

PROJ 201 Project Final Report

Project Title: Risks and Returns of Cryptocurrencies

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ABSTRACT

The main objective of our research is to understand the performances of cryptocurrency and stocks over the last 4 years to understand if it is worth investing in any of them at all and to where it would be more productive to invest in cryptocurrency or stocks. We evaluated the returns of each for the last 4 years and we found out that investing in cryptocurrency brought more returns however had a higher risk evaluation as values varied moreover investing in stocks had less risk associated with it. We can come to the conclusion that a risk-loving person should invest in cryptocurrency however a risk-averse person would rather invest in stocks. We also came to the conclusion that cryptocurrency more often than not had spikes in their values over certain period of time then they fall to previous level before the spike we can then say as for cryptocurrency it is better to invest for short term when the values go on a high to make maximum profit possible as for stocks they have a more stable and long term growth which meant they were less likely for sudden spikes and falls hence stocks are a more safe investment for the long run. Choosing to invest in stocks or cryptocurrency depends on the goal of investing as for cryptocurrency invest and take profits when the values go on a spike and for stocks invest for long term and take profits when at a good profit and visible decrease without increase in the market is observed.

INTRODUCTION

Cryptocurrency is a digital currency whereby transactions are verified and records maintained by a decentralized authority using cryptography. The decentralized nature of cryptocurrencies makes it such that there is no one governing authority controlling the whole system instead it is maintained by a decentralized system hence breakage or problem with one of the systems will not cause a problem to all the systems, unlike the situation whereby a bank goes bankrupt thus more people are going more towards cryptocurrency because it has more safety for the people involved moreover it is beyond the control of the government as well. Cryptocurrency runs on a public ledger called blockchain, this system works by collecting information together in groups known as blocks that hold sets of information. Each block has a storage capacity and when filled is then closed and linked to a previously filled block forming chain-linked data thus the name blockchain. The system of blockchain made it difficult for fraud due to the fact that every fully

existing data must be linked to previously existing data hence nothing can be added without being referenced in the system. Cryptography is a mathematical and computational practice of encoding and decoding information in the blockchain. Mining is the process of acquiring more cryptocurrency by solving complex mathematical problems. Bitcoin is one of the earliest cryptocurrencies to be launched now over a decade old it is still the most in-demand cryptocurrency despite its volatile nature in value. Cryptocurrency practices are now being used more often in upcoming fields such as NFTS (nonfungible tokens) in this regard Ethereum is the most used.

METHODS & MATERIALS

The cryptocurrencies that we are going to examine are Bitcoin (BTC), Ethereum (ETH), Ripple (XRP), Monero (XMR), Dash (DASH), Cardano (ADA), Binance Coin (BNB), Neo (NEO), Litecoin (LTC), Dogecoin (DOGE) and the companies that we are going to examine are Johnson & Johnson (JNJ), Oracle Corporation (ORCL), PepsiCo, Inc. (PEP), Lockheed Martin Corporation (LMT), Walmart Inc. (WMT), Visa Inc. (V). Also, we will create two distinct portfolios. The first portfolio will contain Bitcoin (BTC), Ethereum (ETH), Litecoin (LTC) and Dash (DASH). The second portfolio will contain Johnson & Johnson (JNJ), Visa Inc.(V), PepsiCo, Inc. (PEP), Lockheed Martin Corporation (LMT).

All measurements and calculations will be done using Excel. The database used in this project is obtained from finance.yahoo.com. After typing the name of the investment in finance.yahoo.com, we are going to click the “Historical Data” section and filter the start date of data with “1/1/2018”. We are going to examine the historical data weekly; therefore, we are going to change the data frequency from Daily to Weekly and click “Apply”. After we made these changes to the data, we are going to download this data by clicking “Download Data” and save the file with a .csv extension. After downloading the file with a .csv extension we are going to open this file in Excel. In Excel, we will be using only the “Date” and “Adj Close” columns.

Now we are going to calculate the risk and return of the ten cryptocurrencies and six company stocks by using Excel. We will start by calculating the return of the asset in the C and D columns. In the C column, we will calculate the weekly return of the asset by entering $=100*(B3-B2)/B2$

into the formula bar. We will apply the formula in all cells of the same column after each calculation. In the D column, we are going to calculate the mean return for every 20 weeks by using `=AVERAGE(C3:C22)` in the formula bar. After the calculations of returns now we are going to calculate three risk metrics. In the F column, we are going to calculate the standard deviation in the last 20 weeks, and we will be using the formula of `=STDEV(C3:C22)`. After calculating the standard deviation, in the E column we are going to calculate the semi-deviation in the last 20 weeks by using the formula `=SQRT(SUM(IF(C3:C22<D22;((C3:C22)-D22)^2))/(COUNTIF(C3:C22;"<"&D22)-1))`. In the G column, we will be using the `=MIN(C3:C22)` to calculate the Value-at-Risk (VaR). After the calculation of return and risk measures now we are going to calculate performance measures which are Sharpe Ratio, Sortino Ratio and Return-to-VaR Ratio. In order to calculate Sharpe Ratio in the H column, we will be using the `=D22/E22`. After that in the I column, we will be calculating the Sortino Ratio using the `=D22/F22`. Lastly in the J column, we are going to calculate the Return-to-VaR Ratio `=D22/G22`.

After calculating the performance measures, we are going to take the average of each performance measure. We will be using the `=Average(H:22,H:222)` for Sharpe Ratio, `=Average(I:22,I:222)` for Sortino Ratio, and `=Average(J:22,J:222)` for Return-to-Var Ratio.

After calculating the average of performance measures, we are going to calculate statistics which are Mean, Median, Standard Deviation, Skewness, Kurtosis, Minimum and Maximum. We will be using the `=Average(C:3,C:222)` for Mean, `=MEDIAN(C:3,C:222)` for Median, `=STDEV(C:3,C:222)` for Standard Deviation, `=SKEW(C:3,C:222)` for Skewness, `=KURT(C:3,C:222)` for Kurtosis, `=MIN(C:3,C:222)` for Minimum, `=MAX(C:3,C:222)` for Maximum.

Now we are going to do calculate these three performance measures and six statistics for each asset by following these steps. After we are done with these calculations, we are going to interpret the data with each other by comparing the ratios that we calculated.

Here are the definitions of the metrics that we used:

Return: This refers to the profit made from an investment over time

Mean return: This refers to the mathematical average of returns over a time period

Variance: This also known as risk refers to how often the values of returns change around the mean returns.

Standard deviation: This is another measure of risk it is the square of the variance. it is also known as volatility

Semi-Deviation: This is another measure of volatility however it only measures the volatility in values below the mean returns value.

Value-at-Risk: This gives us information on the amount we may lose within a time period and gives us a metric where we can rank the investments from best to worse.

Sharpe ratio: it provides a means of comparison between returns and risk of an investment.

Sortino ratio: is the statistical tool that measures the performance of the investment relative to the downward deviation. The Sortino ratio is the statistical tool that measures the performance of the investment relative to the downward deviation.

Return-to-VaR(Value at Risk): Value at Risk (VaR) is a statistic that quantifies the extent of possible financial losses within a firm, portfolio, or position over a specific time frame.

Kurtosis: refers to the possibility of the extreme values observed in a set of values.

Skewness: This refers to the asymmetry of the normal distribution of the values how much does it move towards the left and right

Maximum: The lowest value observed from among a set of values

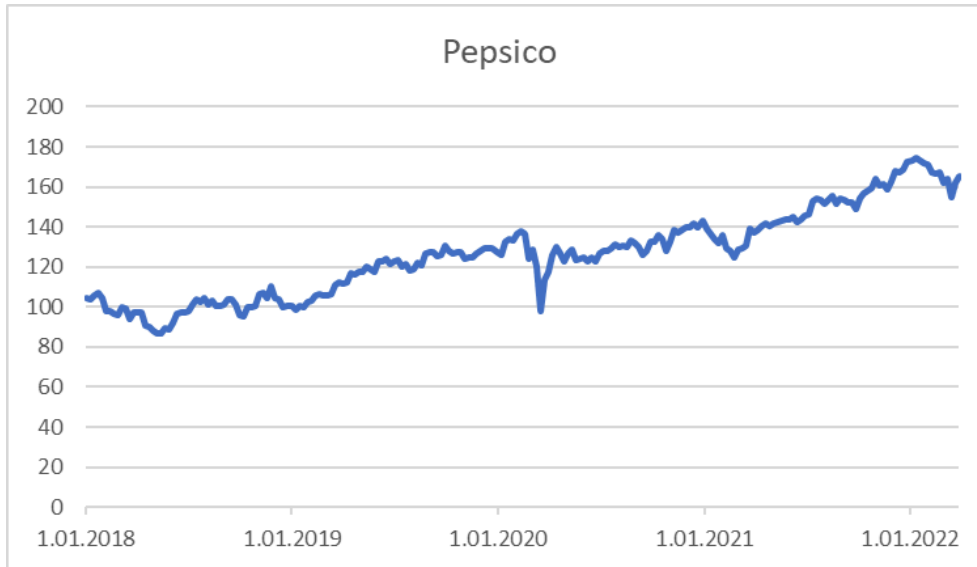
Minimum: The lowest value observed from among a set of values

Median: the values that are at the center of a set of numbers

Mean: The average value of a set of values. the value where each value is centered around

RESULTS

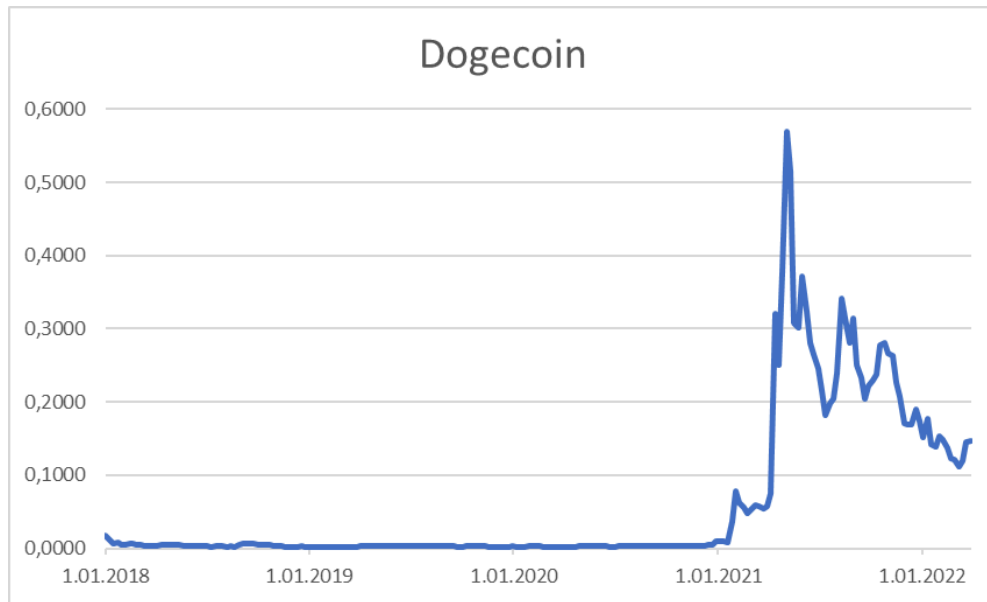
FIGURES



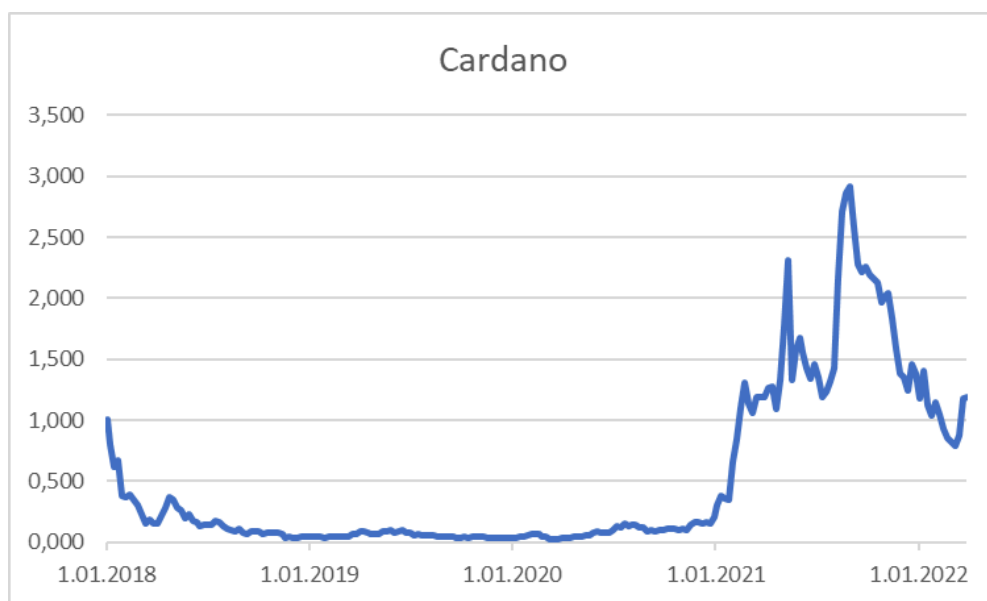
(Figure 1)



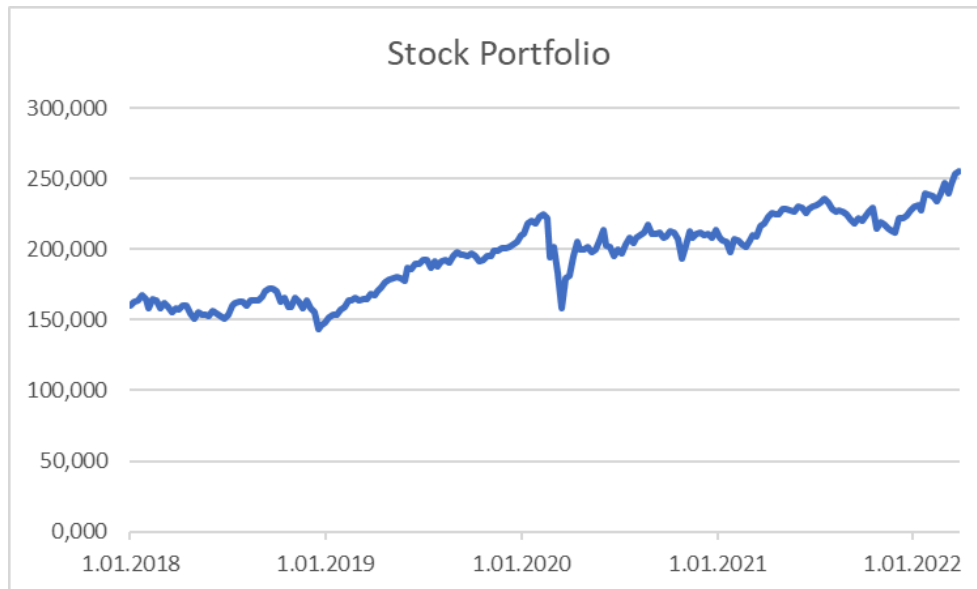
(Figure 2)



(Figure 3)



(Figure 4)



(Figure 5)



(Figure 6)

Both of the cryptocurrencies (Fig. 3 and Fig. 4) show a similar graph in terms of prices. Generally low and stable until the beginning of 2021 and after the beginning of 2021 both of the cryptocurrencies' prices skyrocketed along with some dramatic drops until today.

In terms of stocks (Fig. 1 and Fig. 2) both graphs show similar behaviour. Both of the stocks increase slowly but without any dramatic drops or rapid increases.

Lastly, in the case of the Stock Portfolio (Fig. 5), we can see similar behaviour with the individual stocks. Three of the graphs (Fig. 1, Fig. 2 and Fig. 5) increase gradually without any massive changes. Moreover, in the case of Crypto Portfolio (Fig. 6), we can also see a similar trend with both of the individual cryptocurrencies (Fig. 3 and Fig. 4). Considerably low prices until the beginning of 2021 and a sharp rise after the beginning of 2021 followed by dramatic increases and decreases.

TABLE 1

Panel A. Cryptocurrencies	Mean	Median	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Binance Coin (BNB)	2,768	1,150	17,331	-53,281	115,445	2,029	12,198
Bitcoin (BTC)	1,015	1,352	10,353	-33,494	29,788	-0,204	0,767
Cardano (ADA)	1,474	-0,630	17,266	-43,412	92,300	0,961	3,615
Dash (DASH)	0,313	-1,094	16,880	-54,319	95,703	1,261	5,820
Dogecoin (DOGE)	4,167	-1,648	36,783	-41,072	329,309	6,619	54,128
Ethereum (ETH)	1,471	1,499	13,776	-41,196	53,368	0,014	1,507
Litecoin (LTC)	0,706	0,477	14,654	-51,616	51,941	0,376	1,632
Monero (XMR)	0,560	0,913	13,281	-41,693	53,043	0,062	1,389
Neo (NEO)	0,963	0,755	18,083	-53,168	84,138	1,035	4,300
Ripple (XRP)	0,918	-0,321	18,947	-49,099	110,371	2,172	10,366

Panel B. Stocks	Mean	Median	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Johnson & Johnson (JNJ)	0,188	0,398	2,745	-10,723	8,939	-0,542	2,013
Lockheed Martin (LMT)	0,254	0,233	3,650	-14,087	19,627	-0,173	5,387
Oracle (ORCL)	2,667	0,325	41,335	-85,220	606,250	14,235	209,405
PepsiCo (PEP)	0,249	0,382	2,923	-18,454	15,904	-0,685	10,687
Visa (V)	0,369	0,233	3,621	-16,492	14,382	-0,282	3,815
Walmart (WMT)	0,263	0,207	2,893	-11,347	9,621	0,018	2,291

Panel C. Portfolios	Mean	Median	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Crypto Portfolio	0,876	1,427	12,552	-43,071	43,657	-0,076	1,158
Stock Portfolio	0,322	0,469	2,584	-14,261	12,073	-0,879	7,889

In Panel A. of Table 1, Dogecoin (DOGE) has the highest mean return, and Monero (XMR) has the lowest mean return. Therefore, on average it can be concluded that Dogecoin provides the highest profit and Monero provides the lowest profit. In Panel A. of Table 1, Ethereum has the highest median return and Dogecoin has the lowest median return. In Panel A. of Table 1, Dogecoin has the highest standard deviation of returns and Bitcoin has the lowest standard deviation of returns. The standard deviation is a way to calculate an asset's possible risks and predictability. Therefore, it can be interpreted that Dogecoin is a riskier and less predictable investment compared to other cryptocurrencies. On the other hand, Bitcoin is less risky and more predictable than other cryptocurrencies according to their standard deviations. In Panel A.

Bitcoin has the highest minimum return and Dash has the lowest minimum return. In Panel A. Dogecoin has the highest maximum return and Bitcoin has the lowest maximum return. For this reason, we can say that Bitcoin has a low volatility. In Panel A. of Table 1, Dogecoin has the highest skewness and Bitcoin has the lowest skewness. Skewness shows the symmetry or asymmetry of the returns. A higher, positively skewed distribution like Dogecoin has, means large positive returns are more probable than large negative returns and a lower, negatively skewed distribution like Bitcoin has, means large negative returns are more probable than large positive returns. Lastly, in Panel A. of Table 1, Dogecoin has the highest kurtosis and Bitcoin has the lowest kurtosis. Kurtosis shows the probability of extreme returns, which will increase the risk of the asset due to its high volatility. Therefore we can conclude that according to their kurtosis, Dogecoin seems riskier than the other cryptocurrencies that we investigated and Bitcoin seems less risky.

In Panel B. of Table 1, Oracle has the highest mean return and Johnson & Johnson has the lowest mean return. Therefore it can be seen that on average Oracle provides the highest profit. In Panel B. of Table 1, Johnson & Johnson has the highest median return and Walmart has the lowest median return. In Panel B. Oracle has the highest standard deviation and Johnson & Johnson has the lowest standard deviation. Therefore, we can say that Oracle is riskier and less predictable than other stocks. On the other hand, Johnson & Johnson is less risky and more predictable than other stocks due to their standard deviations. In Panel B. of Table 1, Johnson & Johnson has the highest minimum return and Oracle has the lowest minimum return. In Panel B. Oracle has the highest maximum return and Johnson & Johnson has the lowest maximum return. According to these minimum and maximum returns, we can conclude that Oracle has high volatility. In Panel B. of Table 1, Oracle has the highest skewness and Johnson & Johnson has the lowest skewness. Therefore, we can interpret that for Oracle, large positive returns are more probable than large negative returns and for Johnson & Johnson has, means large negative returns are more probable than large positive returns. In Panel B. of Table 1, Oracle has the highest kurtosis and Johnson & Johnson has the lowest kurtosis. Since kurtosis shows the probability of extreme returns, Oracle seems riskier than other stocks and Johnson & Johnson seems less risky.

In Panel C. of Table 1, Crypto Portfolio has a higher mean return than Stock Portfolio. This shows that investing in a variety of cryptocurrencies provides more profit than investing in stocks. In Panel C. of Table 1, Crypto Portfolio has a higher median return than Stock Portfolio. In Panel C. of Table 1, Crypto Portfolio has a higher standard deviation than Stock Portfolio. As standard deviation is a way to indicate the risks of assets, we can say that Crypto Portfolio is riskier than the Stock Portfolio. In Panel C. of Table 1, Crypto Portfolio has a lower minimum return than Stock Portfolio. Moreover, Crypto Portfolio has a higher maximum return than the Stock Portfolio, which shows the high volatility of the Crypto Portfolio. In Panel C. of Table 1, Crypto Portfolio has a higher skewness than Stock Portfolio, which indicates that for Crypto Portfolio, large negative returns are more probable than large positive returns and for Stock Portfolio, large negative returns are more probable than large positive returns. Lastly, in Panel C. of Table 1, as opposed to what could be expected, Crypto Portfolio has a lower kurtosis than Stock Portfolio. Therefore, according to their kurtosis Crypto Portfolio seems less risky than Stock Portfolio.

If we compare all types of assets we can see that on average, individual cryptocurrencies have a higher mean return than individual stocks. For the standard deviation, on average we can see that cryptocurrencies have a higher standard deviation than stocks, which indicates that cryptocurrencies are generally riskier due to their higher standard deviation but provides a higher profit. Since we choose Bitcoin, Ethereum, Litecoin and Dash for our portfolio we can see that the portfolio is more balanced than the individual cryptocurrencies but with a slightly lower mean return. For the Stock Portfolio, we chose Johnson & Johnson, Visa, PepsiCo and Lockheed Martin, which gave a slightly higher mean return with a considerably low skewness compared to individual stocks. Lastly, if we compare the two portfolios, we can see that Crypto Portfolio gives a higher mean return, with more risk due to its high volatility.

TABLE 2

Panel A. Cryptocurrencies	Sharpe Ratio
Binance Coin (BNB)	0,153
Bitcoin (BTC)	0,140
Ethereum (ETH)	0,126
Cardano (ADA)	0,081
Monero (XMR)	0,072
Dogecoin (DOGE)	0,046
Neo (NEO)	0,041
Litecoin (LTC)	0,039
XRP (XRP)	0,031
DASH (DASH)	0,003
Panel B. Stocks	Sharpe Ratio
PepsiCo, Inc. (PEP)	0,163
Visa Inc. (V)	0,148
Oracle Corporation (ORCL)	0,129
Walmart Inc. (WMT)	0,119
Johnson & Johnson (JNJ)	0,095
Lockheed Martin Corporation (LMT)	0,088

Panel C. Portfolios	Sharpe Ratio
Stock Portfolio	0,166
Crypto Portfolio	0,088

TABLE 3

Panel A. Cryptocurrencies	Sortino Ratio
Binance Coin (BNB)	0,207
Dogecoin (DOGE)	0,162
Bitcoin (BTC)	0,161
Ethereum (ETH)	0,155
Monero (XMR)	0,134
Cardano (ADA)	0,110
XRP (XRP)	0,076
Litecoin (LTC)	0,069
Neo (NEO)	0,057
DASH (DASH)	0,025

Panel B. Stocks	Sortino Ratio
PepsiCo, Inc. (PEP)	0,173
Visa Inc. (V)	0,145
Oracle Corporation (ORCL)	0,141
Walmart Inc. (WMT)	0,137
Johnson & Johnson (JNJ)	0,094
Lockheed Martin Corporation (LMT)	0,093
Panel C. Portfolios	Sortino Ratio
Stock Portfolio	0,171
Crypto Portfolio	0,100

TABLE 4

Panel A. Cryptocurrencies	Return-to-VaR
Dogecoin (DOGE)	0,235
Binance Coin (BNB)	0,167
Cardano (ADA)	0,149
Ethereum (ETH)	0,124
Bitcoin (BTC)	0,115

Monero (XMR)	0,063
Litecoin (LTC)	0,054
XRP (XRP)	0,049
Neo (NEO)	0,047
DASH (DASH)	0,028
Panel B. Stocks	Return-to-VaR
PepsiCo, Inc. (PEP)	0,127
Visa Inc. (V)	0,107
Walmart Inc. (WMT)	0,087
Oracle Corporation (ORCL)	0,087
Lockheed Martin Corporation (LMT)	0,074
Johnson & Johnson (JNJ)	0,065
Panel C. Portfolios	Return-to-VaR
Stock Portfolio	0,123
Crypto Portfolio	0,074

In Table 2, Binance Coin (BNB) has the highest Sharpe ratio among other cryptocurrencies while Dash has the lowest Sharpe ratio among other cryptocurrencies. In Panel B of Table 2, Pepsi has the highest ratio and Lockheed Martin has the lowest Sharpe ratio. In Panel C of Table 2, the Stock portfolio' Sharpe ratio is higher than the Cryptocurrency portfolio. A higher Sharpe ratio is better because it shows low risk. Thus, we can say that investing in Dash and Lockheed Martin is much riskier than investing in BNB and Pepsi. In Table 3 which is sorted according to Sortino Ratio, the highest and lowest assets are the same as in Table 2. In Panel A of Table 4, Dogecoin (DOGE) has the highest Return-to-VaR while Dash has the lowest among other cryptocurrencies. In Panel B of Table 4, PepsiCo has the highest Return-to-Var value while Johnson and Johnson have the lowest value. In Panel C of Table 4, the stock portfolio has a higher value than the cryptocurrency portfolio.

In general terms, these ratios show the performance metrics of each asset. By only looking at Table 2 which displays Sharpe Ratios of assets, we could say that Binance Coin (BNB) must be the safest cryptocurrency but by looking at different performance metrics such as the Return-to-VaR ratio, we could say the same thing for Dogecoin (DOGE). Therefore, we must understand that different performance metrics focus on different data. In terms of Sharpe and Sortino ratio, BNB has much less risk but in terms of return-to-VaR, BNB has higher risk than Dogecoin (DOGE). In addition to this, we can see that there are plenty of ranking differences between tables which is also caused by the different performance metrics and their different focuses.

The performance measures show that the cryptocurrency portfolio is much riskier than the stock portfolio. Even though cryptocurrencies have much more volatility and risk, which is shown by standard deviation, they also have significantly more returns which can compensate for their risk. In terms of the risk, there is a recognizable pattern that according to every performance measure, Dash is at a significantly higher risk than any other cryptocurrency or stock. This is due to the poor performance of DASH and the high level of volatility. The poor performance of DASH also increases the risk of the cryptocurrency portfolio and therefore cryptocurrencies like Binance Coin (BNB) and Cardano (ADA) have a lower risk than the cryptocurrency portfolio. Also, some cryptocurrencies have lower risk than stock portfolios such as Binance Coin (BNB) and Dogecoin (DOGE). Due to the Binance Coin (BNB)'s a good performance in terms of mean

return and DASH's poor performance, we can say that performance of categories also depends on the individual performance of each asset.

Dogecoin (DOGE) has the highest mean return according to Table 1. Dogecoin (DOGE) also has a significantly lower risk than any other asset on our list due to the high return-to-VaR value. Dogecoin (DOGE) has good performance among other assets according to performance ratios. Dogecoin (DOGE) has a high standard deviation which means high volatility, but also it has a high level of return; therefore, the risk is lower. In terms of the mean return, Johnson & Johnson has the lowest mean return. Therefore, it has much more risk than other assets except for some cryptocurrencies and performs poorly. Even though DASH has more mean returns than Johnson & Johnson, DASH also has a significantly higher standard deviation. Due to this DASH has the lowest performance according to performance ratios.

DISCUSSION AND CONCLUSION:

With this project our aim was to understand and calculate the risk-reward ratio of some cryptocurrencies. By finding these ratios we compared them to normal or traditional stocks of major companies, by this we were able to compare the performance of the two markets. With the evidence provided by the tables above we deduced that overall returns are higher in the cryptocurrency market. This means that the highest returns were possible on this market. But this does not mean that the crypto market is solely profitable. As we can see the crypto market also has had the biggest drop offs. In the evidence we can also see that the unproductiveness and risk is proven by the numbers. Overall the stock market has and mostly will be the de facto place to invest in but with the rise of cryptocurrencies and their unimaginable chance for very high returns makes it a lucrative investment for people who are willing to take that extra risk.

