**Research Article**

# A comparison between the movement between the capital and the cryptocurrency markets?

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## Abstract

This article demonstrates the comparative possibility of a movement correlation between the cryptocurrency market and the world stock market indices. To encapsulate the study, three cryptocurrency and five world market indices have been taken into consideration for the comparison. These findings are relevant for the people who are investors, programmers, analysts as some of the findings are in alignment in the cryptocurrency market response to such drastic market crashes. The objective of this paper is to determine whether there is a degree of relationshipbetween the indices and cryptocurrencies which would be proved by the quantitative results from the correlation method, which will prove to be of great help to the investors who are looking for alternative assets to hedge the risk and diversify their investment portfolio. This paper has taken four indices and three cryptocurrencies by market capitalizationfor the purpose of research as the indices represents different economies of the world from developed countries to developing economies, this will encapsulate how the markets move and affects the world markets which translates into the movement of the cryptocurrency market if the correlation exists. This article has also cross checked the stationarity of data which will help with the study of the quantitative calculations of the data, this helps with the dependability of the data.

## 1. Introduction

Investors are always looking for ways to hedge their gains and losses, to do this they are always looking for alternatives to for the same. As Cryptocurrency have experienced high traction of incoming investors after the start of the pandemic as the population across the globe saw staggering triple digit returns in a matter of few months which led to the attraction of new investors in the market, investing heavily in large sums of money. Considering cryptocurrencies are (i) cannot be controlled by any government or central bank and (ii) are not connected with the real economy. Taking these aspects of cryptocurrencies in account, can these be seen as an alternative to conventional stock markets and how they move in co-relation to the market.

As cryptocurrencies are not tied to the real economy, there are few reasons that may affect their price movements unlike public companies where there is a plethora of reasons that can move the prices of their shares in the capital markets. The public companies have many reasons that affect their prices such as management decisions, earnings reviews, corporate actions, issues with the government of the country, changes in laws and regulations in the country.

In the empirical section of this paper, we hypothesize that the movement between cryptocurrencies and the capital markets are correlated to each other.

To support this hypothesis, we quantitatively analyze the movement behavior of Bitcoin, Ethereum, Ripple and Cardano representing cryptocurrencies and Dax, Cac, Nasdaq, S&P 500, Nifty and Hang Seng as stock market indices. Focusing on the stationarity of data, we have used Augmented Dickey Fuller Method as a Unit Test Method (*https://sci-hub.hkvisa.net/10.2307/1912517*). Adding to this we will be using co-relation method (*https://www.york.ac.uk/depts/maths/histstat/bravais.htm*). to mathematically calculate the correlation between the movement between the indices and the cryptocurrencies.

## 2. Literature Review

Before starting with the quantitative calculation, let's understand the meaning of correlation between indices and between returns between indices and cryptocurrencies.

Having affirmed the non-normal distribution of the two variables, the question of stationarity of the two-time series posed concerns*https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.830.5895&rep=rep1&type=pdf*). Cryptocurrencies could be considered as perfect diversifiers during downturns or periods of high uncertainty, since public companies and fiat currencies are strictly connected with the state of the economy. The future of fiat currencies is related to their corresponding countries;thus, they are vulnerable to any macroeconomic and political factor that destabilize the proper growth of the economy. However, when it comes to cryptocurrencies, the main driver of their price is their internal ratio of demand and supply and what the investors are ready to pay for the coin. One connection of cryptocurrencies with the real economy is the fiat currency in which they are expressed. This connection would be related to the central bank policies or other exchange rates. Nevertheless, cryptocurrencies seem not to be correlated to international exchange rates (Baur et al., 2018; Corbet et al., 2018) and researchers are unable to find any correlation between cryptocurrencies and changes in the monetary policies. (Wenjun Feng, Yiming Wang, Zhengjun Zhang, Informed trading in the Bitcoin market). Therefore, a digital currency might be a good choice as an alternative to the conventional capital markets.

In figuring out how much correlation there is between the volatility of crypto markets and traditional financial markets, the first step is to figure out how cryptocurrency came to be. For this information, we examine the paper "Peer-to-Peer Electronic Cash System" called Bitcoin.

Roman Matkovskyy and Akanksha Jalan, France. 2019. The study "Market oil intermediate for the US bitcoin and financial markets" found that there is no significant relationship between the various leaks in the US financial market and US bitcoin, the study concluded that there is a lot of work to be done in the future because the period taken by the researchers was from 2010 to 2017, which does not provide many historical data to compare the cryptocurrency, so it gives researchers and market investors more room for the future. Muhammad Owais QARNI, Saqib GULZAR*, Syeda Tamkeen FATIMA, Majid Jamal KHAN, Khurram SHAFI, Pakistan, 2019. "Exploring cross-market volatility spillovers in the US. Bitcoin and Financial Markets" concluded that the relationship between the two is insignificant and thus may be important for future financial markets. "Luisanna Cocco, Giulio Concas and Michele Marchesi, South Africa. The 2015 year. To find out if there is a relationship between the cryptocurrency market and the financial market". This paper concludes that a correlation analysis of Bitcoin returns and financial indices, especially the DJIA in the US market and the ASX in Australia and the AUD / USD exchange rate, showed that the price movement of Bitcoin does not follow either of them. Instruments, In summary, Bitcoin returns have several fascinating statistics and are expected to be constantly unpredictable, which may require in-depth analysis to explain its extreme volatility.

After the various literature review, what can be concluded is that prediction of the crypto market is unpredictable, and hence that investors may invest in the market by seeing its future scope as a commodity and less as a financial market instrument.

## 3. Data:

The data that has been used in this study has been sourced from Thomas Reuters Rifinitiv Eikon business terminal. In particular to analyses different behavior of cryptocurrencies and the world stock market indices. These indices are taken to cover the wide spectrum of global markets and the co-relation in the movement amongst the indices as the global markets are co-related when it comes to movement (*https://arxiv.org/pdf/1102.1339.pdf?mod=article _inline*). The data for the markets have been consolidated as per weekly basis to simplify complex data into smaller comprehendible fragments for the purpose of developing graphs.
For the stock market indices, we have taken Dax, Cac, Nifty, Nasdaq, S&P 500 and Hang Seng, these indices have been selected in order to show the representation of market around the world. The cryptocurrencies taken in consideration are Bitcoin, Ethereum, Ripple and Cardano, these are taken for empirical calculations because they are the largest cryptocurrencies in terms of the market capitalization.

In Table 1, we show the descriptive statistics. It features that stock markets have given a lower weekly average return. Adding to this the standard deviation of weekly change in the cryptocurrencies are significantly higher compared to the stock market indices. The study also encapsulates the frequency of the data from which a lot of useful information can be extracted. The data taken for the calculation for the descriptive statistics has been taken at a time-series of 5 years which enables us to get along-term vision of how these assets move and at what is their quantitative behavior.

## 4. Methodology

As the research starts with the quantitative calculation of the behavioral movements of the world stock market indices and cryptocurrencies, we will be using co-relation method and for unit test analysis, Augmented Dicky Fuller (ADF) test.

### 4.1. Analysis of the Compound Growth of Stock Market Indices and Cryptocurrencies.

The calculation of the growth of the asset's simple percentage change with taking the base as the oldest data point which yields in a compounded growth rate.

Analyzing Chart 1 and Chart 2 brings us to a consensus that cryptocurrencies have given stellar

performance when it comes to returns. Cryptocurrency were able to give such stellar returns because of their hype formed after the pandemic (*https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8597403/*)

Another point to note from the below two charts is that indices have the same trajectory as one another and the same goes for the cryptocurrencies. This is because the factors that affect these markets are similar (*https://ieeexplore.ieee.org/abstract/document/9211195*).
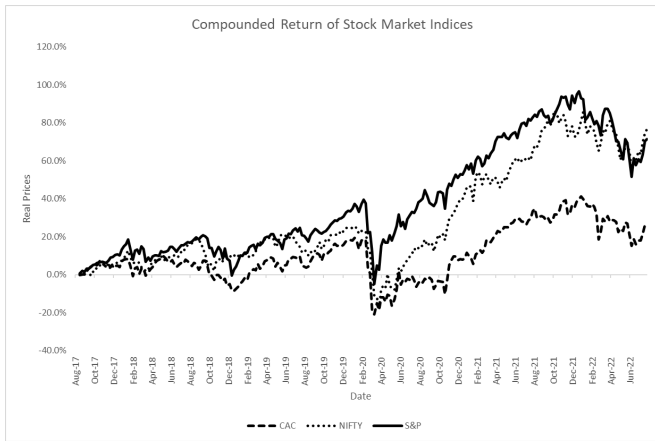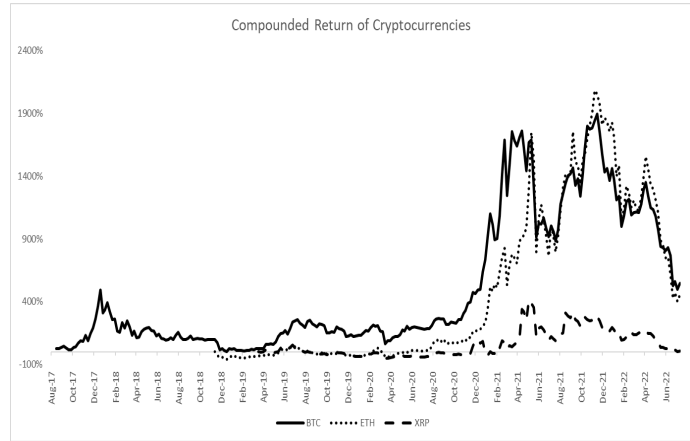


*Chart 1*



*Chart 2*

Chart 1: This shows the growth of World Indices over the period of last 5 years where NIFTY and S&P 500 have given ~80% returns and the French CAC index has given ~30% return. This is correlated to the GDP growth of the country and several macroeconomic factors.

Chart 2: This chart shows the returns of cryptocurrencies such as BTC, ETH and XRP which have given astronomical returns over the period of last 5 years. BTC and ETH have given ~420% returns where they peaked at an astounding ~2200% return in a period of one year.

These charts are taken into consideration for the purpose of comparison of the returns generated by

the assets over the period of last five years which can be used to hedge the risk.

## 4.2. Analysis of Descriptive Statistics

For the calculation of descriptive statistics a few most used statistics have been used such as average weekly return which calculates the mean of the returns generated by the asset in the time period, standard deviation which looks after the deviation of returns from the mean which basically means how volatile the asset is, more the standard deviation more the volatility, the variance illustrates how far the data sets are from the mean by the help of squaring the data numbers.

## Table 1: Descriptive Statistics

| | Average Weekly Return | Median | Standard Deviation | Variance | Minimum | Maximum | Kurtosis | Skewness | No. of Observation |
|---|---|---|---|---|---|---|---|---|---|
| CAC 40 | 0.0014 | 0.0033 | 0.0291 | 0.0008 | -0.199 | 0.107 | 10.352 | -1.417 | 260 |
| DAX | 0.0009 | 0.0030 | 0.0298 | 0.0009 | -0.200 | 0.109 | 9.910 | -1.304 | 260 |
| NIFTY 50 | 0.0026 | 0.0050 | 0.0254 | 0.0006 | -0.122 | 0.127 | 5.217 | -0.219 | 260 |
| S&P 500 | 0.0024 | 0.0051 | 0.0272 | 0.0007 | -0.150 | 0.121 | 6.603 | -0.707 | 260 |
| BTC | 0.0150 | 0.0126 | 0.1149 | 0.0132 | -0.367 | 0.310 | 0.811 | -0.139 | 261 |
| XRP | 0.0151 | -0.0055 | 0.1807 | 0.0326 | -0.513 | 1.243 | 13.988 | 2.469 | 178 |
| ETH | 0.0207 | -0.0055 | 0.1375 | 0.0189 | -0.453 | 0.508 | 1.636 | -0.069 | 196 |

## 4.3. Analysis of the results from Augmented Dunking Fuller Test.

An Augmented dunking fuller test (ADF) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used but is usually stationary or trend stationary. It is an augmented version of the Dicky-Fuller test for a larger a more complicated set of time series models.

## 4.4. Analysis of the co-relation between the indices and the cryptocurrency.

For the empirical calculation of the hypothesis whether the stock market indices and the cryptocurrencies move in a similar manner or in other world are the movements of these two markets co-related to one another. To perform this test four worldwide stock market indices were taken to represented different economies of the world from developing to developed. This gives us a wider perspective of the research and will include different situations with the data.

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

$r$ = correlation coefficient
$x_i$ = values of the x-variable in a sample
$\bar{x}$ = mean of the values of the x-variable
$y_i$ = values of the y-variable in a sample
$\bar{y}$ = mean of the values of the y-variable

The correlation has been divided into three sections i.e., past one year, three year and five-year correlation to see the long- and short-term movement behavior. In table **x** we can see that in long-term the correlation between indices and cryptocurrencies are all in positive position which

concludes that in the five-year time period the stock market indices market and the cryptocurrency market are correlated. The highest correlation in 5-year time period is with the S&P 500 index with 91% correlation with Bitcoin and 92% correlation with Ethereum.

| 5Yr Correlation | BTC | XRP | ETH |
|---|---|---|---|
| CAC 40 | 79% | 73% | 84% |
| DAX | 84% | 78% | 84% |
| NIFTY 50 | 88% | 75% | 91% |
| S&P 500 | 91% | 79% | 92% |

| 3Yr Correlation | BTC | XRP | ETH |
|---|---|---|---|
| CAC 40 | 75% | 72% | 82% |
| DAX | 82% | 78% | 81% |
| NIFTY 50 | 84% | 74% | 89% |
| S&P 500 | 88% | 81% | 92% |

| 1Yr Correlation | BTC | XRP | ETH |
|---|---|---|---|
| CAC 40 | 71% | 59% | 77% |
| DAX | 84% | 81% | 84% |
| NIFTY 50 | 70% | 65% | 70% |
| S&P 500 | 85% | 78% | 89% |

# 5. Empirical Results

## 5.1. Analysis of the Compound Growth of Stock Market Indices and Cryptocurrencies.

By analyzing both the charts we can draw a few conclusions, one of them are during the covid-19 market crash both the markets saw huge drops in the value, this was because the people investing in the market have the same market sentiments when it comes to investing in assets (*https://www.nber.org/system/files/working_papers/w21294/w21294.pdf*) due to which the movements in the market becomes similar as people were too cautious about investing during that time (*https://www.tandfonline.com/doi/pdf/10.1080/23322039.2017.1390897*). Second, the markets do recover after the market crash when a short-term unanticipated crash comes along (*https://arxiv.org/pdf/cond-mat/9910213.pdf*), looking at the charts it can also be concluded the same for the cryptocurrency market as they have a positive correlation and also the behavior is the same.

## 5.2. Analysis of Descriptive Statistics

The descriptive statistics have been taken at a daily-time series of 5 years which gives a long-term idea of how the statistics look. It can be seen from table 1 that stock market indices have given lesser returns than the cryptocurrencies i.e., between 0.09% for DAX to 0.246% for Nifty,

these are average weekly returns. The same for the cryptocurrencies go from 1.5% for BTC to 2.1% for ETH, from this we can conclude that cryptocurrencies have yield better returns than the stock market indices.

As per Standard Deviation, cryptocurrencies have a larger standard deviation than stock market indices this shows that with greater return yielding cryptocurrencies comes with a larger volatility factor. The number of observations in some cryptocurrencies are fewer than 260 as of stock market indices because they were introduced 1-3 years back which tags them as new hence their data set have fewer observations.

## 5.3. Analysis of the results from Augmented Dunking Fuller Test.

The Augment Dicky Fuller test (*https://sci-hub.hkvisa.net/10.2307/1912517*) is used to determine the stationarity of the time series data, it is a unit root test which has a null hypothesis as the test performed on the data has a unit root. We decided to use ADF to the closing prices of indices and cryptocurrencies in order to determine the stationarity of the time-series of the data. For performing the ADF test.

For each stock the t-statistic is all negative which indicates that the data is non-stationary which means we can move ahead with the quantitative calculation of finding the correlation.

| | | t-statistics | probablity | | | t-statistics | probablity |
|---|---|---|---|---|---|---|---|
| BTC | | -5.610 | 0 | ETH | | -5.146 | 0.0002 |
| | 1% Level | -3.994 | | | 1% Level | -4.008 | |
| | 5% Level | -3.428 | | | 5% Level | -3.434 | |
| | 10% Level | -3.137 | | | 10% Level | -3.141 | |
| NIFTY | | -6.828 | 0 | S&P | | -17.202 | 0 |
| | 1% Level | -3.995 | | | 1% Level | -3.994 | |
| | 5% Level | -3.428 | | | 5% Level | -3.427 | |
| | 10% Level | -3.137 | | | 10% Level | -3.137 | |
| DAX | | -15.910 | 0 | CAC | | -15.802 | 0 |
| | 1% Level | -3.994 | | | 1% Level | -3.994 | |
| | 5% Level | -3.427 | | | 5% Level | -3.427 | |
| | 10% Level | -3.137 | | | 10% Level | -3.137 | |

## 5.4. Analysis of the co-relation between the indices and the cryptocurrency.

For the observation of correlations, the division of results into three sections gives us a perspective of how the movement of the prices of the assets move with respect to each other (indices and cryptocurrencies). In the first part taking the correlation data we can observe that the correlation between indices and cryptos are all above between 0-100% which are all positive which indicates that these two markets are highly correlated that means a movement in on will instigate a movement in the other. This is a big revelation as investors will take this into consideration that investing in both instruments might result in the same movement thought he amplitude of movement might be different.

In the past one-year correlation we can see that the correlation data is still positive that means there are no further signs that these markets may go into reverse correlation in near future, the movements remain similar throughout the time period since inception of the cryptocurrency markets.

## 6. Conclusion

As we have observed from the qualitative and quantitative literature review, empirical calculations that the world stock market indices and cryptocurrencies are correlated with one another since the correlation between them has turned out to be a positive one. With this information in hand investors can anticipate that their investment in short-term might show the same trajectory as the adjacent market (indices/cryptos) but the magnitude of the movement might be different *(https://drive.google.com/file/d/1eHtIPUZMav0e5 sZPVlMPpqSvp79Z185l/view)*.

The analysis of historical data also suggests that cryptocurrencies have given astronomical returns compared to the indices. This is one of the many reasons why investors look towards cryptocurrencies for hedging the risk and also

getting extra returns over a short period of time, this is why the cryptocurrencies became very famous and people invested a huge sum of money in it.

The data used for the research has been sourced from the Thomas Reuters Rifinitiv Eikon terminal which has been tested on the stationarity by the help of the Unit Root Test and Augmented Dicky Fuller Test, which has proved that the data used for the research is stationary meaning the mean and variance are stable and does not fluctuate. These results were promising while performing the next set of quantitative tests.

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