

# Decentralized Finance: Non-Fungible TokenValuation and its Impact on Global Markets

Arnav Gowda

G/T Research

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Ms. Julia Bakhru

## **Abstract**

Non-fungible tokens were first created in 2014 and since then have increased in price by over 100,000% (Avegotchi). With these substantial gains also comes risk, calculated through financial models such as the Treynor ratio, Sharpe ratio, and Jensen's alpha. The conclusion is made that investments made in the NFT market pose a greater risk than traditional investments (see Appendix A). Furthermore, their value in global markets can be measured through wavelet coherence. Using this method high-value NFT projects are compared to major cryptocurrency exchanges and a slight correlation is found between them (see Appendix B). This data paired with data from volatility transmission provides the conclusion that collectible NFT projects have little comovement with cryptos and almost no comovement with one another. This means the value of NFT collectibles will quickly diminish in the coming quarters and due to their lack of comovement, the lost investment value will not have a significant impact on the overall economy. In the future, due to the value of blockchain technology, NFTs will evolve into a possession technology for noninvestment goods and potential asset security.

## Introduction

The non-fungible token market's capitalization grew to thirty billion dollars by the end of 2021 which is a significant increase from its original valuation of 120 million dollars in quarter one of 2020. This is a staggering 25,000% gain in two years allowing it to outperform all traditional investing models such as index funds and real estate during one of the largest bull runs in history (Usman, 2020). The mass appeal that NFTs have gained has posed a question regarding whether it could be a potential contender for a new global financial market or if it is a temporary vogue that will crash like the many other bubbles throughout history. The NFT market's current state is temporary and will eventually quickly decline, causing minimal repercussions on global markets, but will eventually remerge as a possession and asset security technology due to its independent status, nominal comovement, and market valuation. The purpose of this paper is to summarize research surrounding the current state of NFTs and how they will move and evolve in the future as digitization and online asset management grow standardized among the general populace.

NFTs are unique digital items that are bought and sold using various crypto-currencies, primarily Ethereum and Bitcoin. These items can be many different things such as digital artwork, video game items, unique collectibles, or something with real-world use, such as a concert ticket(Avegotchi, 2021). Each type of NFT is sorted into various sectors. The most prominent types of NFTs are the collectibles sector, which features collections of simple figures each with slightly varying characteristics and designs. Then it is the artwork sector featuring paintings, illustrations, and digital models; then the sports sector featuring sports cards, sports clips, and interviews; and also the game sector, which contains various videogames and in-game items (Avegotchi, 2021). Though there are a variety of other sectors, their total market share accounts for less than two percent of the market capitalization (Avegotchi, 2021).

NFTs are stored on a decentralized blockchain system, a form of digital ledger, which means once an NFT is bought, they own it forever until it is sold. Its digital characteristic means that anyone can mint or create an NFT on a simple program for next to nothing and post it on an online marketplace (Fairfield, 2020). This technology is useful in proving the authenticity of a product since all the history of sales is stored digitally on the blockchain. This means it is impossible to counterfeit an NFT and introduces an entirely new system of digital possession (Avegotchi, 2021). They differ from other forms of decentralized financial products such as Bitcoin and initial coin offerings (ICO) because each token has different characteristics and different values associated with those traits, unlike cryptocurrencies where every unit is the same and has the same value (Ghaderi et al., 2020). Despite the increasing popularity, NFTs have received criticism, because like artwork, the value is in the eye of the beholder and they leave a large carbon footprint. In fact each transaction over the blockchain produces the same amount of carbon as a house does over five days (Fairfield, 2020). In the past two years, the price of NFTs has risen at a very high rate, which is a potential indicator of it being severely overvalued. Recently, there have been NFT sales going up by several million dollars daily, along with the sale of a \$69 million NFT (Avegotchi, 2021).

## **Review of Literature**

Each sector of the NFT market and each cryptocurrency acts independently. The possible movement of one sector or one crypto does not directly affect the movement of others, making it unlikely for the four dominant sectors to crash. This is seen through economic trends measured in volatility transmission, understanding a buyer's mindset, and total market share (Dowling, 2021). It is commonly known that a large portion of the NFT user base is made up of people that hold cryptocurrencies in their wallets (Dowling, 2021). However, when comparing the two sets of markets, this has very little impact on pricing.

The first method of measuring comovement is the spillover effect. The spillover effect is when movement or an event in one distinct market creates a ripple effect that directly or indirectly impacts another market. To measure this, prices are inputted at certain times between various markets and determine if they move and change similarly (Kenton, 2020). The values imputed into the model were from a collectible project called Cryptopunks, a videogame called Axie Infinity, a virtual world called Decentraland LAND, as well as the two most valuable cryptocurrencies: Ethereum and Bitcoin. The data was acquired throughout a rolling 50-week period in 2020-2021 (Dowling, 2021). Upon analyzing the data the most comovement is between the ethereum and bitcoin which range from 30-33, where higher values indicate higher comovement (see appendix D). Comovement is when two or more variables move in the same direction over a cycle. This makes sense because they both serve similar purposes and are bought with one another. The next highest value seen is with Decentraland LAND, which is a project powered by a non-profit that creates a virtual world where people can buy plots of land. The comovement ranges from 12.57-13.57 when compared to crypto which is considered slightly significant (see appendix D). These numbers drop even further when comparing Decentraland LAND to Axie and Cryptopunks with their comovement measuring between 2.49-4.32 indicating very rare occasions of comovement which could very well be a coincidence or within the margin of error (see appendix D). Cryptopunks have a spillover of 7.61-10.79 with cryptocurrencies and a spillover of 4.18-6.59 with NFTs, indicating low levels of spillover (see Appendix D). Finally, Axie Infinity has a spillover of 5.44-3.43 with cryptocurrencies and a spillover of 0.49-9.20 with NFTs indicating low to nonexistent levels of spillover (Dowling, 2021)(see Appendix D). From the data, the conclusion can be made that cryptocurrencies have comovement with one another because their transmission is over 30. NFTs, especially Decentraland, have a slight level of comovement with cryptos, and the NFTs have an insignificant level of comovement with one another because their values are much lower. Due to the lack of comovement NFTs have, it is clear that any drastic price changes will have minimal impact on other markets.

The next way to measure the correlation between various cryptos and NFTs is with a model called wavelet coherence. This is used to study the interaction between various time series and how they evolve, making it very useful in identifying regions and areas of high comovement at certain times. To use this, data is inputted and mapped in the form of  $C_x(a,b)$  and  $C_y(a,b)$  where  $x$  and  $y$  denote the continuous wavelet transforms,  $a$  is the scale, and  $b$  is the position. The movement is then put into the form of a heat map where it can be visually analyzed for comovement and general movement (Anindya et al., 2015). The values imputed into the model were 7,578 trades of Cryptopunks, 95,272 trades within Axie Infinity, 4,936 trades within Decentraland LAND, and 50 weeks of prices of ethereum. Because wavelet coherence uses bivariate wavelets, only two data sets at a time can be compared, so each NFT is analyzed against ethereum since NFTs are typically registered on an Ethereum blockchain. It is split up into Ether-Decentraland, Ether-CryptoPunks, and Ether-Axie (Dowling, 2021). Upon analyzing the data, the results from the spillover model are confirmed. Like before, Decentraland has the highest comovement with cryptocurrency, especially in 2020, although the degree of correlation varied greatly (see appendix C). This could be because of the bull run, stimulus package, or economic worries caused by the COVID-19 pandemic (Dowling 2021). The other two, Axie and Cryptopunks, had short cycles of approximately 1-4 week cycles of positive correlation against Ethereum (see Appendix C). This began at the same time as the United States was given stimulus packages, which shows that there is a correlation between the pricing of decentralized assets and disposable income. The heat maps provide conclusive evidence and confirm previous findings that there is a slight comovement between Decentraland LAND and cryptocurrency and very little between the others with some exceptions that arise due to macroeconomic events (Dowling, 2021).

When evaluating how each sector affects one another, it is important to consider the market share each sector holds over the total market. As stated previously, the collectibles sector dominates a majority of the market holding a stake of 76%. Then comes the art sector with a 9% share, then games with a 7% share, utilities with a 4% share, metaverses with a 2% share, and finally sports with a 1% share

(Avegotchi, 2021). From the models above, metaverse projects like Decentraland LAND show the highest comovement with NFTs and cryptos but when taken into consideration, the low market share means it is unable to make a significant impact on the overall market and instead moves along with it. The rest of the sectors show significantly lower signs of comovement but have higher market shares so they are also unable to make a significant impact (Every, 2021). This data is important to consider when predicting a potential crash because it says that a sudden and immediate crash like Black Monday or the Dot Com Bubble is highly unlikely and instead, the popularity of NFTs will slowly fade out, creating very little spillover into other financial markets (Every, 2021). Overall, pricing indicators show that the NFT market has little spillover into other financial markets and little comovement with one another which tells us that if the pricing starts to decay it will fade out.

The current NFT market is overvalued and therefore a temporary trend that will eventually decline to an insignificant market valuation. The valuation of NFTs was determined using risk analysis, expert opinions, and volatility. When comparing the risk-return of NFTs with various other financial assets, NFTs have a positive correlation with cryptocurrencies such as Ethereum but also a negative correlation between NFTs and risk hedges, such as Vanguard funds, gold, and bonds (Kong and Lin, 2021). This is significant because it indicates the more disposable cash people have, the more likely they are to invest in NFTs despite the high risk. This risk paired with an influx of cash is attributed to two factors. The first is NFTs becoming one of the highest-returning financial assets with an average monthly return of 17% (Kong and Lin). When compared to traditional stock market exchange-traded funds (ETF) like the S&P 500 or Dow Jones Industrial Average, this is massive since they have returned an average of 0.83% per month since their inception. The second factor is its high standard deviation, which measures how close the data is to its mean. NFTs have a standard deviation of 58.77% which is thirteen times higher than stocks (Kong and Lin). When an asset has a high standard deviation it is often associated with high risk because the prices are volatile and the prices have fluctuated frequently resulting in an unpredictable market. This means that NFTs are volatile and serve as a risky investment.

Other than capital pricing models there are many ways to tell the NFT market is overvalued. Michael Every, the Head of Financial Markets Research Asia-Pacific at Rabobank, claims that the soaring price of NFTs is because it is a temporary craze that young millennials and Gen Z are buying into as a quick way to make money. The people buying these assets lack the understanding of how to conduct proper due diligence when buying securities and as a result, investing in NFTs is similar to buying a lottery ticket due to the high risk incurred and low chance of success (Every, 2021). Overvalued financial assets share similar characteristics that are also apparent in NFTs. This includes its reliance on the public sentiment towards them. If people decide one day that they don't like NFTs it won't have anything to back up its prices like an earning report or innovations. Another characteristic is its sudden and booming growth which indicates that NFTs filled a much-desired hole in the market and now that it has been filled people are going crazy over it, but eventually, people get bored of them. Also out of the hundreds of thousands of NFTs that have been minted, less than 1% of them have entered the secondary market sales achieved success. This includes less than 2% of NFT projects that succeed (Hawkins, 2021). This data proves that new NFTs are not worth buying because there is a high chance few will buy them from the secondary market. With all of the data and characteristics provided about NFTs, it is clear that they are hazardous and overvalued investments.

Once the NFT market lowers in value it will remerge in a more stable and less volatile form with its main purpose being used as a proof of possession system (Fairfield). This is because NFT technology has revolutionized the digital ownership of property. When the internet and computers were first introduced and popularized they threatened intellectual property rights by allowing people to create an infinite number of copies of something for free (Fairfield). If someone wanted a digital copy of a document they could easily find it online and save it as their own. This made the production of counterfeit and pirated products easily accessible to the public with very minimal risks (Fairfield). NFT technology completely changes this by bringing an alternative to creating a new form of digital uniqueness, where every legitimate copy of something can be tracked. The blockchain technology NFTs are built on is a



massive digital web where every item that has been created can be tracked and carries an ID and particular characteristics that prove its uniqueness (Fairfield). This means that whenever someone buys an NFT people can verify the authenticity of ownership by quickly checking which wallet the NFT is registered to or by a simple biometric imprint that is unique to the holder. For example, if someone wished to attend a sporting or music event they could buy their ticket in the form of NFT, and upon arrival, they could gain entry by showing their digital NFT ticket which is verified by security and allows the user to gain access (Fairfield). The NFT market will most likely stabilize into a more stable and less volatile form because this is commonly seen with other historical booms. For example, during the ICO boom companies attempted to raise funds using useless cryptocurrencies and as a result, there was a bust resulting in Bitcoin falling 65% (Fairfield). After this happened cryptocurrencies started to grow at a more stable rate. The same can be said for the tech bubble where a new digital revolution created a craze that resulted in a bubble that eventually popped. Now the tech sector is classified as high growth and contains the most valuable companies (Fairfield).

NFT technology could be used in a variety of situations because ownership means a lot to people, especially in an increasingly digitized world, but a quick and practical use case scenario would be property records (Fairfield). The current method of tracking and sorting through who owns what property in the U.S. could be more efficient because it is difficult to track previous owners, sale prices, and mortgages. With this, homeowners can organize each property or land deed into an NFT which people can buy. The NFT would store data about how much it was purchased for, every wallet/person who owned it, and the form of payment. Not only would this make it easier to handle large-scale transactions, but it would also reduce mortgage fraud, make it easy to organize important data and provide an additional source of residency that cannot be crafted (Fairfield).

## **Research Methods and Data Collection**

To collect data, I used economic models and NFT pricing data to determine if NFTs are overvalued, how much risk they carry, and if they have comovement with other financial markets. This information provides insight into valuation and risk. Also, the data can determine how likely NFTs are to fail and how much effect it has on other financial markets. I can determine the risk by using economic models that compare a securities price against a variety of other factors like open volatility, beta, and standard deviation. Each model outputs a number which I can compare with the outputs of various investments and based on how much higher or lower it is, the relative risk is determined. The index funds I am comparing NFTs against are the S&P 500, the Dow Jones Industrial Average, and Nasdaq because these are the most commonly referenced and they tell the general trend of the market. I am also using gold and bonds because they are common risk hedges against a recession and treasury bonds don't carry risk so it provides a good comparison. The first models used are the beta coefficient and standard deviation of the data for each security. These two values are commonly used in other economic models and provide a good baseline. The beta coefficient measures how an asset moves against the rest of the stock market which is important in determining comovement and volatility spillover. The standard deviation measures how close the data is to its average which is important in determining volatility. Afterwards, three more experiments are run on the Sharpe ratio, Treynor ratio, and Jensen's alpha. These models calculate risk with different methods and under different circumstances. The Sharpe ratio calculates the return versus the risk, the Treynor ratio compares the returns of security with risk compared to one without risk (treasury bills), and Jensen's alpha determines risk by comparing the returns to the theoretically expected returns.

## **Results and Data Analysis**

The Sharpe ratio is a formula used to calculate the performance of an investment or portfolio compared to a risk-free asset, after adjusting for its risk. It is calculated with the equation where the numerator is the difference between the average rate of return of an asset and the rate of return of risk-free

security divided by the standard deviation of the underlying asset (Liodus, 2021). When the one-month treasury bill is used for the risk-free asset it is seen that the NFT Index has an average geometric Sharpe ratio of 28.74% (see Appendix A). This is comparable to the S&P 500 index and NASDAQ index which have geometric averages of 26.22% and 33.75% (see Appendix A). This means the NFT index has a risk-reward similar to high market cap stocks which are often speculative and do not guarantee any returns.

Although the Sharpe ratio is the standard benchmark used for risk-reward, its data still must be cross-checked with other forms of risk calculators such as Jensen's alpha ( $\alpha$ ) and the Treynor ratio. Jensen's alpha measures the average return of an investment or portfolio compared to a capital asset pricing model based on the beta and average return after adjusting for risk. It is calculated using  $\alpha = R(i) - (R(f) + B \times (R(m) - R(f)))$  where  $R(i)$  is the realized return of the investment,  $R(m)$  is the realized return of the market index,  $R(f)$  is the risk-free return rate, and  $B$  is the beta of an investment compared to its respective market (Chen 2020). The resulting data for the NFT index is 12.44% (see Appendix A). This is extremely high when compared to the NASDAQ, S&P500, Dow Jones, gold, and bond indexes, which have values ranging from 0.13% to .32% (see Appendix A). The only values that close to this are Etheruma nd VIX which have traditionally high volatility. This high alpha reading could be perceived as beneficial to NFT investors but is bad because it means that when pricing NFTs as a whole. The tokens are almost worthless in value with a select few tokens having high gains. This means that the NFT market is highly speculative and risky because it is impossible to predict which NFTs will boom in price and which ones are worthless, especially since there is no middle ground.

The Treynor ratio is another risk analysis tool very similar to the Sharpe ratio but instead of analyzing the risk to the reward it analyzes the excess games to each unit of risk in an investment or portfolio And how an investment outperforms the equity market as a whole. It is calculated with where  $r_p$  is the return of an investment,  $r_f$  is the risk-free rate and  $\beta_p$  is the beta of the investment (Kenton, 2020). Upon analyzing the resulting data it is very similar to Jensen's alpha with the NFT index at 15.34% with

other stock indexes and traditional investments at 0.27% to 3.22% (see Appendix A). This means that the NFT index is a bad investment because the excess gains made do not outweigh the risk.

## Discussion and Conclusion

In conclusion, the NFT market will eventually die down but will not impact other markets and will eventually grow back at a stable pace with a greater emphasis on its applications as a possession technology (Fairfield). Due to the data provided by wavelet coherence and volatility transmission, we can conclude that each NFT sector acts independently so a crash would be independent of the rest of the economy (Dowling). This is further proven by the low level of comovement between NFTs and cryptocurrencies and the small role it plays in portfolios. Also, many professionals in the field of economics as well as data provided by the Sharpe ratio and other risk analysis tools prove that it is risky and speculative which points to it being heavily overvalued (Lin). After this bubble eventually bursts the NFT market will remerge in a more stable and less volatile form with its main purpose being used as a proof of possession system. At this point, the mania behind game theory will not be as prominent and NFTs will revolutionize digital ownership by creating a new system of authenticity and verification.

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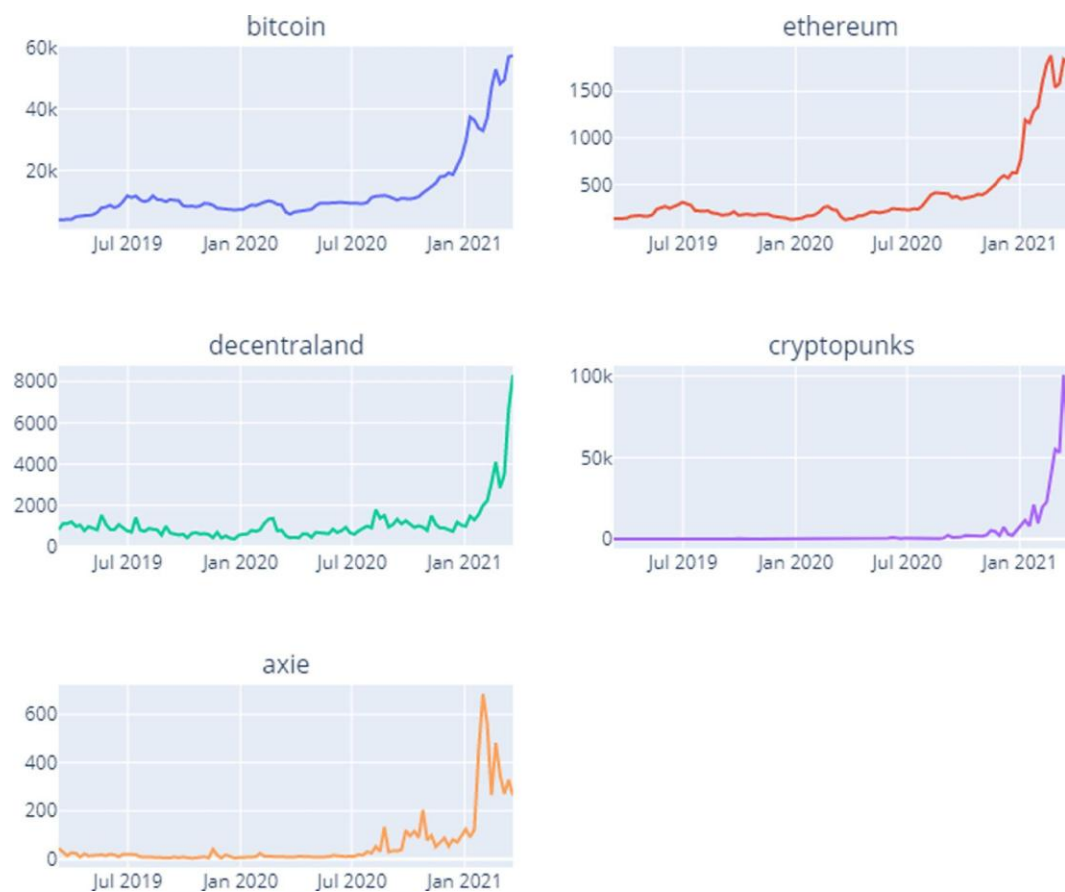
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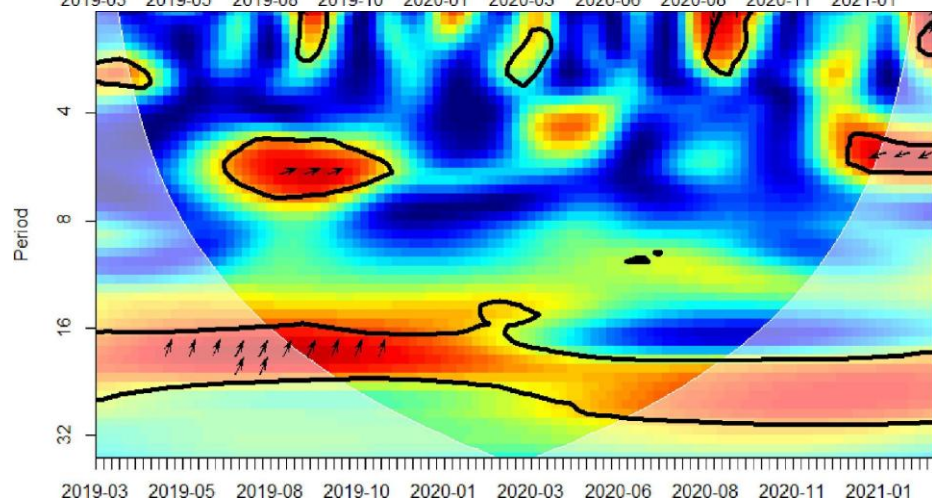
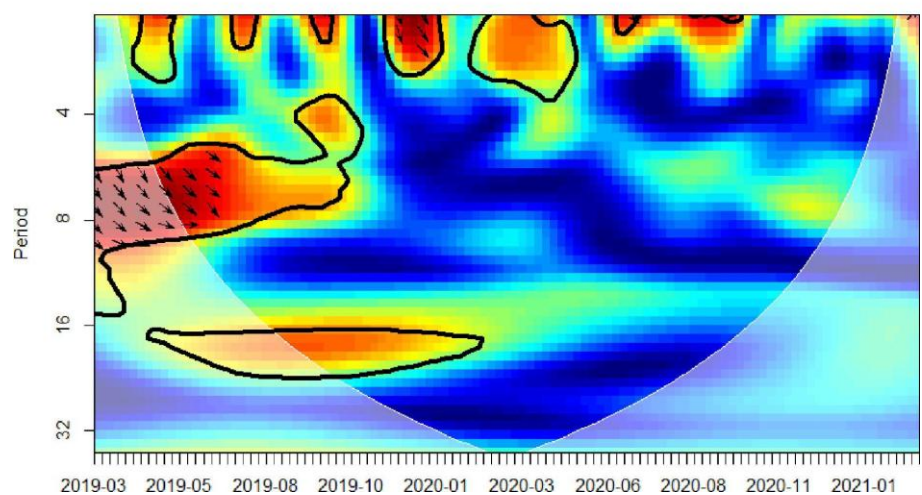
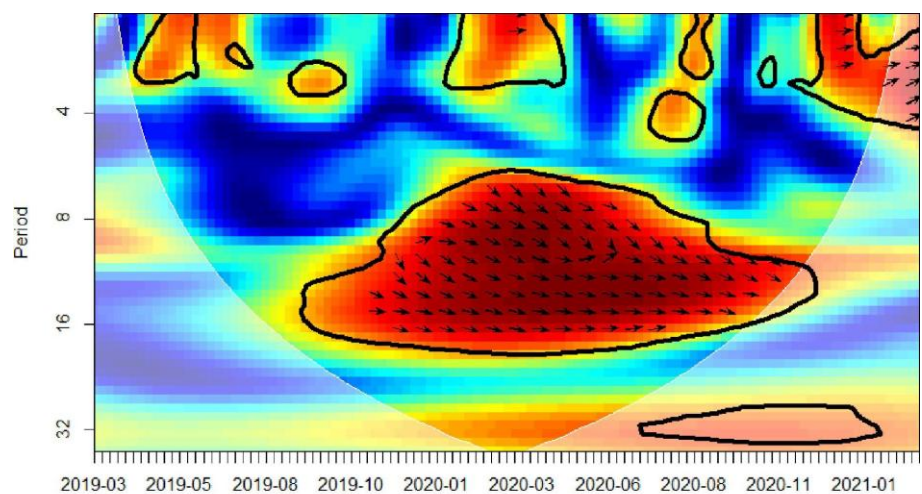
## Appendix A

Index	Standard Deviation	Beta	Jensens Alpha	Treynor Ratio	Sortino Ratio
NFT	2.13	0.97	12.44	15.34	94.6
ETH/USD	1.26	0.99	8.78	2.65	31.11
NASDAQ	0.31	0.84	0.29	0.8	56.37
S&P 500	0.21	1	0.32	0.5	41.38
Dow Jones	0.15	0.98	0.13	0.13	33.34
VIX	0.46	-4.94	10.23	-1.21	12.25
Bond	0.04	-0.22	1.98	-1.89	11.69
Gold	0.25	0.11	0.32	4.11	48

## Appendix B



## Appendix C



## Appendix D

	Bitcoin	Ether	Decentraland	CryptoPunks	Axie	from others
Bitcoin	50.30	33.60	10.11	4.73	1.26	49.70
Ether	30.70	45.38	13.69	5.77	4.46	54.62
Decentraland	13.57	12.75	66.88	2.49	4.32	33.12
CryptoPunks	7.61	10.79	6.59	70.83	4.18	29.17
Axie	5.44	3.43	9.20	0.49	81.46	18.54
to others	57.31	60.56	39.59	13.48	14.22	37.03

