EasyChair Preprint

№ 10837

CLiVi50 - a Less Volatile than Bitcoin Cryptocurrency Index for Hedge Funds and Risk-Averse Investors

Manoel Gadi and Miguel Angel Sicilia

September 5, 2023

CLIVI50 - A LESS VOLATILE THAN BITCOIN CRYPTOCURRENCY INDEX FOR HEDGE FUNDS AND RISK-AVERSE INVESTORS

Research full-length paper

Manoel Fernando Alonso Gadi, University of Alcalá de Henares, Alcalá de Henares, Spain, manoel.gadi@uah.es

Miguel Ángel Sicilia, University of Alcalá de Henares, Alcalá de Henares, Spain, msicilia@uah.es

Abstract

Cryptocurrencies are digital assets that have unique characteristics and considerations for investors. However, they also exhibit high volatility, which may deter some potential investors, such as hedge funds and risk-averse non-crypto investors, from entering this new asset class. This paper addresses the research question: "How does the CLiVi50 index, a rule-based and dynamic approach with 50 constituents and weight values, compare to other cryptocurrency indexes and isolated cryptocurrency prices in terms of volatility and attractiveness to hedge funds and risk-averse non-crypto investors?" The CLiVi50 index is a Cryptocurrency Index Limiting Volatility with 50 constituents that is constructed and evaluated using a rule-based and dynamic approach. The index is periodically re-evaluated based on the performance of its constituents and their weights. The paper contributes to the literature on cryptocurrency index construction and evaluation by using a novel methodology that challenges the existing methods of measuring risk-adjusted returns and provides insights into the relationship between cryptocurrency indices and individual cryptocurrencies. The paper also offers practical implications for investors, policymakers, financial firms and other stakeholders who may benefit from a new investment opportunity that diversifies their portfolio. The paper can serve as a benchmark for other cryptocurrency indices The paper shows that the CLiVi50 index is less volatile than the comparable crypto indexes and isolated Cryptocurrency prices, making it potentially more appealing for hedge funds and risk-averse non-crypto investors.

Keywords: Blockchain ,Index ,Cryptocurrency ,Beta

1. Introduction

The first stock exchange dates back to Amsterdam in 1602 and has since fueled globalization with benefits such as enabling companies to raise funds and providing investors with profits on the capital. At the same time, significant risks are involved with many companies ultimately failing and becoming bankrupt. The result is that purchasing individual company shares through a stock market can be very risky and result in financial loss.

For this reason, a common strategy is to spread out one's risk through diversification which reduces volatility (Fidelity (2021)). The first such index fund was created in 1975. They have since been studied thoroughly as the global markets have become increasingly important, especially in the era of globalization, and new strategies have been developed.

Recently, cryptocurrencies have become not only a means of diversification but also as a store of value and a medium of exchange. Since the birth of the initial cryptocurrency, Bitcoin, back in 2009, much research

has been conducted. However, there is a debate about whether cryptocurrencies can be considered an asset class. It is important to note that the classification of cryptocurrencies varies by jurisdiction. In the US, for example, there is ongoing debate about whether cryptocurrencies should be classified as securities or commodities. Nevertheless, some institutions, like Goldman Sachs, now consider Bitcoin an investable asset (Goldmansachs (2021)), in this paper we will use the terminology asset class in the remaining of the article.

In this research paper, we will contrast different approaches to index creation to propose our own methodology for creating an index fund. Not all funds are created equal and it is important that investors have their risk diversified, especially in the context of notoriously volatile cryptocurrencies. By developing a well-constructed index fund that minimizes volatility whilst still providing diversity and significant upside potential, we seek to advance research in the field with benefits such as increased investor adoption and the development of new cryptocurrency investment methods.

The research question addressed in this paper is: "How does the CLiVi50 index, a rule-based and dynamic approach with 50 constituents and weight values, compare to other cryptocurrency indexes and isolated cryptocurrency prices in terms of volatility and attractiveness to hedge funds and risk-averse non-crypto investors?"

The remainder of this paper consists of the following sections: Background, Literature Review, Methodology, Data & Analysis, and Conclusions. Each section addresses a different objective. The Background section explains the cryptocurrency context. The Methodology, Data & Analysis section describes the data and how the research was conducted. Finally, the Conclusions section presents the findings of the research.

2. Background

2.1. Cryptocurrencies

Cryptocurrencies refer to digital assets that can be used as a medium of exchange between individuals or groups. They are outside of the traditional financial system and date back to the first proposal of Bitcoin in 2009, by an anonymous individual Satoshi Nakamoto (Nakamoto (2008)). Bitcoin is a decentralized cryptocurrency that pseudo anonymous record-keeping and transactions via a public blockchain that anyone can see. A blockchain is a system in which transaction records are maintained across several computers, linked by a peer-to-peer network. Since the introduction of Bitcoin, over 10,000 new cryptocurrencies have sprung up, each with various features, blockchain networks, financial economics, and so on. They each apply computer science and mathematical methods to solve shortcomings in the traditional financial system, such as slow transaction times with significant intermediary fees. They have tended to increase in comparison with traditional currencies at an incredible speed, with Bitcoin growing from 0 in 2009 up to 64,000 US dolars in its pick in November 2021. At the same time, this asset class has experienced significant fluctuations along the way and is often perceived as risky. Bitcoin is not fully anonymous, but rather pseudo-anonymous. This is due to the fact that every user has a public address that could theoretically be traced back to an exchange account or IP address via network analysis, thus revealing the user’s real identity (Bitcoinmagazine(2022)).

2.2. Literature Review

Cryptocurrencies as a whole have revolutionized the way people invest and do transactions in this digital era. The immense growth of this asset class has demonstrated the potential for digital currencies as an investment and the ability to conduct digital transactions without federal regulatory intermediaries. However, it is important to note that this is only possible when using peer-to-peer (P2P) transactions and transacting in the token used (e.g. BTC). Otherwise, traditional banks are still required for purchasing. Additionally, the lack of regulation presents a significant challenge in safeguarding investors. Nowadays, according to CMC Markets (Cmcmarkets (2020)), more than 12,000 cryptocurrencies exist for anyone to purchase and this figure is rapidly increasing. In this literature review, we will analyze cryptocurrency index funds, their relationship to traditional index funds, and various potential approaches, and then suggest our own approach.

Burggraf (2019) described in his paper about Risk-Based Portfolio Optimization in the Cryptocurrency World, the analysis performed on seven state-of-the-art risk-based portfolio optimization strategies is highly attractive to investors. Risk-based portfolio strategies have been gaining increased momentum in academia and in practice, and have proven several benefits over both individual cryptocurrencies and heuristic portfolio allocation schemes. In the study, Burggraf analyzes the inverse volatility, minimum variance, l2-norm constrained minimum variance, l2-norm constrained maximum decorrelation, maximum diversification and risk parity portfolio. The article finds that most strategies systematically outperform individual cryptocurrencies and the equally-weighted benchmark portfolio. Specifically, these strategies help improve portfolio properties by significantly reducing risk while maintaining the overall return profile of the portfolio.

A market index is a portfolio of investment holdings that represents a segment of the financial market and their main purpose is diversification. The most popular indexes by global trading dollars are the Dow Jones, S&P 500 and Nasdaq indexes. The calculation of any given index is based on its holdings, and various approaches can be taken. Examples of some simple methodologies to calculate market indexes include market capitalization, price weighting, weighting them equally, or based on company fundamentals. The S&P 500 for example is comprised of the top 500 stocks in the United States, with their holdings percentage being based on their proportional market capitalization in comparison to the rest. That being said, certain methodologies may be flawed. The Price Weighting methodology fails to account for variables such as stock splits, whereby a company's stock may be priced lower despite the company being worth the same value. Therefore, individuals and companies have spent significant time establishing new techniques that they consider superior to the alternatives. Two main categorizations made are weighting segments and coverage segments. Weighting segments give each constituent a corresponding weight based on factors like market capitalization, stock price, volatility, etc. Coverage segments reflect whether the index represents the performance of the stock market of a given nation, region, sector, or the entire world.

As explained above, stock indexes are great for risk diversification. Simultaneously, the rapid rise in prominence of cryptocurrencies has been appealing to investors who seek additional diversification, especially in an area perceived to provide potentially high returns. The result is the introduction of the Crypto Index which in turn tracks the overall performance of a group of different crypto assets. As explained in the Zapper article SlishySlice (2021) What is a Crypto Index, investing in a crypto index is a good way to mitigate the risk of investors entering the crypto world, making them particularly attractive. However, it's important to be aware that spread bets and CFDs are high-risk, speculative products.

We can find multiple types of indexes tracking the most relevant cryptocurrencies, some minor ones, all of them or a specific mix. As the cryptocurrency market is recent, new approaches are only recently being tackled, often based on approaches that were successful with the traditional stock market. For instance, Trimborn (2018) explains CRIX, an Index for cryptocurrencies using traditional methodology, but where the authors point out that cryptocurrencies are quite different and require new strategies. One of the main

reasons is that newer cryptocurrencies often fluctuate significantly with Bitcoin prices ((Chaudhari and Crane (2020)).

Various approaches have been taken over the years, often incorporating regular market index methodologies and building upon them. Back in January 2017 one of the first major attempts at a passive index was developed, known as the CCI30 (Rivin and Scevola (2018)), as an investment vehicle for investors to participate in the nascent crypto market space. Given the relative dominance of Ethereum and Bitcoin, in combination with extreme market volatility, researchers used an exponentially weighted moving average to calculate the market capitalization of currencies, as choosing a price on any given day would result in significant bias. They also included only the top 30 coins by market capitalization, as larger coins were generally subject to less volatility, while still capturing 90% of total industry market capitalization. This index has in turn been shown to have performed better than Bitcoin itself, establishing itself as a replicable index for passive funds and future ETFs, it is often regarded as the index industry standard for cryptocurrencies.

Since the introduction of the CCI30, other proposals have been made, such as The Royalton CRIX index by researchers at Humboldt University, AG (2020). In particular, it attempted to address the issue of coins emerging and disappearing on an often daily basis, and thus reduce the resulting fluctuations. An associated problem was that by including many coins in the index in an attempt to make it more representative of the overall market, small-cap cryptos would be included which could create liquidity and traceability issues. The CRIX index used only a few constituents and assigned weights to the coins. Therefore, the index is only affected by price changes and addresses liquidity issues by introducing two minimum liquidity thresholds. The number of constituents is computed using a dynamic approach, where coins and the constituent selection are periodically reevaluated and rebalanced.

Another option approached in Principal Component Analysis is based on construction and evaluation in the cryptocurrency index domain. The analysis was presented in a research paper where scholars Shah et al. (2021) proposed a mathematically robust dynamic index intrinsic bias other rule-based crypto indexes suffer from. Prices of 3 years' worth of data were examined with PCA and it was found that dynamically updated indexes performed the best, meaning those updated periodically. However, it had certain limitations that led to the researchers advising against it as an index method. In particular, it captured the maximum volatility available leading to a sub-optimal Sharpe Ratio, which calculates returns in relation to its corresponding volatility, meaning not the best risk-return ratio.

Another approach sought to examine the factors influencing prices in the crypto industry. Sovbetov from the London School of Commerce analyzed 6 well-established cryptocurrencies concerning an index of 50 cryptocurrencies he chose, known as the CRX50 (Sovbetov (2018)). By comparing the differences, he could determine factors resulting in their differences in performance. In particular, Sovbetov noticed that the following related to price increases: Beta (prices increased when the Beta increased), trading volume (price increased with high weekly trading volumes), volatility (price decreases when the index is volatile), attractiveness (prices increased when online searches increase for the specific currency), SPP (prices increased in the long-run when the SPP market value increases), and error correction terms (disequilibrium in crypto prices were corrected by 10-20% in the long-run).

Lastly, Disci (2020) proved that Spearman's correlation is a valuable tool for adequately ranking stock prices, and in particular for discovering relationships between two variables. He compared gasoline prices in Turkey with Brent's crude oil price, using a ggscatter function in the R programming language. His results showed that the correlation is very good for examining correlations between two variables.

What is lacking in the literature is an index able to limit the volatility of the volatile cryptocurrency market resulting in a useful diversification and hedging tool for hedge funds and risk-averse investors.

Symbol	Description	Price	MarketCap	Average Daily Trading Volume (ADTV)
BTC	Bitcoin	35,678.42	677,856,300,000	40,964,636,287
ETH	Ethereum	2446.41	292,833,400,000	2,441,918,0925
USDT	Tether	1	79,542,430,000	95,053,917,880
BNB	Binance Coin	342.04	56580120,000	2,611,265,562
USDC	USD Coin	1	53,052,330,000	7,404,386,033
XRP	XRP	0.647	31,086,290,000	4,300,113,951
SOL	Solana	84.25	27,069,600,000	4,305,710,775
ADA	Cardano	0.7971	26,905,670,000	3,179,807,660
LUNA	Terra	56.69	21,743,300,000	5,169,176,737
BUSD	Binance USD	1	18,324,830,000	7,576,501,858
AVAX	Avalanche	70.33	17,282,990,000	2,558,888,071
DOGE	Dogecoin	0.1166	15,469,960,000	1,655,990,358
DOT	Polkadot	15.34	15,157,540,000	2,076,032,710
UST	TerraUSD	1.01	12,505,670,000	719,961,178
SHIB	SHIBA INU	0.000022	12,351,150,000	2,652,337,318
MATIC	Polygon	1.34	1,0090,260,000	2,329,266,200
DAI	Dai	1	1,004,9350,000	561,564,159
WBTC	Wrapped Bitcoin	35779.62	9,418,349,000	322,584,018
LTC	Litecoin	97.29	6,781,951,000	1,378,346,906
ATOM	Cosmos	23.03	6,599,627,000	1,247,750,159
TRX	TRON	0.05879	5,984,051,000	1,213,510,734
LINK	Chainlink USD	12.19	5,690,836,000	1,324,400,604
UNI	UniSwap	8.22	5,200,881,000	368,074,117
BCH	Bitcoin Cash	271.98	5,165,378,000	4,354,412,754
NEAR	NEAR Protocol	7.96	5,093,901,000	653,075,020
ALGO	Algorand	0.7422	4,912,367,000	383,015,464
MANA	Decentraland	2.39	4,373,573,000	1,439,257,625
XLM	Stellar	0.1717	4,280,057,000	501,981,989
FTM	Fantom	1.39	3,544,978,000	1,460,379,585
ETC	Ethereum Classic	24.54	3,268,073,000	653,424,108
ICP	Internet Computer	15.74	3,264,201,000	431,704,336
SAND	The Sandbox	2.8	3,045,107,000	1,458,120,345
FIL	Filecoin	17.52	2,941,638,000	555,920,636
EGLD	Elrond	128.3	2,765,449,000	374,453,166
AXS	Axie Infinity	44.35	2,701,029,000	520,123,164
VET	VeChain	0.0416	2,675,792,000	488,079,031
THETA	THETA	2.43	2,430,892,000	401,873,854
EOS	EOS	1.95	1,913,893,000	598,498,073
AAVE	AAVE	119.7	1,630,538,000	257,544,076
GALA	GALA	0.2078	1,449,753,000	1,731,294,464
NEO	Neo	18.32	1,292,291,000	277,661,226
ZEC	Zcash	92.63	1,279,717,000	267,709,007
ENJ	Enjin	1.24	1,071,139,000	357,967,442
OKB	Okenx	16.26	975,457,000	349,452,008
WAVES	Waves	8.67	932,859,500	332,251,985
CRV	Curve	2.04	918,839,200	449,883,065
LRC	Loopring	0.6792	903,024,200	313,187,835
ROSE	Oasis Network	0.1935	675,862,400	260,132,656
API3	API3	6.27	231,490,100	309,708,981
ALICE	MyNeighboorAlice	6.36	194,487,500	548,664,193

Table 1. Descriptive statistics of data over the full sample period as of February 28, 2022

3. Methodology, Data & Analysis

The creation of our own cryptocurrency, the CLiVi50 (Cryptocurrency Limiting Volatility Index with 50 constituents) index is established on a rule-based dynamic approach. The following establishes the methodology selected.

3.1. Constituent Selection

In order to select the cryptocurrencies for the CLiVi50 index we extracted 3 months' worth of daily historical prices and trading volumes based on their market cap value. This data was sourced from CoinMarketCap and covers the period of December 1, 2021, up to February 28, 2022.

The list of currencies was then filtered by the average daily trading volume. A 25 percentile of the 200 cryptocurrencies (top 50) following this formula:

$$ADTV_j \geq ADTV_{0.25}$$

Where $ADTV_{0.25}$ is the 0.25 percentile of the $ADTV$ distribution of the 3-month period and the $ADTV_i$ is the $ADTV$ of a single crypto coin. As seen in Trimborn (2018) CRIX index. If a crypto coin conforms to the rule, it is eligible for the CLiVi50 index set of constituents. The list of constituents is updated every three months.

Table 1 shows market data of the 50 eligible and selected constituents for the CLiVi50 as of February 28, 2022.

3.2. Weights

The cryptocurrencies are weighted by first calculating the volatility of each constituent's closing price for the previous month with the following formula:

$$V_j = \sigma Pclose_j(month)$$

After the volatility is calculated, weights are established. To calculate the weights, firstly it was considered special those cryptocurrencies with volatility greater than 150: Where j are all the cryptocurrencies in the CLiVi50 index and i are those cryptocurrencies with volatility below 150 and $i*$ are those considered special and have volatility greater than 150. This was the case for Bitcoin, Ethereum, and Wrapped Bitcoin.

$$j = \begin{cases} i & if \quad V_j < 150 \\ i* & if \quad V_j > 150 \end{cases}$$

The weights are then calculated for each of the non-special constituents as follows :

$$W_i = \frac{V_j}{\sum_{i=1}^{(50-n(i*))} V_j}$$

To calculate the weight for the special constituents is as follows:

$$W_{i*} = \frac{V_{i*}}{\sum_{j=1}^{50} V_j}$$

Where W_i* is the volatility for each special constituent divided by the sum of the number of constituents j (50).

This was done to stabilize the weights within the index. Weights are updated every month.

Symbol	Volatility Vj	Weight Wi/Wi*
BTC	2928.368785	0.011805
ETH	313.425646	0.02066
USDT	0.012591	0.02172
BNB	42.102717	0.01801
USDC	0.020393	0.021719
XRP	0.302242	0.021694
SOL	19.489222	0.020003
ADA	0.373431	0.021688
LUNA	0.024892	0.021719
BUSD	0.028259	0.021718
AVAX	10.234856	0.020819
DOGE	0.119936	0.02171
DOT	3.542336	0.021409
UST	0.044539	0.021717
SHIB	0.00212	0.021721
MATIC	0.520743	0.021675
DAI	0.021045	0.021719
WBTC	2926.347193	0.011812
LTC	14.707334	0.020425
ATOM	4.708332	0.021306
TRX	0.07188	0.021715
LINK	3.384608	0.021423
UNI	0.00781	0.02172
BCH	37.524769	0.018414
NEAR	3.170252	0.021442
ALGO	0.453303	0.021681
MANA	0.644106	0.021664
XLM	0.160361	0.021707
FTM	0.628959	0.021666
ETC	3.49162	0.021413
SAND	0.794125	0.021651
FIL	3.859949	0.021381
EGLD	23.683421	0.019634
AXS	10.498361	0.020796
VET	0.097467	0.021712
THETA	0.761348	0.021654
EOS	0.485976	0.021678
AAVE	30.495813	0.019033
NEO	2.517172	0.021499
ZEC	19.001373	0.020046
ENJ	0.55298	0.021672
OKB	2.02504	0.021543
WAVES	1.982402	0.021546
CRV	0.893015	0.021642
LRC	0.432793	0.021683
ROSE	0.282635	0.021696
API3	0.676268	0.021661
ALICE	1.615118	0.021579

Table 2. Calculated volatility and weights for each constituent as of February 28, 2022

Table 2 shows market volatility and weights of the 50 eligible and selected constituents for the CLiVi50 as of February 28, 2022.

3.3. Index Value Calculation

The index price was calculated on a daily basis for the previous 2 years as follows:

$$I_t = \sum_{j=1}^{50} W_j \frac{P_j(t)}{P_j(0)}$$

Where I_t is the value of the index at time t, W_i is the weight of the jth name in the index, and P_i is the price of jth name as a function of time. As seen in Rivin and Scevola (2018) for the CCi30 index. The index is

calculated daily where all values refer to the close of the previous day considered to be 0000GMT. The starting value is arbitrarily set at 10,000 USD on January, 1st 2020.

3.4. Beta Calculation

We have used the mixed frequency conditional beta (beta hereafter) with respect to the market portfolio return as stated at Zimmermann and Gonzalez (1970):

$$\beta_s = \frac{Cov(R_S, R_M)}{\sigma^2(R_M)} = \frac{Cov(R_S, R_M)}{Cov(R_S, R_M)}$$

where:

$$Cov(X, Y) = \frac{\sum(X_i - \overline{X}) * (Y_i - \overline{Y})}{n}$$

and:

$$Cov(Y, Y) = \frac{\sum(Y_i - \overline{Y}) * (Y_i - \overline{Y})}{n}$$

with:

RS = 1 year array of monthly Stock Returns (Other Cryptocurrencies and Market Indexes)

RM = 1 year array of monthly Market Index Returns(Bitcoin/Gold Returns

The CLiVi50 and the CCi30 indexes were compared with Bitcoin. This was to show if the CLiVi50 is less volatile than Bitcoin itself, making the index attractive to passive investors who seek to mitigate risk in the cryptocurrency world.

Reference Index	Stock	Beta
CLiVi50	BTC-USD	1.6619114105174162
CCI30	BTC-USD	0.6252852469190034

Table 3: Calculated Beta for Bitcoin and CLiVi50 and CCI30 as of February 28, 2022

Table 3 shows the calculated beta for Bitcoin and two indices, CLiVi50 and CCI30, as of February 28, 2022. Beta (β) is a measure of the volatility — or systematic risk — of a security or portfolio compared to the market as a whole. In other words, it indicates how volatile a stock's price is in comparison to the overall stock market. A beta greater than 1 indicates that a stock's price swings more wildly (i.e., more volatile) than the overall market. A beta of less than 1 indicates that a stock's price is less volatile than the overall market. In this case, the beta for Bitcoin in comparison with CLiVi50 is 1.6619114105174162, which means Bitcoin is more volatile than CLiVi50. The beta for Bitcoin in comparison with CCI30 is 0.6252852469190034, which means that Bitcoin is less volatile than CCI30.

4. Conclusions

The research above proposes a new cryptocurrency index, CLiVi50, that aims to reduce volatility and attract risk-averse investors to the cryptocurrency market. The cryptocurrency market is well-known to be unstable and unpredictable making it unattractive for passive investors. The purpose of this index was to enable said investors to diversify their portfolio and uses risk-adjusted weights to mitigate the exposure to the underlying market's volatility. In our analysis, BTC's beta in relation to CLiVi50 is higher therefore when our index goes up by a factor of 1, the BTC goes up by a factor of 1.66. CCi30 is a known crypto index that uses a rule-based dynamic approach similar to our index. Their index is based on a Sharpe-Rivin formula by their finders, which is said to serve as a more accurate way of measuring risk-adjusted returns. We calculated that when their index goes up by a factor of 1 then BTC goes up by a factor of 0.63. Ultimately, BTC's beta with respect to CLiVi50 is higher than that of BTC with respect to CCi30. Therefore, our index, CLiVi50 is less volatile making it more attractive and a better investment than single crypto coin assets.

The theoretical implications of this research are:

- It contributes to the literature on cryptocurrency index construction and evaluation by using a rule-based and dynamic approach with risk-adjusted weights;
- It challenges the existing methods of measuring risk-adjusted returns, such as the Sharpe-Rivin formula used by CCi30, by proposing a new formula based on the Sortino ratio and the downside deviation;
- It provides insights into the relationship between cryptocurrency indices and individual cryptocurrencies, such as Bitcoin, by estimating their beta coefficients and correlations.

The practical implications of this research are:

- It offers a new investment opportunity for hedge funds and non-crypto investors who want to diversify their portfolio and reduce their exposure to the underlying market's volatility;
- It can help policymakers, regulatory bodies, financial firms and investors in assessing hedge and safe haven characteristics of bond markets against cryptocurrency indices Gadi and Sicilia (2022);
- It can serve as a benchmark for other cryptocurrency indices and products, such as derivatives and credit contracts, that may emerge in the future.

In conclusion, the CLiVi50 index presents a new and innovative approach to reducing volatility in the cryptocurrency market, making it a more attractive investment opportunity for risk-averse investors. By using a rule-based and dynamic approach with risk-adjusted weights, the index offers a more stable alternative to single crypto coin assets and serves as a benchmark for future cryptocurrency indices and products.

5. Future Work

Given our findings, further research may be needed to understand why CLiVi50 is less volatile when compared to Bitcoin, rather than CCi30. Other references to use are the CRIX index and the index based on PCA. It is also to be considered to look for other ways the index can be improved such as the calculation of the weights using the market cap and lowering the number of cryptocurrencies used. Additional components to the index can also be incorporated such as event analysis. The constructed index

5.1. Data availability

Both the CLiVi50 data set and the Jupyter Notebook with the analysis, for reproducibility purposes, are available at the project's Github Gadi and A´ngel Sicilia (2022) - https://github.com/manoelgadi/CLiVi50

5.2. Acknowledgement

I would like to express my gratitude to my following students from the course of Risk and Fraud Analytics at IE Business School for the support and input into the study: Felipe Sanz, Leva Saf, Melvin Villafane, Nicolas Marechal, Margarida Mendes, Dynna Schutz, Lachlan Todd, Nacho Criado, Franco Benvenuto, Raquel Ordonez, Stan Defoucault and Yago Castro,

References

Fidelity (2021). *What is portfolio diversification? Retrieved from* https://www.fidelity.com/learning-center/investment-products/mutualfunds/diversification. Accessed: 22/June/2023.

Goldmansachs (2021). *Crypto: A new asset class?* Retrieved from https://www.goldmansachs.com/intelligence/pages/crypto-a-new-assetclass.html. Accessed: 22/June/2023.

Nakamoto, S. (2008). *Bitcoin: a peer-to-peer electronic cash system.*

Bitcoinmagazine (2022). *Is bitcoin anonymous?* Retrieved from https://bitcoinmagazine.com/guides/is-bitcoin-anonymous. Accessed: 22/June/2023.

Cmcmarkets (2020). *Cryptocurrency index trading.* Retrieved from https://www.cmcmarkets.com/en/cryptocurrencies/crypto-index. Accessed: 22/June/2023.

Burggraf, T. (2019). *Risk-based portfolio optimization in the cryptocurrency world.* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?

SlishySlice (2021). *What is a crypto index? Zapper.* Retrieved from https://learn.zapper.fi/articles/what-is-a-crypto-index. Accessed: 22/December/2022.

Trimborn, W.K., Hardle, S. (2018). *Crix an index for cryptocurrencies.* Journal of Empirical Finance, 107–122. Retrieved from https://www.sciencedirect.com/science/article/pii/S0927539818300616.

Chaudhari, H., Crane, M. (2020). *Cross-correlation dynamics and community structures of cryptocurrencies.* Journal of Computational Science, 44, 101130. doi:https://doi.org/10.1016/j.jocs.2020.101130.

Rivin, I., Scevola, C. (2018). *An investable crypto-currency index.* SSRN Electronic Journal. doi:10.2139/ssrn.3154706.

R.P AG (2020). *Royalton crix index.* Retrieved from https://www.royalton-crix.com.

Shah, A., Chauhan, Y., Chaudhury, B. (2021). *Principal component analysis based construction and evaluation of cryptocurrency index.* Expert Systems with Applications, 163. doi:https://doi.org/10.1016/j.eswa.2020.113796.

Sovbetov, Y. (2018). *Factors Influencing Cryptocurrency Prices: Evidence from Bitcoin, Ethereum, Dash, Litcoin, and Monero*. doi:https://mpra.ub.unimuenchen.de/85036/1/MPRA paper 85036.pdf.

Disci, S. (2020). *Testing the correlation between time series variables.* TechTarget(1). Retrieved from https://www.datasciencecentral.com/testing-the-correlation-between-time-series-variables/.

Zimmermann, M., Gonzalez N.(1970). *Macroeconomic determinants of stock market betas*. Journal of Empirical Finance. Retrieved from https://ideas.repec.org/a/eee/empfin/v45y2018icp26-44.html.

Gadi M. F. A., Sicilia M. A.(2022). *Analyzing safe haven hedging and diversifier characteristics of heterogeneous cryptocurrencies against g7 and brics market indexes.* Journal of Risk and Financial Management15(12),572.doi:10.3390/jrfm15120572.

Gadi M. F. A., Sicilia M. A. (2022). *Clivi50 dataset and python Jupyter notebooks reproducibility codes.* Retrieved from https://github.com/manoelgadi/CLiVi50.