Risk Management Analysis on Cryptocurrency Portfolio

DSA 5303 Financial Engineering Analytics

Final Project Report

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Introduction

In today's world, financial portfolio is not bound to only stock options. Cryptocurrencies has been on the rise since its bear run in 2017. Young generations became more intrigue on investing in the blockchain technology. Although, the cryptocurrencies tend to be more volatile than the stock market itself. That is why is wise to analyze the behavior of the cryptocurrencies as one would before investing in the stock market.

According to Business Insider, the top 10 cryptocurrencies in 2020 are Bitcoin (BTC), Ethereum (ETH), Ripple's XRP, Bitcoin Cash (BCH), Bitcoin SV (BSV), Tether (USDT), Litecoin (LTC), EOS, Binance Coin (BNB), and Monero (XRM). Although they are in the same top 10 category, they are not in the same price range (Bitcoin is in $9,000 range and XRP in $0.25 range as of February 2020). Therefore, analysis, such as, the ones that are done for regular stock market would be a good start in minimizing the risk and gaining better returns in cryptocurrency market.

The method that will be used in weighing the risk and the returns for the cryptocurrency portfolio project is the Capital Asset Pricing Model (CAPM). The Capital Asset Pricing Model (CAPM) approach will be able to help weighing the risk and returns for this portfolio by finding Beta and expected returns of certain cryptocurrency and calculating its expected return. This will be used to calculate Beta in the cryptocurrency portfolio, which shows the correlation of the market behavior with the cryptocurrency investment. The analysis will show if CAPM approaches would also work for cryptocurrency.

Problem Description

Background

a digital asset designed to work as a medium of exchange using cryptography to secure transactions, to control the creation of additional value units, and to verify the transfer of assets." (Härdle 3) It uses blockchain technology, which is "a distributed ledger technology (DLT) that allows data to be stored globally on thousands of servers – while letting anyone on the network see everyone else's entries in near real-time. That makes it difficult for one user to gain control of, or game, the network." (Mearian) There are different types of cryptocurrency: Transaction Mechanism, Distributed Computation, Utility Token, Security Token, Fungible Token, Non-fungible Token, and Stablecoins.

Problem Definition

The goal of this report is to produce a model that will be able to create a good Capital Asset Pricing Model (CAPM) by finding the best benchmark market for the cryptocurrency. CAPM are based from:

$$\bar{r_i} - r_f = \beta_i(\bar{r}_M - r_f)$$

Where,

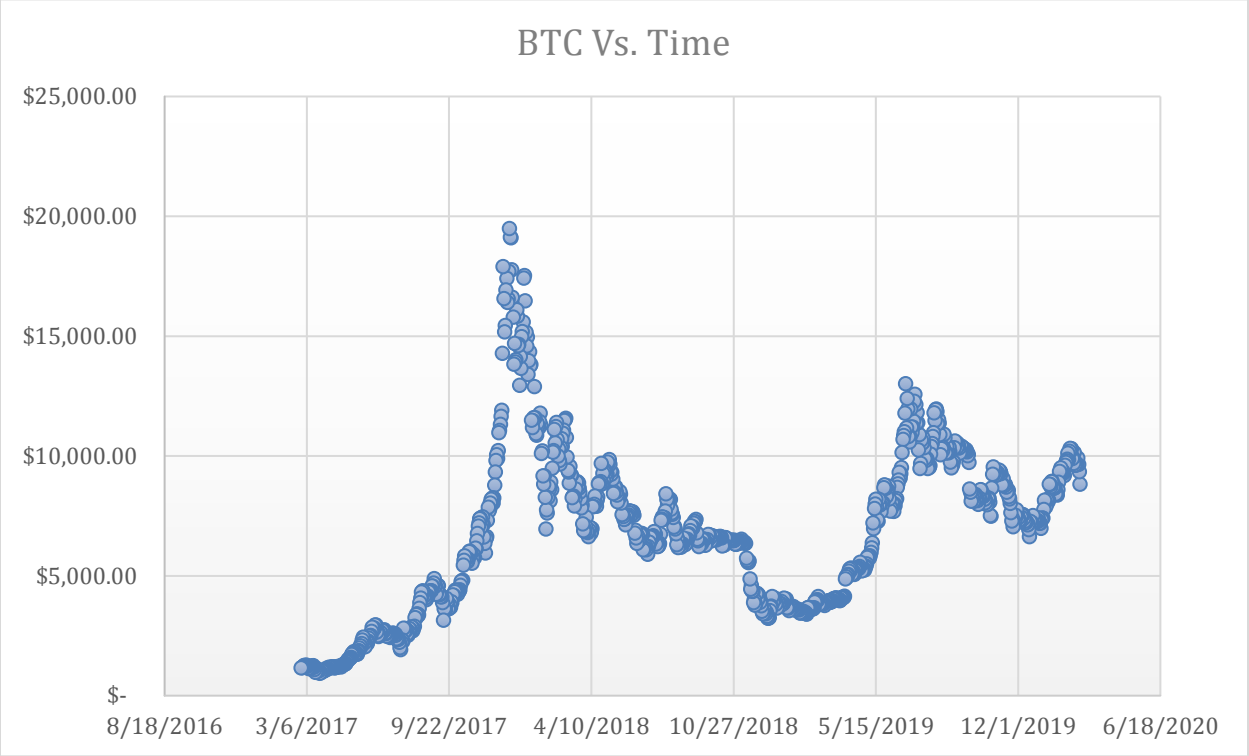
$\bar{r_i}$ is the expected return of the investment

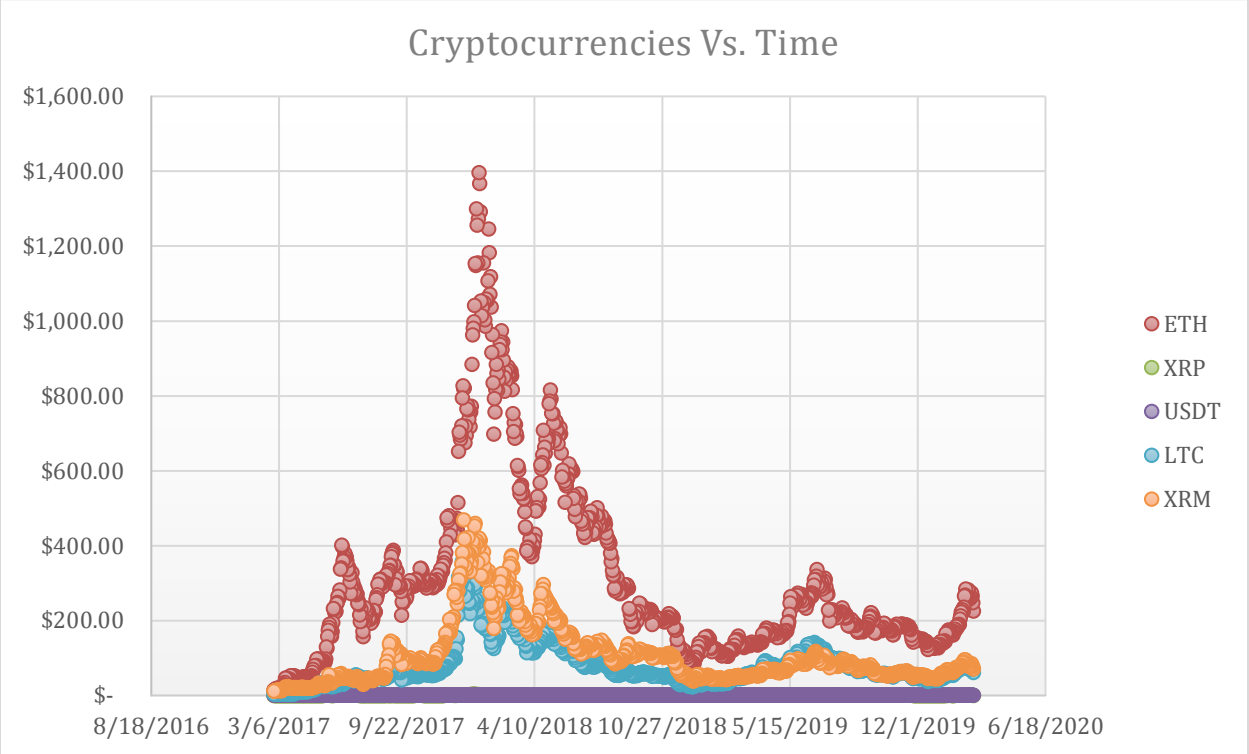
r_f is the risk-free rate

β_i is the beta-value of the investment

$(\bar{r}_M - r_f)$ is the market risk premium

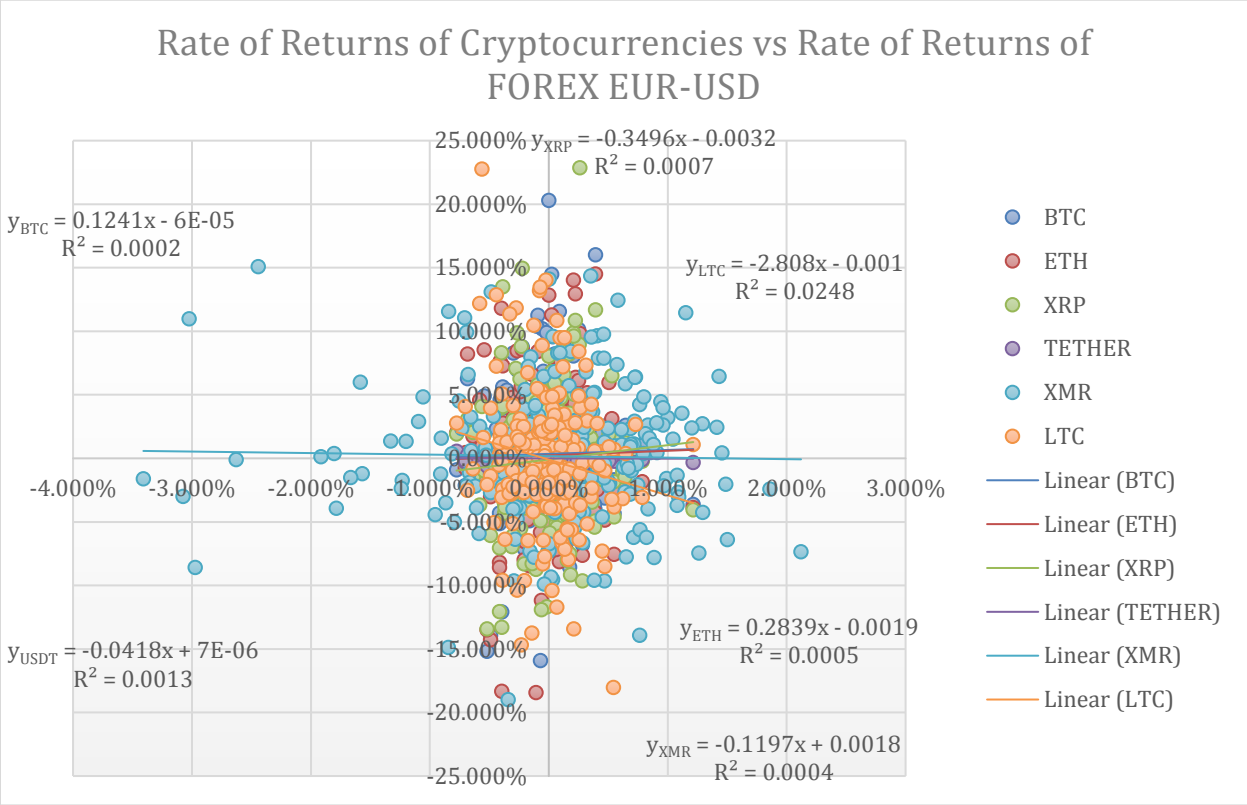
Cryptocurrencies Data

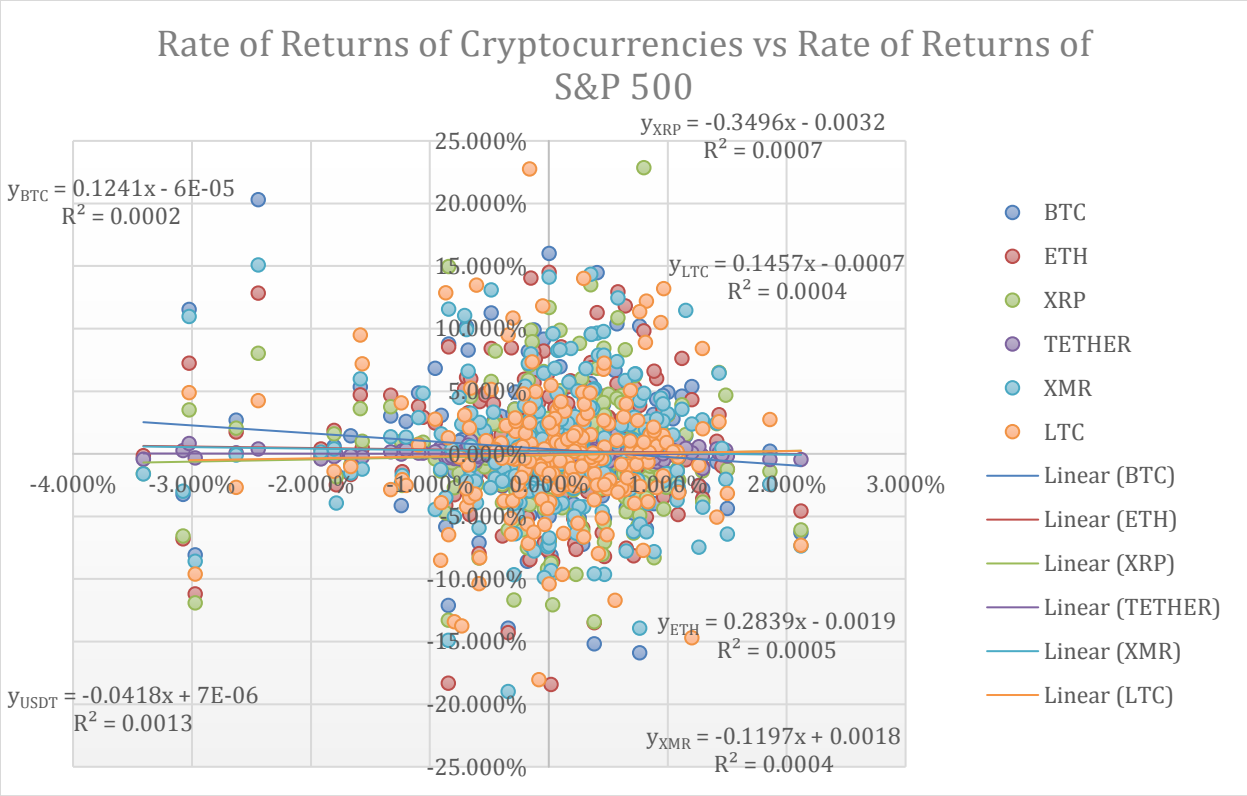


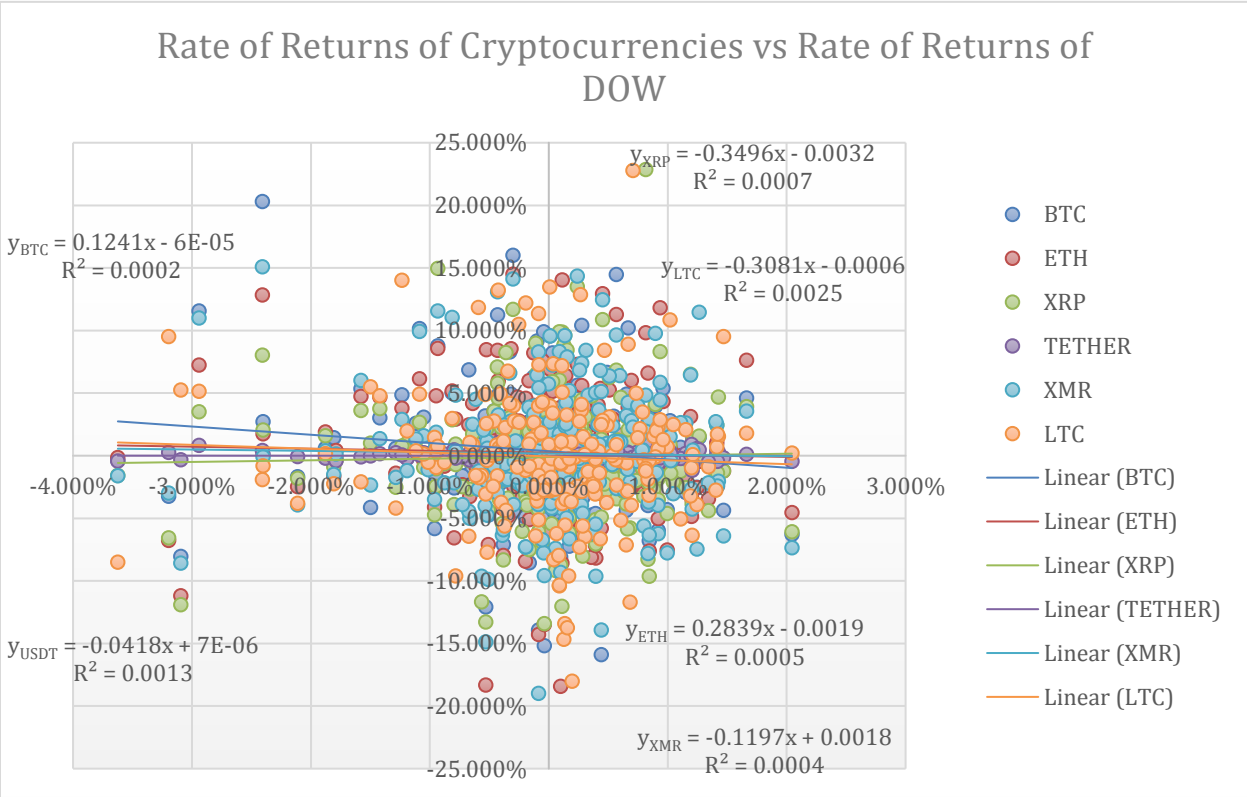


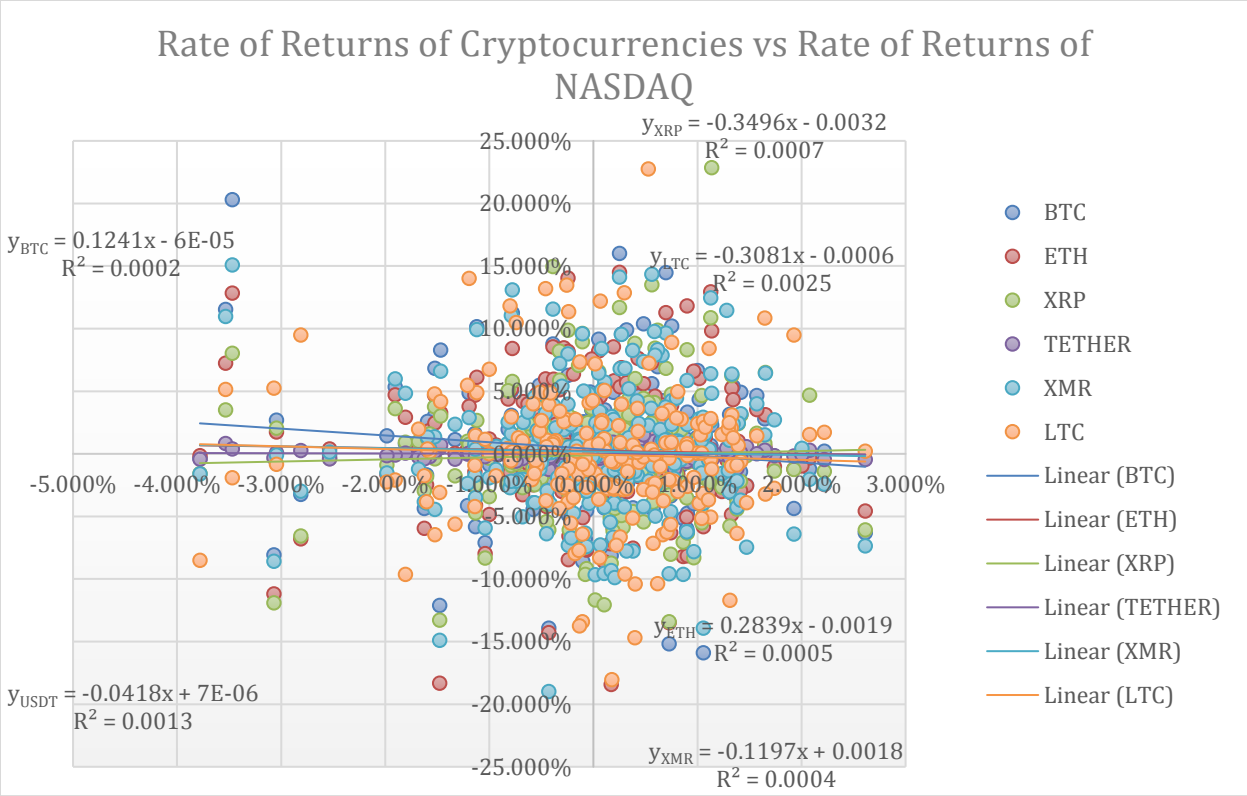
The data used to create these graphs are from Yahoo!Finance. The historical data start from February 2017 to February 2020.

Below shows the correlation of different stock market index with several different cryptocurrencies between February 2019 – February 2020.

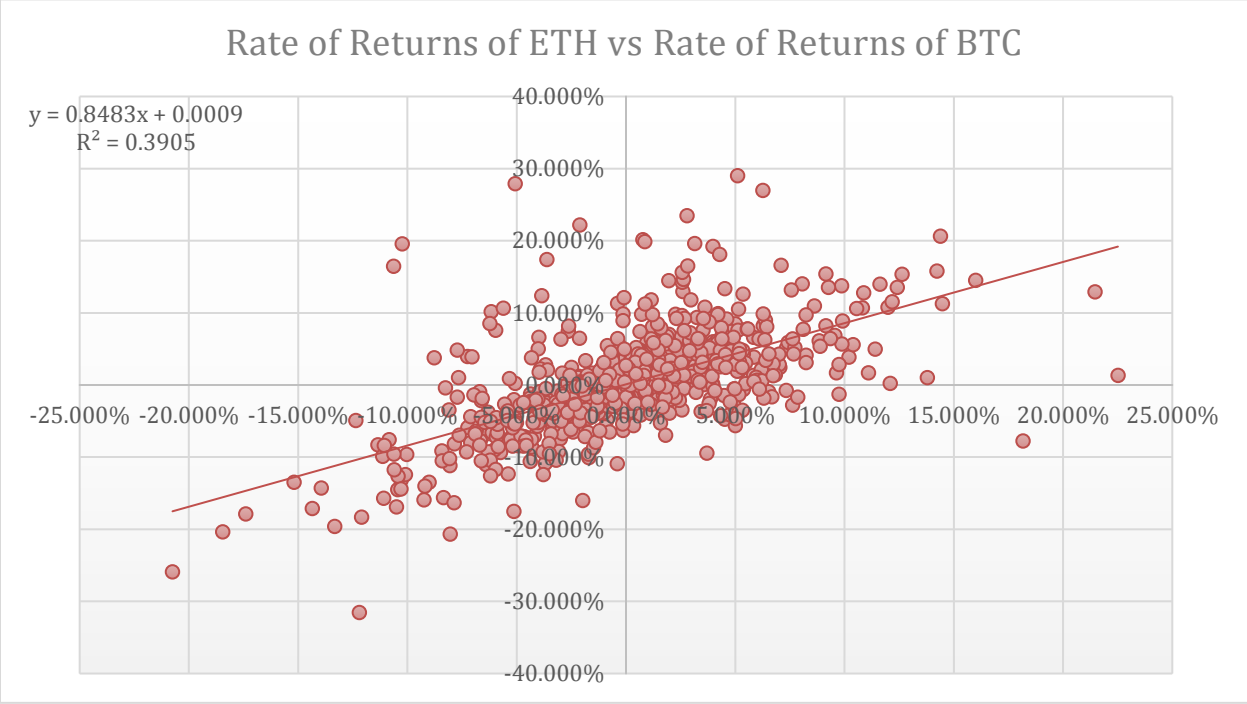


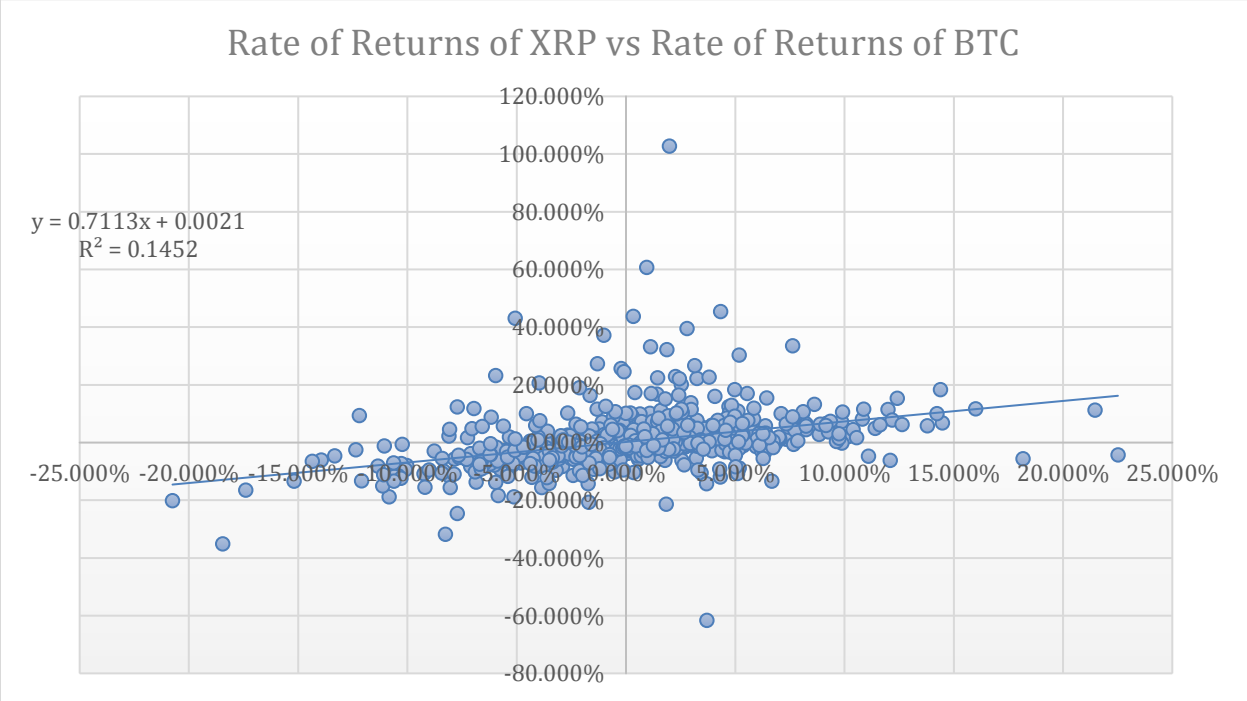

Rate of Returns of Cryptocurrencies vs Rate of Returns of S&P 500
$y_{XRP} = -0.3496x - 0.0032$
$R^2 = 0.0007$
$y_{BTC} = 0.1241x - 6E-05$
$R^2 = 0.0002$
$y_{LTC} = 0.1457x - 0.0007$
$R^2 = 0.0004$
$y_{ETH} = 0.2839x - 0.0019$
$R^2 = 0.0005$
$y_{USDT} = -0.0418x + 7E-06$
$R^2 = 0.0013$
$y_{XMR} = -0.1197x + 0.0018$
$R^2 = 0.0004$
25.000%
20.000%
15.000%
10.000%
5.000%
0.000%
-5.000%
-10.000%
-15.000%
-20.000%
-25.000%
-4.000%
-3.000%
-2.000%
-1.000%
0.000%
1.000%
2.000%
3.000%
BTC
ETH
XRP
TETHER
XMR
LTC
Linear (BTC)
Linear (ETH)
Linear (XRP)
Linear (TETHER)
Linear (XMR)
Linear (LTC)

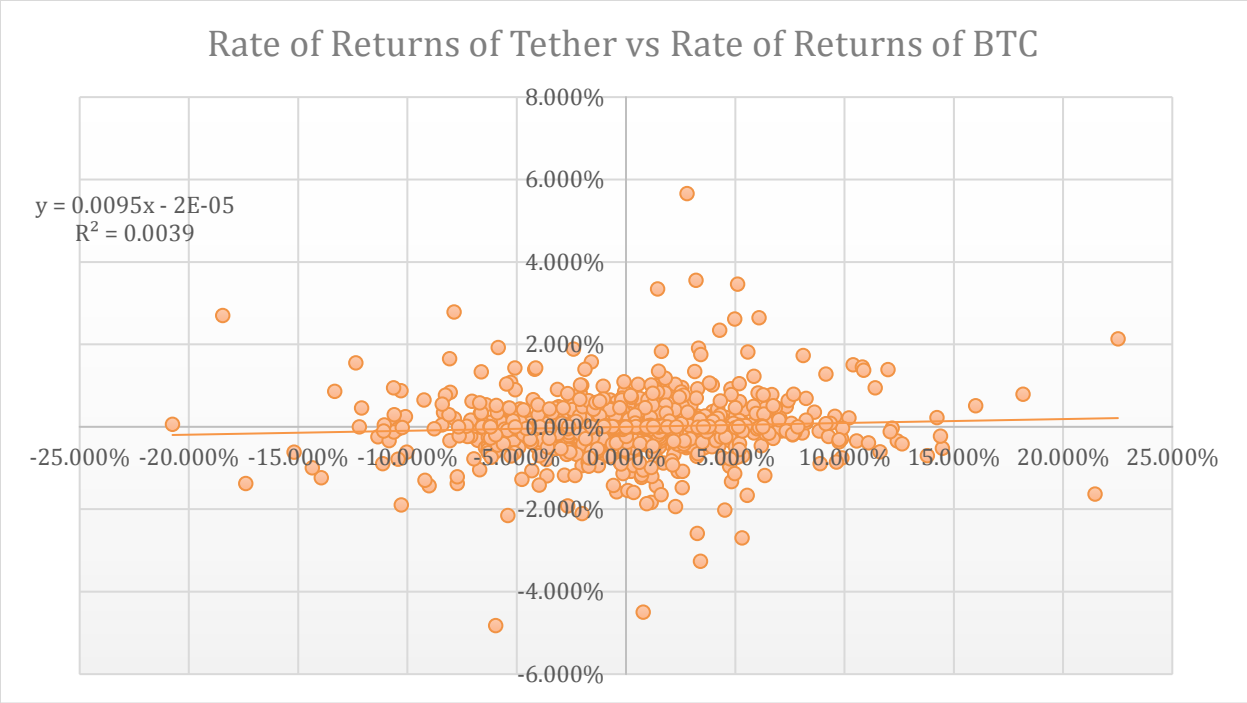

Rate of Returns of Cryptocurrencies vs Rate of Returns of DOW
$y_{XRP} = -0.3496x - 0.0032$
$R^2 = 0.0007$
$y_{BTC} = 0.1241x - 6E-05$
$R^2 = 0.0002$
$y_{LTC} = -0.3081x - 0.0006$
$R^2 = 0.0025$
$y_{ETH} = 0.2839x - 0.0019$
$R^2 = 0.0005$
$y_{USDT} = -0.0418x + 7E-06$
$R^2 = 0.0013$
$y_{XMR} = -0.1197x + 0.0018$
$R^2 = 0.0004$
25.000%
20.000%
15.000%
10.000%
5.000%
0.000%
-5.000%
-10.000%
-15.000%
-20.000%
-25.000%
-4.000%
-3.000%
-2.000%
-1.000%
0.000%
1.000%
2.000%
3.000%
BTC
ETH
XRP
TETHER
XMR
LTC
Linear (BTC)
Linear (ETH)
Linear (XRP)
Linear (TETHER)
Linear (XMR)
Linear (LTC)

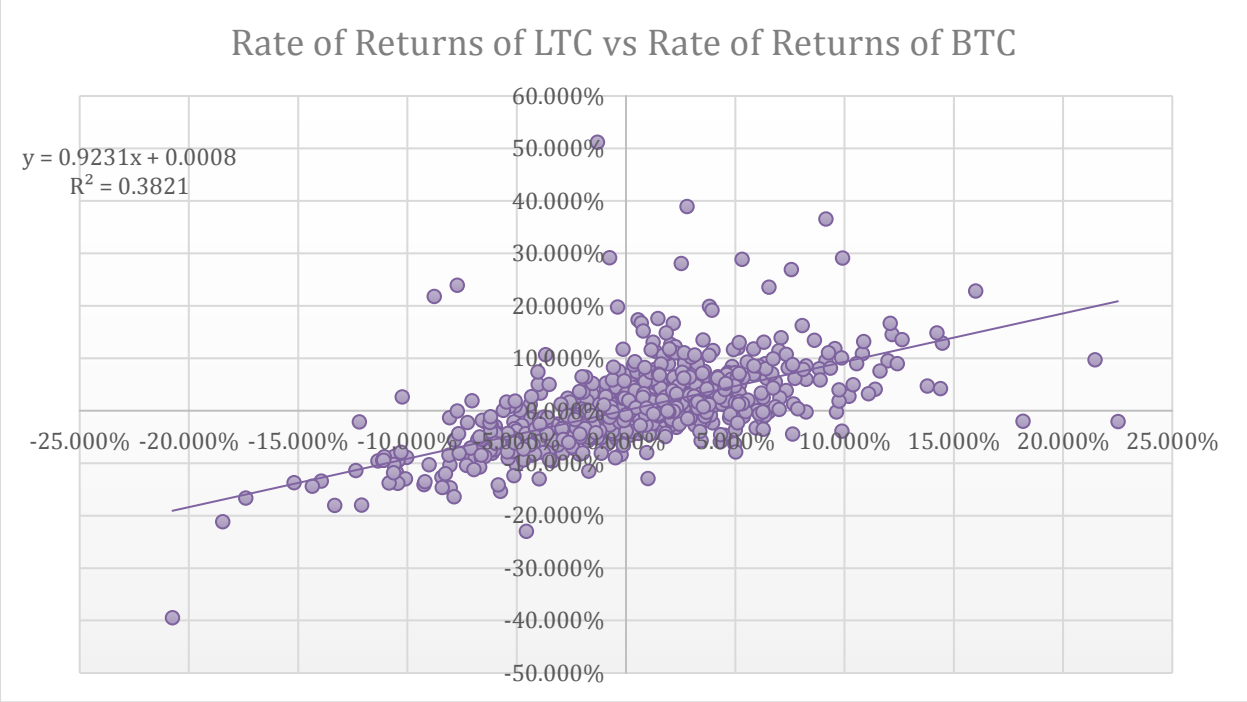

Rate of Returns of Cryptocurrencies vs Rate of Returns of NASDAQ
y_XRP = -0.3496x - 0.0032
R² = 0.0007
y_BTC = 0.1241x - 6E-05
R² = 0.0002
y_LTC = -0.3081x - 0.0006
R² = 0.0025
y_ETH = 0.2839x - 0.0019
R² = 0.0005
y_USDT = -0.0418x + 7E-06
R² = 0.0013
y_XMR = -0.1197x + 0.0018
R² = 0.0004
25.000%
20.000%
15.000%
10.000%
5.000%
0.000%
-5.000%
-10.000%
-15.000%
-20.000%
-25.000%
-5.000%
-4.000%
-3.000%
-2.000%
-1.000%
0.000%
1.000%
2.000%
3.000%
BTC
ETH
XRP
TETHER
XMR
LTC
Linear (BTC)
Linear (ETH)
Linear (XRP)
Linear (TETHER)
Linear (XMR)
Linear (LTC)

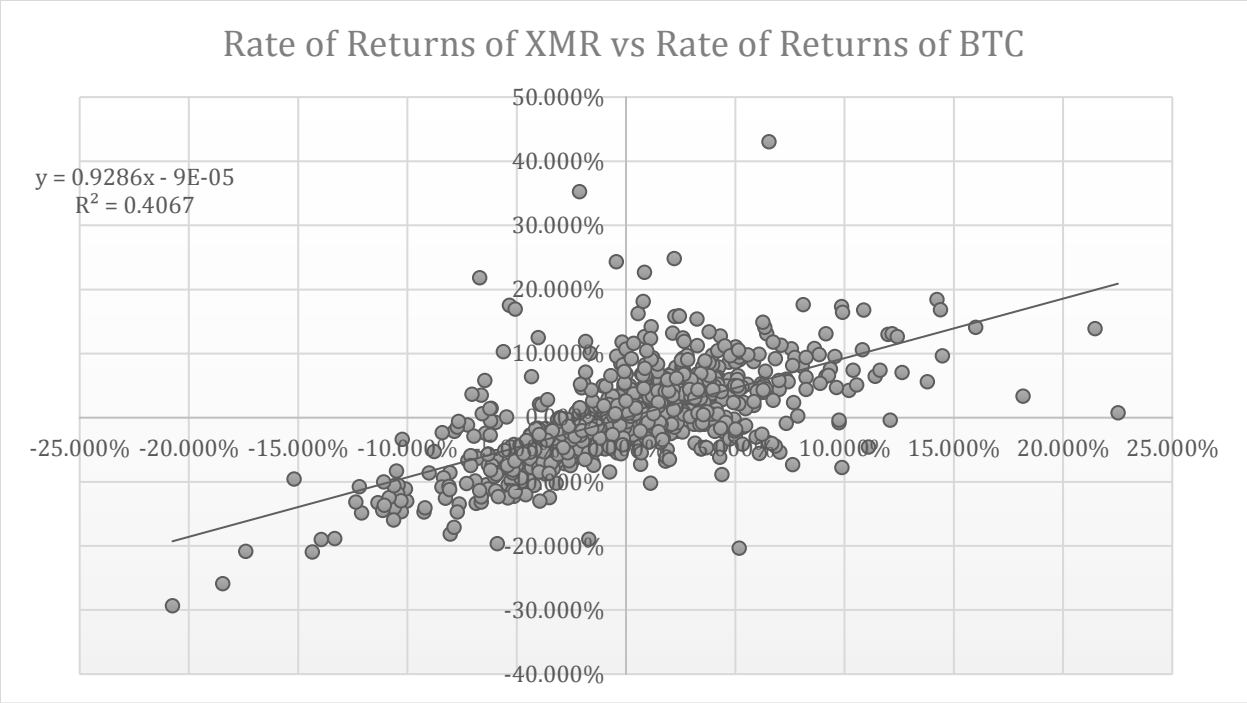
Below, shows the Bitcoin correlation with other cryptocurrencies from February 2017 – February 2020 (Yahoo!Finance historical data):






Rate of Returns of Tether vs Rate of Returns of BTC
y = 0.0095x - 2E-05
R² = 0.0039
8.000%
6.000%
4.000%
2.000%
0.000%
-2.000%
-4.000%
-6.000%
-25.000% -20.000% -15.000% -10.000% -5.000% 0.000% 5.000% 10.000% 15.000% 20.000% 25.000%


Rate of Returns of LTC vs Rate of Returns of BTC
y = 0.9231x + 0.0008
R² = 0.3821
60.000%
50.000%
40.000%
30.000%
20.000%
10.000%
0.000%
-10.000%
-20.000%
-30.000%
-40.000%
-50.000%
-25.000% -20.000% -15.000% -10.000% -5.000% 0.000% 5.000% 10.000% 15.000% 20.000% 25.000%



The R^2 is the beta-value in CAPM.

Conclusion

From the results of the beta-value from the CAPM, it can be concluded that the stock market does not correlate with cryptocurrency, which support the decentralized principal of the cryptocurrency. It also shows that using Bitcoin is not necessarily result in a high correlation with other cryptocurrencies. Future investigation is needed to see if CAPM method would work better if the rate of return of the cryptocurrency market is based on the type of the cryptocurrency mentioned before.

References

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