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MARKET MOVERS: THE CASE OF BITCOIN IN THE COVID-19 SETTING

Impulsores del mercado: el caso de Bitcoin en el contexto de la COVID-19

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KEYWORDS

Bitcoin
Blockchain
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COVID-19
Cryptocurrency

ABSTRACT

Bitcoin is a virtual currency that provides a completely decentralized secure alternative to the currencies currently used. Nakamoto, the creator of this cryptocurrency, published an article on an encryption mailing list in 2008 with the title "Bitcoin: A Peer-to-Peer Electronic Cash System", thus giving the creation of this virtual currency. This study aims to analyze the Bitcoin and what factors can influence its price, in the context of a pandemic. This work will focus on the bitcoin price and on five different factors likely to have an influence on his price, such as: Hash Rate, Mining Difficulty, Volatility Index, Google Search and Transaction Cost. The period for this research ranges from 15/03/2020 to 14/11/2021, a total of 96 weeks, to integrate the covid-19 factor into the study. The results show that the variables fsCoinCirculation and fsTransationCost are both necessary conditions for an increase on the bitcoin price, but for low values of bitcoin price there are no necessary conditions. Additionally, findings suggest that Hash Rate influences the price of bitcoin. Finally, fsVix variable was found to be a variable with an important implication in price, namely, in its volatility.

PALABRAS CLAVE

Bitcoin
Blockchain
fsQCA
COVID-19
Criptomoneda

RESUMEN

El Bitcoin es una moneda virtual que proporciona una alternativa segura completamente descentralizada a las monedas que se utilizan actualmente. Nakamoto, el creador de esta criptomoneda, publicó un artículo sobre una lista de correo de encriptación en 2008 con el título "Bitcoin: A Peer-to-Peer Electronic Cash System", dando así la creación de esta moneda virtual. Este estudio tiene como objetivo analizar la Bitcoin y qué factores pueden influir en su precio, en el contexto de una pandemia. Este trabajo se centrará en el precio de bitcoin y en cinco factores diferentes que pueden influir en su precio, tales como: tasa de hash, dificultad de minería, índice de volatilidad, búsqueda de Google y costo de transacción. El periodo para esta investigación va del 15/03/2020 al 14/11/2021, un total de 96 semanas, para integrar el factor covid-19 al estudio. Los resultados muestran que las variables fsCoinCirculation y fsTransationCost son ambas condiciones necesarias para un aumento en el precio de bitcoin, pero para valores bajos de precio de bitcoin no hay condiciones necesarias. Además, los hallazgos sugieren que la tasa de hash influye en el precio de bitcoin. Finalmente, se encontró que la variable fsVix es una variable con una implicación importante en el precio, es decir, en su volatilidad

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1. Introduction

Technological advances have been contributing to the development of various areas of the daily life of the human being, from entertainment to security, both physical and virtual, which consequently, because it is new and unexpected, becomes unpredictable (Nagy et al., 2013). This study aims to understand if certain external factors influence Bitcoin´s value.

Bitcoin is a virtual currency that provides a completely decentralized secure alternative to the currencies currently used. (Bouoiyour & Selmi, 2017). Nakamoto, the creator of this cryptocurrency, published an article on an encryption mailing list in 2008 with the title "Bitcoin: *A Peer-to-Peer Electronic Cash System*" (Nakamoto 2008), thus giving the creation of this virtual currency.

For this, we decided to study theoretical and practical subjects, presenting a chronological line of thought, and addressing aspects of common understanding. The fsQA program will then be used. That said, this article is based essentially on scientific articles, dealing with all definitions supported on theoretical bases.

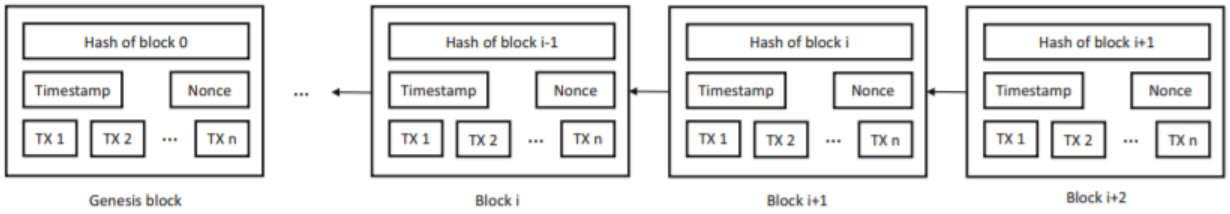
In a few minutes, the following chapters are structured in such a way as to facilitate the reader's understanding, starting first, with a literature review, as literary support. Next, we will address the main theme, proving the influence of the factors in changing the price of bitcoin.

2. Literature review

2.1 Blockchain

Blockchain technology is not only the basis of all cryptocurrencies but has found a broad application in the traditional financial industry (Di Pierro, 2017). The technology known as blockchain was made known to the world by Satoshi Nakamoto in his article: "Bitcoin: A Peer-to-Peer Electronic Cash System". This article revealed the mathematical rationale for the functioning of bitcoin. The problem that Satoshi Nakamoto wanted to solve is the "elimination" of an intermediary in a particular transaction between a buyer and a seller, functions which banks have in the classical financial systems. The big step would be for people to be able to rely on an entirely digital system composed of algorithms and lines of code. It was through the blockchain system that this trust was achieved. "Blockchain is the public ledger for all Bitcoin transactions that have already been executed. It is constantly growing as miners add new blocks" (Swan, 2015).

Figure 1: Example of a blockchain



Source: (Zheng et al. 2016)

In figure 1, we can observe a typical example of a blockchain. Blockchain consists of a set of data that is composed of a chain of data packets (blocks) where a block comprises multiple transactions. The blockchain is extended by each additional block and therefore represents a complete ledger of transaction history (Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. 2017).

2.2 Bitcoin

Bitcoin is a decentralized digital currency, without any kind of regulatory body controlling it, which can be transferred from one user to another within your network without any need for an intermediary (Calvery, 2013).

In this place, before presenting the peculiarities of this currency it is crucial to have present that bitcoin is an open-source peer-to-peer digital currency, which does not depend on a central authority (Ulrich, 2014, p. 17).

In recent times there has been a growing wave of demand for this electronic currency, leading to extreme cases such as the numbers of Central America, which has taken it as an official and alternating currency to attract more tourists and facilitate transactions between citizens. "We need to break the paradigms of the past, President Bukele tweeted. El Salvador has the right to move towards the first world... "(Rodriques et al, 2021), thus becoming the first country in the world to adopt bitcoin as the official currency.

It can be said that bitcoin is the first fully decentralized international payment system, a fact that can attribute greater advantages and notoriety over others. This is one of the main reasons why this coin is the most popular and the fifth most valuable in the world (Ulrich, 2014).

Bitcoin was created by an enigmatic character, who to this day is not known the identification, "here is a new currency and a payment system. Use it if you like" (Ulrich, 2014, p.12), published Satoshi Nakamoto, in an open forum.

This currency is seen by many as the beginning of a new era of greater financial justice and greater privacy and the end of the weaknesses in the traditional system, constituted using physical currencies, which often fails to keep up with the evolution of the economy due to restrictions or attempts to control governments (Boff et Ferreira, 2016).

Unlike traditional currencies that need the involvement of financial institutions to carry out transactions, this electronic system operates based on *pear-to-pear technology*, that is, allows transactions without interlocutors, thus giving greater privacy and security and less bureaucracy and waste of time to users (Boff et Ferreira, 2016). These transactions can be made at any time of the day, place, or country in which it is, because it is an international currency (Silva, 2016)

Much has been discussed recently about network security, the possibility of being controlled by dishonest people. Although the possibility not being disposable, the evidence shows that this system is much safer than the current ones, because it takes a huge computational capacity and collaboration of a much larger amount of people to achieve this feat (Boff et Ferreira, 2016).

2.3. Market influencers

2.3.1 Hash rate

Hash rate is an indicator of computational potential during the bitcoin mining process, having as a *hash/second* unit of measure. This unit shows the number of calculations that the computer or computer network can perform per second in the mining process (de Vries, 2018).

This indicator determines network security and the probability of success in currency mining since there is a direct and proportional relationship between computational capacity and the ability to mine currency. (Rosenfeld, 2014).

The calculation of hashes stems from the certification of transaction sets, so a transaction is taken as completed at the time that sufficient "work" is recorded to form the block that includes it when connecting the blocks to constitute a chain. The overall work invested in some transfers is permanently increased, constituting an obstacle to the rise of another transaction incompatible with the equal status of recognition devoid of an impediment computational commitment (Rosenfeld, 2014).

Otherwise, when you want to generate new blocks, you need to perform a raw power search for a fractional *hash* shock. It ensures that a block can never be changed without reproducing the entire operation involved to find this *hash shock* (Kraft, 2016). Therefore, any block saw a unit of "atomic update", responding to the imperative of proof of work.

The hash rate is difficult to observe, however, it is feasible to obtain this calculation of the obstacle to observation and the essential effective time to generate new blocks for the system (de Vries, 2018).

Through the analysis of the diverse literature about the hash rate, it is possible to infer that this indicator does not have a direct impact on the pricing of bitcoin. It has however a somewhat relevance when it comes to the price of mining hardware and electricity costs (Kristoufek, 2015)

2.3.2 Mining difficulty

Any user of *the* Bitcoin blockchain can record and verify new transactions within it. The process of registering these new transactions in a ledger is called Bitcoin mining, and its users are (Zhang et al., 2018). According to the Nakamoto protocol, all existing Bitcoins will only have just been mined in February 2140, corresponding to 6929999 blocks (Wright, 2008)digital participation is reliant on information communication technology (ICT. The reason for this process is so time consuming is the *way blockchain has been developed*, since every 4 years there is a division in the number of bitcoins attributed to miners for every 210,000 blocks mined. According to this protocol, every 10 minutes a new block is created, in order to regulate the flow of bitcoins (Bag et al., 2017). Regarding the Bitcoin mining process, the concept of difficulty consists of a measurement indicator that exposes the time required to be mined a new block, the value adjusted every 2016 blocks, approximately 20160 minutes. If the time to such to find the 2016 blocks is longer than the one referred to, the difficulty is then adjusted to a smaller value automatically and vice versa.

With the exponential increase in the price of Bitcoin in recent years, more and more people have adhered to the process of mining this, making the use of professional *equipment and mining pools* quite common. The development of new technologies has allowed an increase in computational power, which added to the growing number of miners leads to the creation of new blocks becoming much faster. This can have negative consequences on *bitcoin's blockchain* in terms of its stability and security. In order to solve this problem, Kraft (2016) proposed

a method to regularly update the difficulty of mining new Bitcoins, thus managing to maintain the stability of the network and regularize the time required to find a new block.

Mining difficulty is highly connected with the hash rate. It can have a significant impact when it comes to the bitcoin pricing. Studies show that a higher mining difficulty will lead to an influx of miners buying bitcoin and quitting the mining process, thus increasing the demand for bitcoin and increasing its price (Kristoufek, 2015).

2.3.3 Google Search

Nowadays, information search engines are widely used as a form of communication, these same tools constitute a basis of trust for decision making in almost all areas of social life. The process of sharing information is a fundamental part for entrepreneurs and professionals from various areas to improve their skills, training, decisions, and results. Thus, there is a correlation between the spread of the bitcoin price and the number of queries in search engines, such as google itself on searches for the term "bitcoin" (Matta et al., 2015).

Digital currencies do not work so linearly, the costs are exceptionally difficult to predict (Abraham et al., 2018), even supported by one of the largest search engines, such as google, that corresponds to 74.5% of the total internet searches (Tetlock, 2007). Such google search data provides credible perceptions according to the common topic of interest and when it becomes more or less engaging (Abraham et al., 2018). Google offers this data through "google trends." This tool has the capability to compile the total amount in fluctuation of google searches for a given term and present its impact for a certain period of time. The values of this research tool offer a *proxy metric for the full interest* associated with cryptocurrencies at any time, a fact that there may be associated with the costs of digital currencies over the years, depending on whether the global interest in the subject higher or lower (Abraham et al., 2018).

The studies on this topic illustrate the trend of bitcoin price fluctuation and market developments, depending on google searches for the term (bitcoin), associated with the phenomena of social networks such as tweets with positive humor, it is possible to predict the market trend with 3 to 4 days of precedence with high chances of success (Matta et al., 2015).

The fluctuation in the value of cryptocurrencies reveals doubts for individuals who want to use them as well as for investors. Digital currencies are a new form of comparatively new value reserve for cash, such as the US dollar (USD) or the Japanese yen currency, which motivates the change in the prices of crypto coins (Ulrich, 2014).

Researcher Ladislav Kiroufek argues that cryptocurrency is a unique asset and digital currencies and their value behave similarly to a traditional financial asset (Kristoufek, 2015).

2.3.4 CBOE volatility index

According to the first studies of the CBOE ,undertaken by Schwert (1990), volatility corresponds to a measure of the degree of price change in a given period of time. This is strongly related to the risk of investing in the financial market. The greater the price change of a stock in a short period of time, the higher the volatility value and consequently the risk involved in trading these assets.

Volatility can be measured in several different ways, which are: price variation in a given period, as mentioned above; the standard deviation of a given asset in a given time interval; the beta, which indicates whether a particular asset is more or less volatile than the market itself as a whole (Mankiw & Shapiro, 1984).

Figure 2: VIX volatility index since March 2020.

Source: Adapted from COMPOSITE Index Charts and Quotes

The CBOE Volatility Index, best known for its VIX ticker, is one of the most used indicators for measuring short-term stock market volatility expectations. This is based on the use of the options price of the S&P 500 index, with

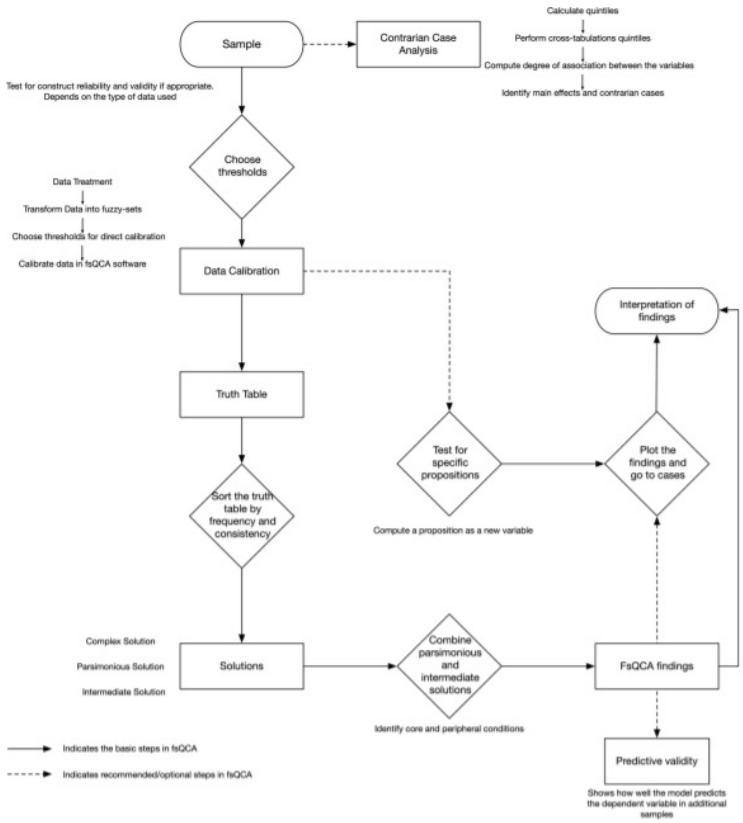
a reduced expiration date, thus being able to predict with great accuracy the volatility present in the (Brenner & Galai, 1989). This is calculated and shared in real time by the CBOE and is also often treated by index or fear meter. Many studies reveal that VIX has a great impact on the price variation of cryptocurrencies(Anamika et al., 2021). Regarding the bitcoin pricing, the CBOE is considered to be one of the most impactful factors, having a rather positive correlation (Gozbasi et al., 2021).

3. Methodology, materials and methods

One methodology for obtaining linguistic summaries of data that are associated with cases, developed by social scientist Charles Ragin, is the fsQCA (Ragin, 2000). FsQCA is a diversity-oriented software approach that proposes different alternative ways to understand the construction of a result and, in addition, is suitable for observing stochastic data and complex phenomena (Kent 2005; Shipley et al. 2013; Henik 2015). Initially, fsQCA was developed for a small sample and, so far, has been used mainly with small and medium samples (Kraus, Ribeiro-Soriano, Schüssler, 2017). However, the method can also be applied with large data sets (Cooper and Glaesser, 2010).

Unlike more quantitative methods based on correlation, the fsQCA seeks to establish logical connections between the combinations of causative conditions and an outcome, which results in rules summarizing the sufficiency between subsets of all possible combinations based on their causative conditions (or their complement) and the outcome (Kraus, Ribeiro-Soriano, Schüssler, 2017). Thus, the fsQCA aims to show the conditions that are sufficient, but not necessary to cause a result (Woodside 2011). Thus, instead of estimating some net effects of independent variables, fsQCA employs a Boolean algebra logic to examine the relationships between a result and all binary combinations of the independent variables. This methodological approach provides the opportunity to detect relevant configurations that ensure high performance in the condition result (Ragin 2000; Fiss 2007; Mayrhofer 2009; Aguilera-Caracuel et al. 2014; Henik 2015). In the first phase of fsQCA analysis, the values of the variables are operationalized as association scores within predefined sets and are obtained through calibration (Ragin 2008a; Meuer 2014).

Figure 3: FSQCA Steps



Source: Pappas, I. O., & Woodside, A. G. (2021).

In the present investigation, the period from 15/03/2020 to 14/11/2021, a total of 96 weeks, was focused with the intention of integrating the covid-19 factor into the study. To have a detailed quantitative analysis, the research team also decided, within the time period referred to above, to analyze different variables where the values were collected had a weekly frequency.

Bitcoin price-influencing variables were chosen:

CASUAL CONDITION	VARIABLE LABEL	SUPPORTING LITERATURE	SOURCE
Bitcoin price at the end of the week	EndBTCprice		Data retrieved from tradeview on November 2021 (market data provided by ICE Data Services)
Hash Rate	Hashrate	Kristoufek L (2015)	Data retrieved from BlockChain.com in November 2021
Mining Difficulty	MiningDifficulty	Kristoufek L (2015)	Data retrieved from BlockChain.com in November 2021
Vix (cboe volatility index)	Vix	Schwert, G. W. (1990)	Data retrieved from Tradeview on November 2021 (market data provided by ICE Data Services)
Google Search	GoogleSearch	Matta, M., Lunesu, I., & Marchesi, M. (2015)	Data retrieved from Google trends in December 2021
Transation Cost	TransationCost		Data retrieved from Ycharts in January 2022

4. Result analysis

4.1 Descriptive analysis

As described in the methodology, the research used 96 weeks as a data sample and 6 statistical variables as potential influencing factors of Bitcoin. Next, Figure 4 shows the structures of the statistical variables, with the proper calibration of the data in values between 0 and 1 (Fiss, 2011).

Figure 4: Descriptive variables

Variable	Mean	Srd.Dev.	Minimum	Maximum	N cases	Missing	Calibration
EndBTCprice	31378.29	19611.29	5392.3	65467	96	0	(60000; 30000; 6000)
Vix	25.57813	10.0875	15.77	74.08	96	0	(50;23;17)
CoinCirculation	18.60529	0.1801558	18.246	18.911	96	0	(18.8;18.6;18.3)
GoogleSearch	34.63542	19.67026	11	100	96	0	(80;32;13)
MiningDifficulty	18.72125	3.053133	13.673	25.046	96	0	(24;19;14)
Hashrate	133.7188	22.45788	84.8	180.8	96	0	(175;133;95)
TransationCost	134.174	87.83619	28.6	300.3	96	0	(285;120;32)

Source: FSQA Program

Calibration cuts were applied in certain parts of the statistical data, and the cuts were made in the zones of 95% in the highest value of Bitcoin, 50% in the average value and 5% at its lowest value. Calibrated variables will have the prefix “fs” before the variable label, e.g fscoincirculation.

4.2 Main analysis

This research aimed to study whether certain factors may influence bitcoin’s rise/fall. To do this, an analysis of all the necessary conditions that can be crucial to influence our variable in fsEndBTCprice study must be carried out. A condition variable is “necessary” if the consistency value is equal to or greater than 0.9, and “almost always necessary” if it is equal to or greater than 0.8 (Ragin, 2008b; Schneider, Schulze-Bentrop, & Paunescu, 2010). Figure 5 shows the set of all variables and the corresponding consistency:

Figure 5: Consistency of variables

Outcome Variable:	fsEndBTCprice	
Conditions tested:		
	Consistency	Coverage
fsVix	0.474979	0.450886
~fsVix	0.773537	0.787565
FsCoinCirculation	0.911154	0.829057
~FsCoinCirculation	0.312977	0.334163
fsGooglesearch	0.783079	0.882226
~fsGooglesearch	0.447837	0.390100
fsTransationCost	0.913910	0.954384
~fsTransationCost	0.325488	0.301928
fsMiningDifficulty	0.769932	0.801368
~fsMiningDifficulty	0.769932	0.420399
fsHashrate	0.785624	0.774943
~fsHashrate	0.440628	0.431219

Source: FSQA Program

We can distinguish the variables in two large groups, those that contribute to the high (positive) values and those that contribute to the low values (negative). According to Figure 4, the variables FsCoinCirculation and fsTransationCost are both higher than 0.9, which represents a necessary condition.

After analyzing the consistency of each of the variables, we move on to a sufficiency analysis and the cautious settings that can drive bitcoin's price increase.

According to Figure 6, the outcome fsEndBTCprice presents 7 final solutions. In an initial instance it is possible to observe the existence of 3 large core variables (Big Black Circles): FsMiningDifficulty, FsGoogleSearch, FsCoinCirculation.

Figure 6: Analysis of variables

	fsEndBTCprice						
Casual Configuration	1	2	3	4	5	6	7
fsVix	●		o	●	●	o	o
FsCoinCirculation		●	●	●	●	●	
fsGooglesearch	●			●	●	●	O
fsTransationCost		●	●	●	●	o	●
fsMiningDifficulty	●	●	O	●		●	O
fsHashrate	●	●	o		●	o	
Consistency	0.93877	0.98173	0.97319	0.98827	0.98640	0.93183	0.98378
Raw Coverage	0.41942	0.64970	0.36959	0.39313	0.39991	0.23770	0.32167
Unique Covarage	0.01251	0.21501	0.04431	0.00318	0.00402	0.00508	0.00212
Overall Solution consistency	0.9516						
Overall Solution coverage	0.8257						

Note: ● represents the presence of a condition, and ● represents the absence of a condition. Large circles indicate core conditions, and small circles indicate peripheral conditions. Blank spaces indicate "does not contribute to the configuration.".

Source: FSQA Program

In a deeper analysis we can group the solutions by similarity in their combinations, for example, solutions 1,2,4 and 5 are solutions in which their combinations have only high values, in which in solutions 1 and 2 the variables fsHashrate and fsMiningDifficulty are present in both. Solutions 4 and 5 are quite similar, in that they have all the same conditions, with the exception that 4 uses the variable fsMiningDifficulty and the 5 uses the variable fsHashrate, all others are equal. On the other hand, solutions 3.6 and 7 present both high variables with low values, all with the similarity that the fsVix variable is present in all low values.

4.3 Suplmentar analysis

Then we can see to observe the opposite direction, the settings that contribute to a decrease in the price of Bitcoin. Figure 7 shows the set of all variables and the corresponding consistency:

Figure 7: Consistency Table

Outcome Variable:	~fsEndBTCprice	
Conditions tested:		
	Consistency	Coverage
fsVix	0.798526	0.785024
~fsVix	0.441441	0.465458
FsCoinCirculation	0.397830	0.374879
~FsCoinCirculation	0.818591	0.905139
fsGooglesearch	0.323915	0.377926
~fsGooglesearch	0.899058	0.811046
fsTransationCost	0.273341	0.295616
~fsTransationCost	0.957821	0.920142
fsMiningDifficulty	0.398444	0.429486
~fsMiningDifficulty	0.815725	0.785954
fsHashrate	0.438780	0.448233
~fsHashrate	0.779689	0.790205

Source: FSQA Program

Figure 8 shows all the combinations that contribute to the decrease in the price of Bitcoin:

Figure 8: Analysis of variables

	~fsEndBTCprice	
Casual Configuration	1	2
fsVix	•	•
FsCoinCirculation	0	0
fsGooglesearch		0
fsTransationCost	0	0
fsMiningDifficulty	0	
fsHashrate		
Consistency	0.971679	0.98139
Raw Coverage	0.681409	0.0307125
Unique Covarage	0.691032	0.403358
Overall Solution consistency	0.968141	
Overall Solution coverage	0.721744	

Source: FSQA Program

We were able to observe that the solutions are very similar, in this case, we were able to achieve only 2 solutions, however, the only variable that presented with great values was the variable FsVix. The solutions are both very similar, containing only core variables and low values to their variable fsVix with high values, all others, low values, and the variable FsHashRate is indifferent to the solutions.

5. Conclusions and discussion of results

After analyzing all the results, we were able to compare them with results of previous research.

Fantazzini, & Kolodin (2020), concluded that the variable Hash Rate, has both a positive and negative impact on the price of Bitcoin, which through certain combinations, both its high value and low value of the same, can increase the value of Bitcoin. Our research achieved the same results, when refering to Hash Rate, in 3 of the combinations, its high value contributes to an increase of bitcoin price. However, in two other combinations, its low value also contributes to an increase in the value of Bitcoin.

In addition, Das & Kannadhasan (2018), explained that the FsVix variable, is a variable with important implication in price. In addition to being an important variation for the volatility of the price, we both conclude that it presents itself as an inverse variable, the higher its value, the lower the value of Bitcoin.

Finally, we were able to conclude that all the variables chosen had an impact and are relevant for predicting the possible rise or fall in the price of Bitcoin.

This study is not free from limitations. The first limitation being the sample, that was limited to the timeframe chose. Another study analyzing the effects of the same variables in other time spans are recommends, for example, in a post-pandemic, or during the current conflict in Ukraine. Finally, this study is also limited to the methodology chosen. This methodology can be complemented with the use of traditional econometric methods, in order to verify if there are differences.

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