method for modeling the securities' behavior are using Log differences or change between days.

For getting the useful return it is not enough to calculate the log difference between today's price and the corresponding price for these five years and require the calculation for an average of APR and ARY calculation. The below tables shows the annual percentage rate (R_Nominal or APR), an average of that, and annual percentage rate (R_effective or APY) with its average respectively;

Table 4 .9 (APR)

Date	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
2017	0.408356	0.345650	0.460754	0.297740	0.426596	0.446534	0.722056	0.186032	0.764415	3.062211	0.440022
2018	-0.016302	0.225484	0.312614	0.030426	-0.222694	0.434708	-0.240321	0.391116	0.154390	-1.056697	0.186203
2019	0.672136	0.475715	0.233811	0.284968	0.487289	0.249859	0.655936	0.220959	0.313163	0.877718	0.462469
2020	0.708365	0.448190	0.641605	0.344332	0.393614	0.617876	0.961286	0.301616	0.186434	1.666973	0.400350
2021	0.021479	0.146003	0.069177	0.321751	0.132692	-0.033145	0.191070	0.201639	-0.089743	0.758319	0.191515

Table 4.10 (average APR)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
Average APR	0.358807	0.328208	0.343592	0.255843	0.243499	0.343166	0.458005	0.260272	0.265732	1.061705	0.336112

Table 4.11 (APY)

Date	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
2017	0.503829	0.412562	0.584580	0.346567	0.531463	0.562248	1.056467	0.204375	1.145173	19.971301	0.552126
2018	-0.016170	0.252794	0.366712	0.030892	-0.199724	0.543897	-0.213721	0.478154	0.166888	-0.653218	0.204579
2019	0.956591	0.608414	0.263262	0.329496	0.627099	0.283679	0.925237	0.247146	0.367468	1.401588	0.587289
2020	1.028567	0.564827	0.897915	0.410702	0.481855	0.853523	1.610083	0.351789	0.204859	4.265930	0.491854
2021	0.021708	0.157024	0.071589	0.378525	0.141754	-0.032609	0.210229	0.223052	-0.085887	1.125997	0.210766

Table 4.12 (average of APY)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
Average APY	0.431531	0.388406	0.409923	0.29151	0.275669	0.409323	0.580757	0.297241	0.304341	1.889723	0.399419

According to the below calculation, APY is greater than APR which is expected. more accurate measurement of return in these underlying securities is R_ efficient which takes into consideration the compounding of respective years. with more trading days will have the equal APY and APR with considering the below equation

$$R_{effective} = limN \to +\infty\{\left(1 + \frac{R_{nominal}}{N}\right)^N - 1\} = e^{R_{nominal}} - 1 \quad \text{... ...Equation 4.11}$$

Risk analysis: there are different type of risk exposure to any type of financial securities or instruments which some of the instrument have specific kind of risk, mentioned below;

A. Bonds and instrument of money- market
    - Interest rate risk
    - High yield securities risk
    - Credit risk

B. Stocks
    - Mid and small-cap risk
    - Volatility risk

The volatility risk calculation needs to provide the adjusted close price of all these instruments. the calculation needs to be done in the daily and annual form. Two approaches can measure the risk

- Volatility risk -standard deviation: commonly used for measuring the finance dispersion
- Volatility risk –variance: synonymous with risk and used for the measure of dispersion, higher variance means the higher risk

Equation 4.12, 4.13, 4.14. 4.15 respectively shows the daily and annually volatility standard deviation risk and daily and annually volatility variance risk;

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{\sum_{i=1}^{N}(R_i - \bar{R}_i)^2}{N}} \qquad \textit{Equation 4-12}$$

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{\sum_{i=1}^{N}(R_i - \bar{R}_i)^2}{N}} \cdot \sqrt{N} \qquad \textit{Equation 4.13}$$

$$Var\ (R) = \sigma^2 = \frac{\sum_{i=1}^{N}(R_i - \bar{R}_i)^2}{N} \qquad \textit{Equation 4.14}$$

$$Var\ (R) = \sigma^2 = \frac{\sum_{i=1}^{N}(R_i - \bar{R}_i)^2}{N} \cdot \sqrt{N} \qquad \textit{Equation 4.15}$$

The table below contains the annualized standard deviation and for better analysis needs to have the average of this calculation.

Table 4.13 (annualized standard deviation)

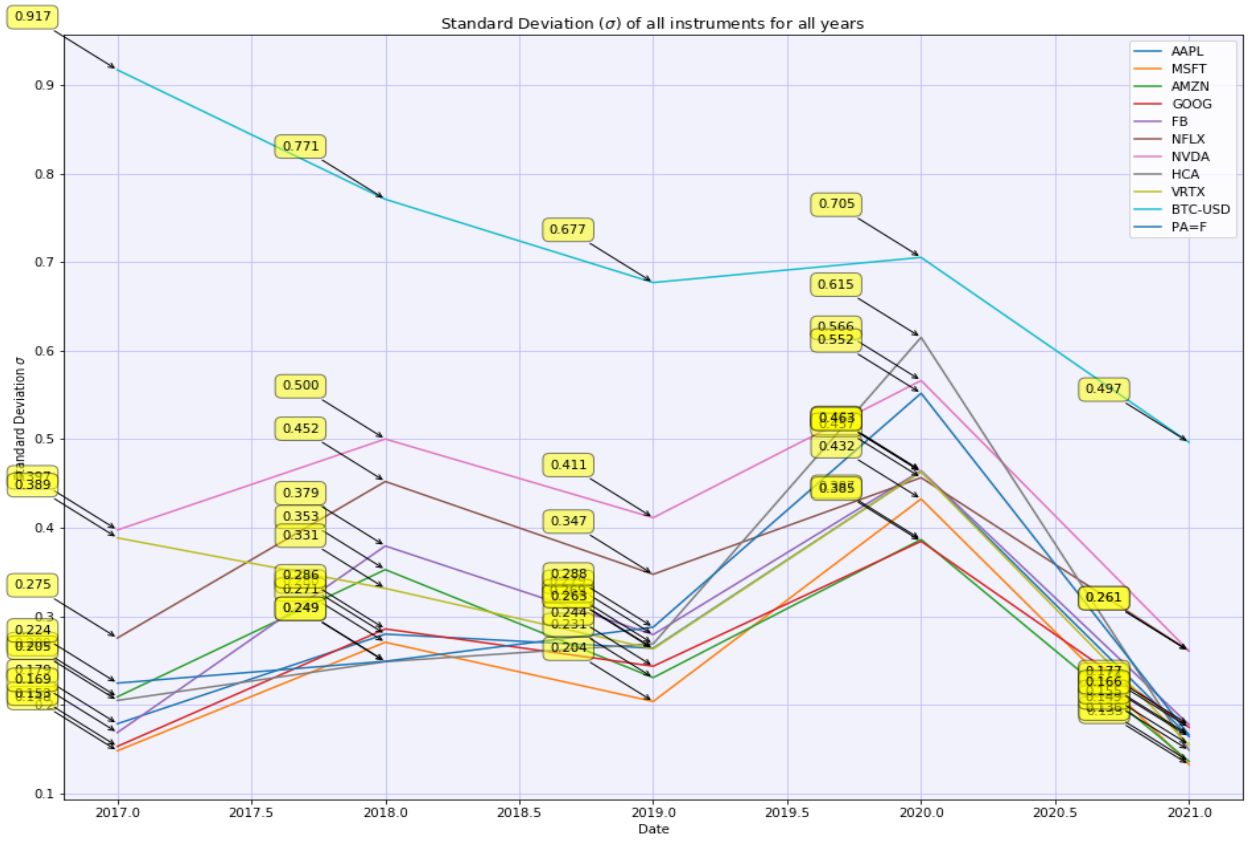
Date	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
2017	0.178584	0.148045	0.209022	0.152994	0.168638	0.275475	0.397476	0.204924	0.388550	0.917174	0.224477
2018	0.279793	0.270629	0.352691	0.285684	0.379418	0.452252	0.500216	0.248676	0.331474	0.771071	0.249144
2019	0.263879	0.203763	0.230670	0.243563	0.279314	0.347396	0.411317	0.268887	0.263041	0.676970	0.287687
2020	0.463413	0.432490	0.386716	0.384675	0.464470	0.456610	0.566334	0.615038	0.463384	0.705377	0.551958
2021	0.164078	0.132520	0.136136	0.174457	0.177469	0.260822	0.260814	0.148727	0.154888	0.496508	0.165992

Table 4.14 (average of annualized SD)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
Average STD	0.269949	0.23749	0.263047	0.248275	0.293862	0.358511	0.427232	0.29725	0.320267	0.71342	0.295852

for a better understanding of standard deviation volatility analysis, the below graph can help with explaining it better;

Figure 4.6 (standard deviation of all instruments)



According to the previous figure roughly the volatility of bond and stocks are at the same level for each of the asset class, but because of the COVID-2019 can see unexpected high volatility value which the high level of them are in 2020, and after that their volatility is decreasing for 2021.

In the continue of volatility standard deviation is the volatility of variance and average of that content in two next tables:

Table 4.15 (annualized variance)

Date	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
2017	0.031892	0.021917	0.043690	0.023407	0.028439	0.075886	0.157987	0.041994	0.150971	0.841208	0.050390
2018	0.078284	0.073240	0.124391	0.081616	0.143958	0.204532	0.250216	0.061840	0.109875	0.594551	0.062073
2019	0.069632	0.041519	0.053208	0.059323	0.078017	0.120684	0.169182	0.072300	0.069190	0.458288	0.082764
2020	0.214752	0.187048	0.149550	0.147975	0.215733	0.208493	0.320734	0.378272	0.214725	0.497556	0.304658
2021	0.026921	0.017562	0.018533	0.030435	0.031495	0.068028	0.068024	0.022120	0.023990	0.246520	0.027553

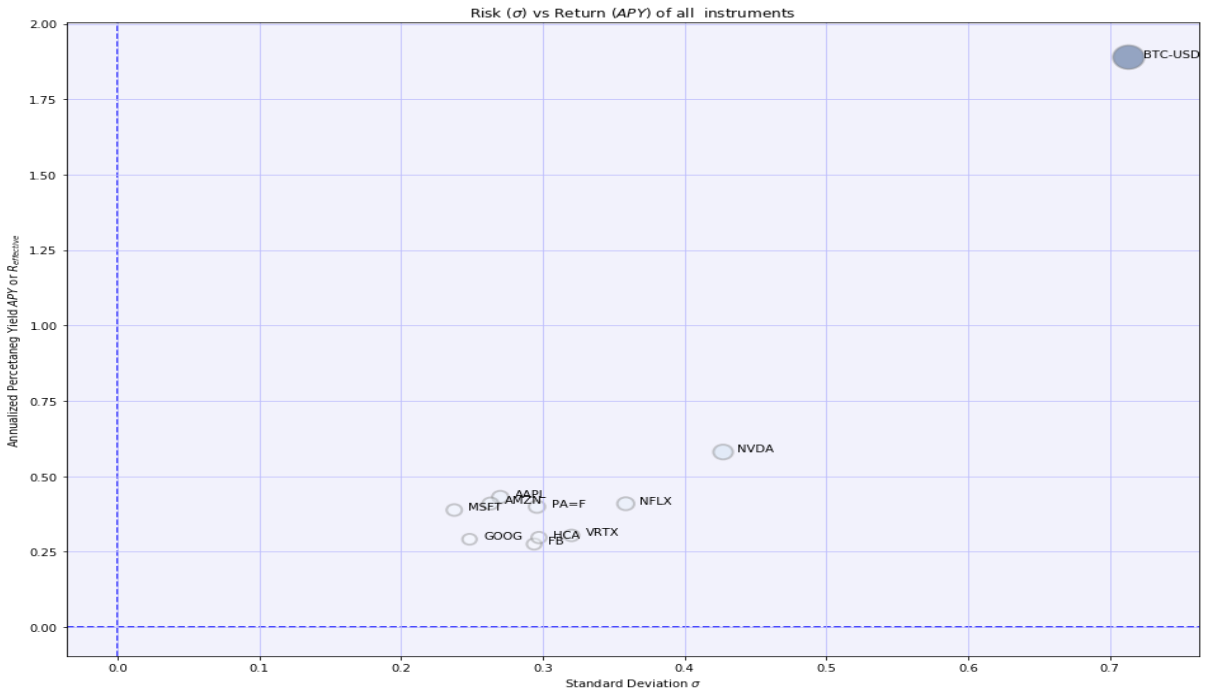
Table 4.16 (Average Annualized variance)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
Average VAR	0.084296	0.068257	0.077874	0.068551	0.099528	0.135525	0.193229	0.115305	0.11375	0.527625	0.105487

Risk verse return

The Next plotted graph is on the bade of the Annual percentage yield of all the securities and demonstrating that the greatest return is for the Bitcoin (BTC-USD) along with high volatility .furthermore the selecting bonds of FB have the lowest portfolio risk, with bad performance rather than other assets.

Figure 4 .7(risk Vs return APY)



CAPM (Capital - Asset Pricing Model):

According to Capital Asset-Pricing Model is that in equilibrium, an asset's riskiness is calculated by its beta rather than its standard deviation of return. The CAPM model (a linear model) assumes that the expected return, E[R], of any instrument (or portfolio), and the expected return of the market portfolio, E [R m], are linearly related. The S&P 500 (SPX), an index of stocks mainly domiciled in the United States, is included in our research as a market portfolio.

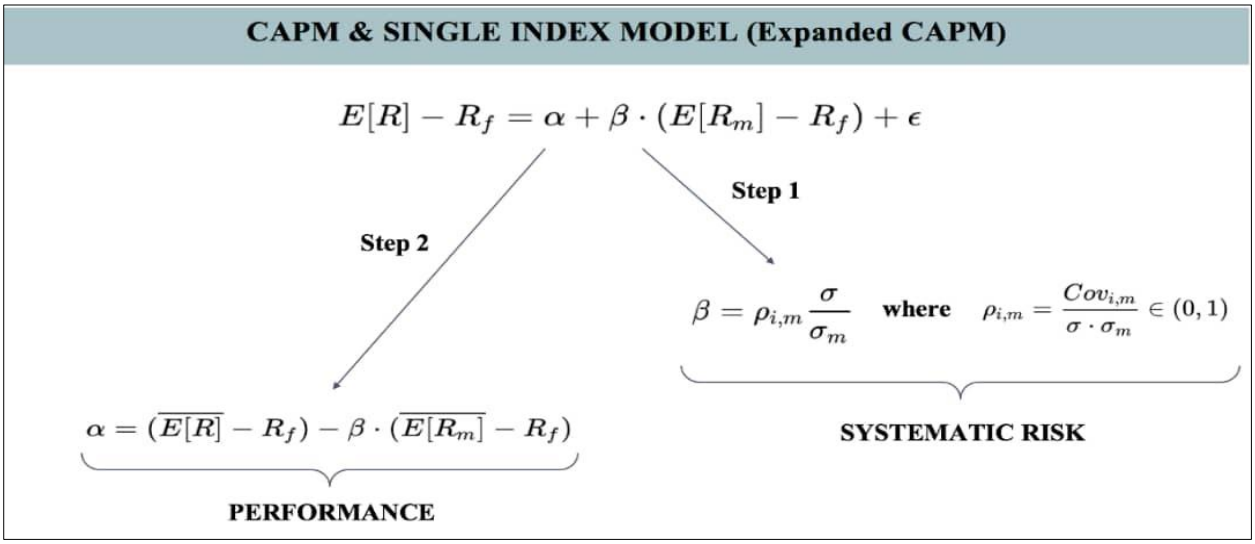
the main factors of these model are:

- (E [R_m]-R_f) factor: this market premium or market portfolio risk with CAPM playing the role as a single factor
- (β)Beta: specific beta coefficient represents the sensitivity of each factor
- (R_f) risk-free rate: it represents virtual risk-free to the last record of all the researching period from very low risk of securities.

Implementation of CAPM model is required to add some assumption related to the process of return generation and estimating the overtime model due to lack of time dimension and generally, their return is consist of two parts: unexpected (systematic risk consist the impact of unexpected macro event +unsystematic risk consist impact of unexpected firm-specific) and unexpected.

figure 4-8 clarify the CAMP model and its two parts;

Figure 4-8(CAPM model)



source; https://paintsearch.chromecrxstore.com/

result of this analysis explains in the below tables which were merged the data for all of the instruments for better compression, this result shows the highest return and returns contrary for the bitcoin

Table 4.17 (Average APR and STD)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F	^GSPC
Average APR	0.358807	0.328208	0.343592	0.255843	0.243499	0.343166	0.458005	0.260272	0.265732	1.061705	0.336112	0.117427
Average STD	0.269949	0.23749	0.263047	0.248275	0.293862	0.358511	0.427232	0.29725	0.320267	0.71342	0.295852	0.153632

Table 4.18 (average Alpha, Beta, and R squared)

	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
Average α	0.205727	0.182049	0.225559	0.114154	0.102842	0.214635	0.252738	0.122136	0.145264	0.966721	0.296604
Average β	1.311571	1.251099	1.005296	1.212033	1.203014	1.097044	1.767648	1.180984	1.026572	0.803863	0.319046
R squared	0.557166	0.655028	0.344736	0.562509	0.395567	0.221008	0.404046	0.372571	0.242504	0.029967	0.027449

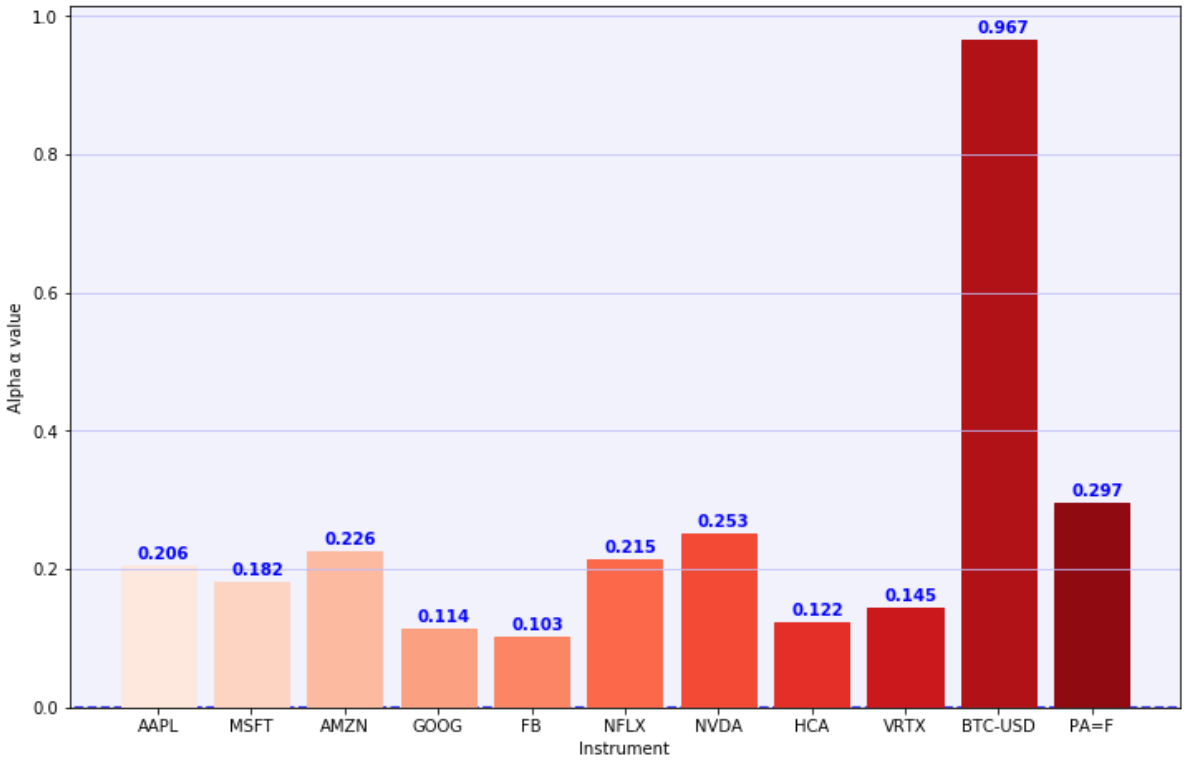
Interpretation of β, α, and R square clarify on the next table;

Table 4.19 (interpretation of the parameter)

Parameter	Explanation
α	$-\ \alpha < 0$: investment in asset i was too risky for the return $-\ \alpha = 0$: investment in asset i earned adequate return for the risk taken $-\ \alpha > 0$: investment in asset i earned excess return for the risk taken $\alpha > 0$ in order to "beat" the market and earn excess return
β	$-\ \beta > 1$: investment in asset i is more volatile than the market $-\ 0 < \beta < 1$: investment in asset i is less volatile than the market $-\ \beta = 0$: uncorrelated to the market $-\ \beta < 0$: negatively uncorrelated to the market $\beta < 1$ so that instruments included in the portfolio are less volatile than the market
R^2	For optimal models (under squared-error loss, shift and scale invariance), R is the square of the correlation between the true and predicted outcomes. This relationship is not true for general f and y. Here linear regression was applied (CAPM) so $R^2 = \rho^2$. $-\ R^2 = 1$, the market **S&P500** completely explains the instrument returns $-\ R^2 = 0$, the market **S&P500** does not explain the instrument returns at all.

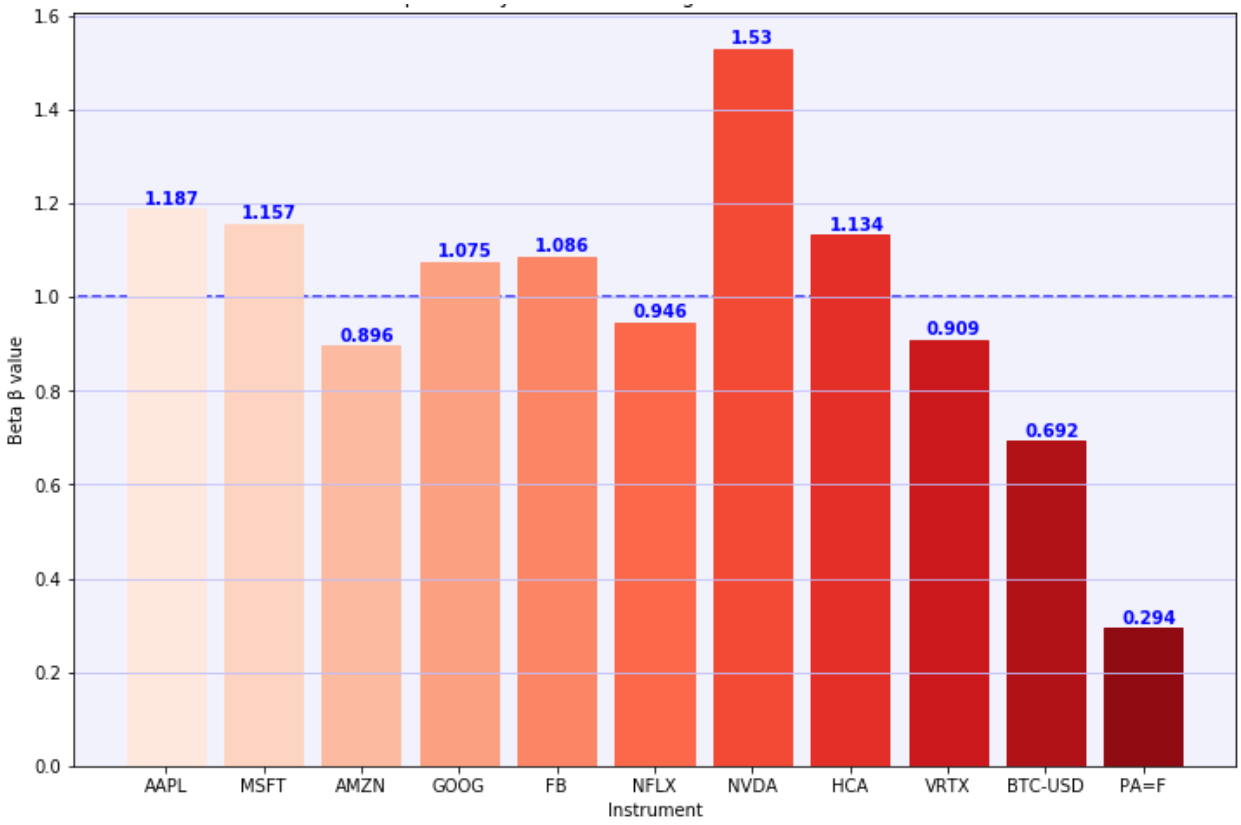
Chart 4-9 and 4-10 interpret the alpha and beta of all these instruments;

Figure 4-9(Alpha for every instrument against the S&P 500 market)



The previous chart shows that all the instruments have positive alpha which explains the excess investment return. Alpha for bitcoin is 0.967 and in the next step palladium with 0.297 will generate excess return .positive alpha is the best and desirable event for the investing on the asset but it needs active- management in the time of discovery in the price and mature of the market.

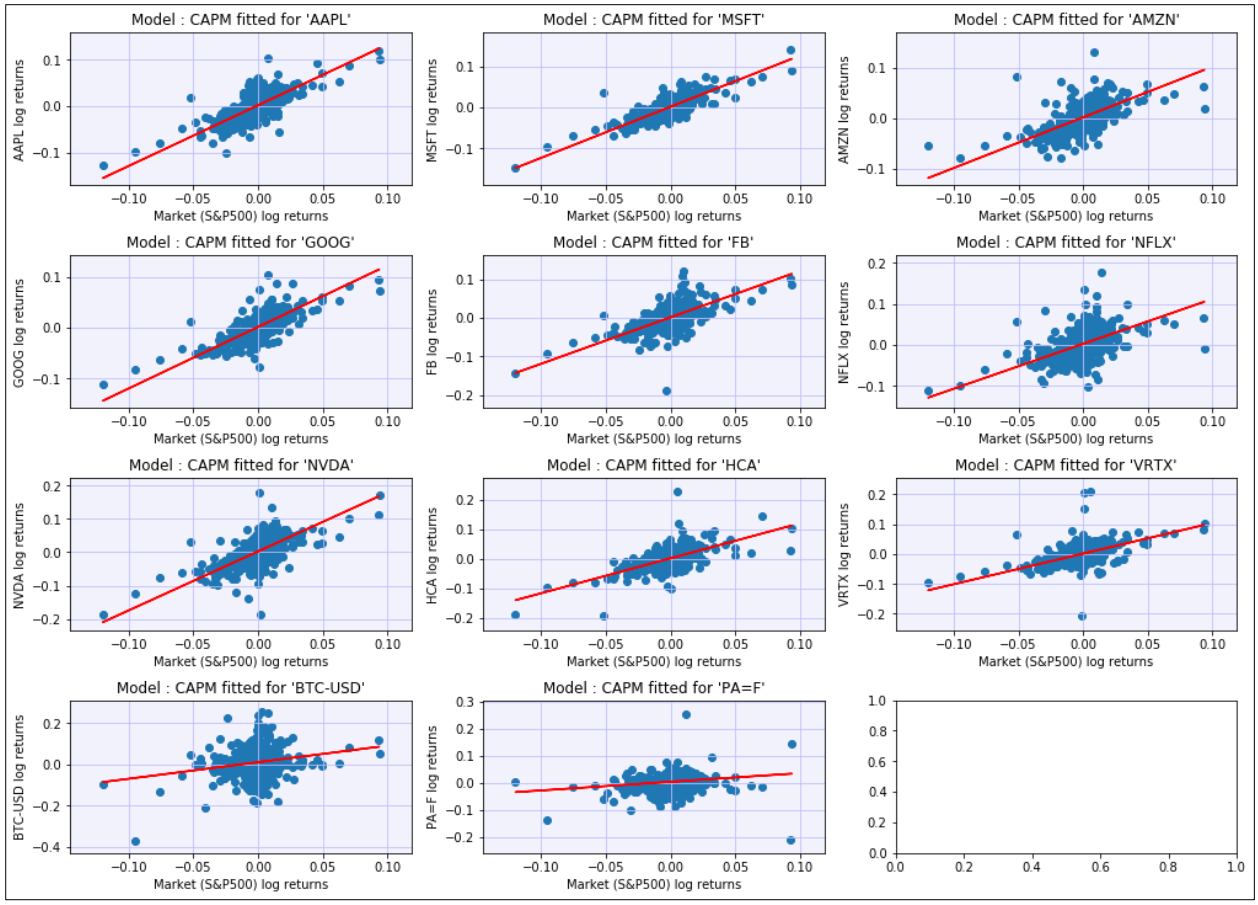
Figure 4.10 (beta for all the instruments)



According to figure 4-6, all the instrument has positive beta and reference to table 4-16 this status implying the positive correlation with the volatility of S&P 500.

Here beta for most of the securities except bitcoin and palladium are more than one and consider the more volatile. volatility less than consider as these securities are not risky and as much as the beta value was near to zero it decrease the risk on that instruments. Visualization of CAPM model can clarify it better;

Figure 4.11 (CAPM model visualized)



CHAPTER FIVE

CONCUSION AND RECOMMENDATION

5. Conclusion:

The first part of this study was started with a quick review about cryptocurrency, throughout cryptocurrency's brief existence, the cryptocurrency industry has grown erratically and at an unparalleled rate. More than 550cryptocurrencies have been created since the public release of the first anarchic cryptocurrency, Bitcoin, in January 2009, the majority with only a sliver of success. Blockchain is a digital ledger for making a transaction on the bitcoin or other cryptocurrency which are recorded chronological order and publicity and through that can have access on the all of information related to the transaction such as the amount of money. Whit launching the Bitcoin cryptocurrency for the first time, blockchain technology was used for the first time also. Bitcoin is still the most widely used framework based on Blockchain technology today. Industry overview of this market shows that cryptocurrency is a big improvement in digital currency and bitcoin is the first cryptocurrency that found a good market cap.

the second part of this study has a brief explanation about the definition of cryptocurrency in details and explain that there is a different kind of cryptocurrency and they are increasing because of high investment in these market. one of the distinguishing characteristics of this market is centralization rather than other assets and digital currency, which makes it different from others.

data of this study was picked up from yahoo Finance, google finance, Quandl, etc. these data involve the high, low, close, open, and adjusted close price of them with their volume, and all the analysis is done in the risk, return and correlation between them with correlation coefficient analysis. Portfolio analysis has been done for finding the return and volatility of

The result of this study shows that it is no difference in the correlation on the price of cryptocurrency and This study explain that almost all the cryptocurrency has correlation with each other's. and behalf of the cryptocurrency, bitcoin was involved in the portfolio analysis. This analysis explore that cryptocurrency can be a suitable and good option in the diversification of portfolio, due to low correlations among the traditional asset and cryptocurrencies, and higher return of average daily return of most cryptocurrencies than other traditional investments. Also plots of the efficient frontier explain that investor have to be aware about the danger of cryptocurrency for having high return and high risk. For the

past eight years, Bitcoin may have existed and stood for something. Cryptocurrency and crypto-tokens, on the other hand, are still in their infancy. We feel that, while our findings are intriguing, many additional concerns must be resolved before cryptocurrencies and crypto-tokens can be considered a viable asset class. Institutions are interested. Due to complication of this technology, investing in this category of investment necessitates an awareness of the accompanying complexities as well as the danger of this technology. Other challenges, such as safekeeping security, reporting without a custodian or trustee, and autonomous cryptocurrency system and decentralized structure of the governance, and complexity and risk of dealing with unregulated identities, required all of them to be considered before emerging a clearer picture .

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Appendix

Appendix .1(cryptocurrency correlation 2018)

	ETH	LTC	XRP	ETC	STR	DASH	SC	XMR	XEM	BTC
ETH	1.000000	0.817922	0.720770	0.789782	0.686034	0.802568	0.703624	0.820965	0.715311	0.821393
LTC	0.817922	1.000000	0.700568	0.723558	0.687398	0.803747	0.732664	0.807216	0.672138	0.851405
XRP	0.720770	0.700568	1.000000	0.640675	0.792483	0.685005	0.677713	0.693242	0.736187	0.714145
ETC	0.789782	0.723558	0.640675	1.000000	0.619490	0.719158	0.613912	0.711497	0.627015	0.733121
STR	0.686034	0.687398	0.792483	0.619490	1.000000	0.692077	0.696601	0.706943	0.752291	0.737675
DASH	0.802568	0.803747	0.685005	0.719158	0.692077	1.000000	0.707462	0.822289	0.691690	0.802794
SC	0.703624	0.732664	0.677713	0.613912	0.696601	0.707462	1.000000	0.712465	0.704682	0.753193
XMR	0.820965	0.807216	0.693242	0.711497	0.706943	0.822289	0.712465	1.000000	0.712102	0.862529
XEM	0.715311	0.672138	0.736187	0.627015	0.752291	0.691690	0.704682	0.712102	1.000000	0.720885
BTC	0.821393	0.851405	0.714145	0.733121	0.737675	0.802794	0.753193	0.862529	0.720885	1.000000

Appendix .2(cryptocurrency price correlation 2017)

	ETH	LTC	XRP	ETC	STR	DASH	SC	XMR	XEM	BTC
ETH	1.000000	0.437609	0.212350	0.601437	0.259399	0.506911	0.373078	0.554632	0.399200	0.410771
LTC	0.437609	1.000000	0.323905	0.482062	0.307589	0.340153	0.339144	0.437204	0.379088	0.420645
XRP	0.212350	0.323905	1.000000	0.114780	0.509828	0.091146	0.243872	0.226636	0.268168	0.131469
ETC	0.601437	0.482062	0.114780	1.000000	0.210387	0.387555	0.298406	0.447398	0.321852	0.416562
STR	0.259399	0.307589	0.509828	0.210387	1.000000	0.183038	0.402966	0.327488	0.339502	0.230957
DASH	0.506911	0.340153	0.091146	0.387555	0.183038	1.000000	0.291424	0.498418	0.325968	0.307095
SC	0.373078	0.339144	0.243872	0.298406	0.402966	0.291424	1.000000	0.378644	0.331350	0.325318
XMR	0.554632	0.437204	0.226636	0.447398	0.327488	0.498418	0.378644	1.000000	0.336076	0.409183
XEM	0.399200	0.379088	0.268168	0.321852	0.339502	0.325968	0.331350	0.336076	1.000000	0.329431
BTC	0.410771	0.420645	0.131469	0.416562	0.230957	0.307095	0.325318	0.409183	0.329431	1.000000

Appendix 3. (correlation of cryptocurrency price 2017)

	ETH	LTC	XRP	ETC	STR	DASH	SC	XMR	XEM	BTC
ETH	1.000000	0.777134	0.761292	0.732913	0.703674	0.795483	0.651511	0.777780	0.683322	0.777536
LTC	0.777134	1.000000	0.669331	0.639108	0.630776	0.683150	0.600181	0.701317	0.566504	0.689720
XRP	0.761292	0.669331	1.000000	0.650972	0.756529	0.693088	0.539216	0.690569	0.583744	0.636173
ETC	0.732913	0.639108	0.650972	1.000000	0.615236	0.633618	0.590134	0.643704	0.596113	0.602848
STR	0.703674	0.630776	0.756529	0.615236	1.000000	0.653040	0.550692	0.625280	0.661482	0.520025
DASH	0.795483	0.683150	0.693088	0.633618	0.653040	1.000000	0.626758	0.764969	0.579224	0.730132
SC	0.651511	0.600181	0.539216	0.590134	0.550692	0.626758	1.000000	0.613320	0.568049	0.618595
XMR	0.777780	0.701317	0.690569	0.643704	0.625280	0.764969	0.613320	1.000000	0.567411	0.749803
XEM	0.683322	0.566504	0.583744	0.596113	0.661482	0.579224	0.568049	0.567411	1.000000	0.545725
BTC	0.777536	0.689720	0.636173	0.602848	0.520025	0.730132	0.618595	0.749803	0.545725	1.000000

Appendix A-(time series of equities)

Date	High	Low	Open	Close	Volume	Adj Close
2017-01-03	29.082500	28.690001	28.950001	29.037500	115127600.0	27.459938
2017-01-04	29.127501	28.937500	28.962500	29.004999	84472400.0	27.429203
2017-01-05	29.215000	28.952499	28.980000	29.152500	88774400.0	27.568691
2017-01-06	29.540001	29.117500	29.195000	29.477501	127007600.0	27.876030
2017-01-09	29.857500	29.485001	29.487499	29.747499	134247600.0	28.131361
...	...	...	...	...	...	...
2021-04-26	135.059998	133.559998	134.830002	134.720001	66905100.0	134.720001
2021-04-27	135.410004	134.110001	135.009995	134.389999	66015800.0	134.389999
2021-04-28	135.020004	133.080002	134.309998	133.580002	107760100.0	133.580002
2021-04-29	137.070007	132.449997	136.470001	133.479996	151101000.0	133.479996
2021-04-30	133.559998	131.070007	131.779999	131.460007	109713200.0	131.460007

Appendix B (daily log returns)

Date	AAPL	MSFT	AMZN	GOOG	FB	NFLX	NVDA	HCA	VRTX	BTC-USD	PA=F
2017-01-03	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-01-04	-0.001119	-0.004474	0.004657	0.000967	0.015660	0.015060	0.023331	0.035858	0.028842	0.106233	0.040744
2017-01-05	0.005085	0.000000	0.030732	0.009048	0.016682	0.018546	-0.025385	-0.004149	0.026087	-0.122410	-0.000813
2017-01-06	0.011148	0.008668	0.019912	0.015277	0.022707	-0.005614	0.013367	-0.002474	0.004174	-0.109711	0.027318
2017-01-09	0.009160	-0.003183	0.001168	0.000620	0.012074	-0.000916	0.040543	0.030018	0.043708	0.000695	-0.001584
...	...	...	...	...	...	...	...	...	...	...	...
2021-04-22	-0.011685	-0.013086	-0.015758	-0.011063	-0.016420	-0.000236	-0.033218	0.020149	-0.017201	-0.039769	-0.011393
2021-04-23	0.018039	0.015476	0.009622	0.020891	0.015547	-0.006349	0.027946	0.004913	0.008890	-0.012917	0.004969
2021-04-26	0.002978	0.001532	0.020390	0.004941	0.006343	0.009396	0.013937	-0.009580	-0.004268	0.057309	0.018340
2021-04-27	-0.002450	0.001606	0.002473	-0.008432	0.001749	-0.009308	-0.006218	-0.007978	-0.006637	0.018721	0.014910
2021-04-28	-0.006027	-0.028286	0.012018	0.031550	0.011628	0.001919	-0.006826	-0.002362	-0.009511	-0.003787	-0.007600