

# CRYPTOCURRENCIES AND FINANCE: THE RELATIONSHIP BETWEEN THE RETURN OF BITCOIN AND THE MAIN DIGITAL CURRENCIES

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## ABSTRACT

Bitcoin is a subject that has been attracted attention to the media and, in an incipient way, the academy, because of the value of trading in brokerage houses and exchanges around the world. Fact is that, from its user today, the Bitcoin has had an exponential growth, considered moreover as a bubble. Given this and other points, it is necessary to understand an interaction of Bitcoin with cryptocurrencies, as part of an alternative investment scenario. Therefore, the objective of this work was to verify if the return of Bitcoin and the main coders were correlated or behaved in a dispersed way between the years 2016 and 2017. By means of regression analysis, we searched for an association. The results pointed out as main cryptocurrencies in the market value, but an association of returns linked to Bitcoin. Given the lack of research such as the cryptocurrencies due to a recent series, the perspective of research such as discussions of the theoretical referential, the possibility that studies may have the same influence on cryptocurrencies.

**Keywords:** Blockchain; Cryptocurrencies; Bitcoin.

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## RESUMO

*Um tema que tem trazido a atenção da mídia e de forma ainda incipiente na academia, tem sido o Bitcoin, isso por causa da disparidade do valor negociado nas corretoras ou exchanges ao redor do mundo, fato é que desde sua concepção aos dias de hoje o Bitcoin teve um crescimento exponencial, considerado inclusive como uma bolha. Diante deste e outros pontos se faz necessário entender a interação do Bitcoin com as demais criptomoedas se consideradas em um cenário de alternativa de investimento. Diante disso o objetivo deste trabalho é verificar o retorno do Bitcoin e das principais criptomoedas são correlacionados ou se comportam de maneira dispersa entre os anos de 2016 e 2017. Por meio de análise de regressão se busca a verificação ou não desta associação. Os resultados apontaram que as principais criptomoedas em valor de mercado possuem sim uma associação de retornos atrelados ao Bitcoin. Dada a inexistência de pesquisas envolvendo as criptomoedas em virtude da temática recente, os resultados obtidos nesta pesquisa e as discussões do referencial teórico, abre-se oportunidades para que novos estudos possam contribuir no entendimento sobre as criptomoedas.*

**Palavras-Chave:** Blockchain; Criptomoedas; Bitcoin.

## 1 INTRODUCTION

The cryptocurrencies became known mainly due to the popularity of Bitcoin, which is a decentralized currency that interacts in protocol form with the conventional financial system as a virtual currency, and make electronic payments (ULRICH, 2014). Much of cryptocurrencies use blockchain technology for online transaction system. Yermack (2017) understands that the blockchain offers the possibility of significant improvements in the liquidity of the securities market values because of its potential to reduce costs and time in the negotiations.

The introduction of this virtual currency appears to be a reflection of current environmental trends. Its growing popularity confirms that it is the right answer to the emerging challenges. Consequently, the relevant authorities struggle to maintain control, countering the growth of virtual currency market and generating uncertainties (WOZNIAK; SCHEIBE, 2015).

Therefore, the merger of two areas of knowledge in which cryptocurrency lies, technology and economy, allowed a glimpse of models that can solve the problems faced by society, such as inflation, economic cycles, unreliable financial institutions and lack of universal service financial (ANTUNES; FERREIRA, BOFF, 2015).

The encryption is based on principles of collaborative open source and peer-to-peer networks, which suggests a commitment to social solidarity and mutual aid (Scott, 2016). However, the Bitcoin image joined the speculators, driven entrepreneurs for profits, market fundamentalists and libertarians technological fetishists (YELLOWITZ; Wilson, 2015).

Among the cryptocurrency research it is highlighted: the economy, technology and governances applied to Bitcoin (BÖHME et al, 2015)., Impacts in the legal field and regulation to prevent Internet crime (ANTUNES; FERREIRA; BOFF, 2015), blockchain and the impact on financial services (FANNING; CENTERS, 2016), statistical analysis of exchange analysis Bitcoin (CHU; Nadarajah; CHAN, 2015), the contribution *blockchain* for the development of smart cities (SUN; YAN; ZHANG, 2016).

As a payment the cryptocurrencies has been gaining ground due to the widespread criticism of the fees charged by credit and debit card networks, since the technology would push the card networks to lower their prices to traders (BÖHME et al., 2015). The cryptocurrencies are encoded from an anonymous system highly liquid, low cost and high speed, which make them more interesting and, in a broader perspective, the system is not controlled by a central body, reducing privacy concerns, or it is linked to any kind of goods, such as gold or silver (CHU; Nadarajah; Chan, 2015).

However studies involving finance aspects applied to cryptocurrencies in Brazil were not found, much less the try to detect associations between existing cryptocurrencies beyond Bitcoin, considering it as an investment alternative. In this sense, this research also becomes relevant to propose the verification of correlation level between cryptocurrencies.

The importance of the subject, according to Martins and Val (2016), involves the decentralization of the monetary system technology, which reveals the formation of interactions between agents. Another point worth mentioning about the economic importance is already trading futures Bitcoin contracts in two US futures and options exchanges: the Chicago Board Options Exchange (CBOE) and the Chicago Mercantile Exchange (CME), the latter one of the largest world (AP, 2017). Thus, it is clear that even the capital of institutional investors can migrate to Bitcoin and with an appreciation of this, a fact that occurred (AP, 2017).

In this sense, a study to investigate the relationship between the various types of cryptocurrencies it is necessary, arising therefore the following research question: How does the return of Bitcoin relates to the main cryptocurrencies? This search problem arises from the assumption that the greater the correlation between assets, the higher the return loss of compound due to higher volatility, so that negatively correlated active investor can provide an advantage of risk and return the asset rebalancing.

Thus, the present work has the objective to verify how the return of Bitcoin relates to the main cryptocurrencies, whether they are related or behave in a dispersed manner. If the different cryptocurrencies tend to follow the same direction, being positively correlated, one can measure the movements by the ratio of the two, leaving the investor to choose the asset by the degree of assumed risk. When in opposite directions, they are negatively correlated and / or when there is no clear trend, so that they are not correlated, open up opportunities for a rebalancing in the portfolio.

Cryptocurrencies are a recent phenomenon, the work will contribute to the deepening of theoretical research on cryptocurrencies through review of academic papers on the subject, the correlation among the largest cryptocurrencies, and will serve as informational source for future research in Brazil.

## 2 THEORETICAL BACKGROUND

In this theoretical framework, are themes that are closely linked, which are: blockchain; The cryptocurrencies support system; the cryptocurrencies, especially Bitcoin; and, finally, the latent issue of regulation, focusing on Brazil situation.

### 2.1 Blockchain

Blockchain consists of a set of data that are composed of a chain of blocks, where by one block comprises multiple transactions. The chain block is extended for each additional block generating a transaction history, being validated by the network using cryptographic means (nofer et al., 2017). The blockchain database maintains a growing list of data that can not change or revision, in this way, *blockchain* becomes a public book of all executed transactions in a linear order, chronological, receiving any form of accurate information on the addresses and balances (FANNING; CENTERS, 2016).

Haber and Stornetta (1991) proposed the use of the data record in a sequential file to mark the creation of intellectual property in the form of digital document, avoiding plagiarism and protecting the intellectual property of the author. The proposed model has ensured the au-

thenticity using hash, a type of encryption that transforms data into hexadecimal codes of fixed length that can not be reversed to retrieve the original entry.

To Yermack (2017), the *blockchain* offers a world of accounting in real time, users of financial information need not rely on the judgment of auditors and the integrity of its managers, reducing problems of moral hazard and agency. Thus, each user of accounting information could create its own financial statements from the data generated by *blockchain* at any time they may want, making their own decisions.

Yermack (2017) mentions that the blockchain is an application of the new technology of cryptography and information to old problems of record-keeping, and shows great potential of this new technology to drive major changes in corporate governance. Many investors in the financial industry started to invest in this new technology, and the stock exchanges have proposed using blockchain as a new method to negotiate corporate actions and control their property.

## 2.2 Cryptocurrencies and Bitcoin

The Bitcoin it is an electronic payment system peer-to-peer operating as an independent currency. It highlights the Nakamoto (2008) discussion about the philosophy of ontological constitution of Bitcoin. Using the ontological triad of the real, the symbolic and the study of imaginary distinguish three ideal typical theories of money: theory of the goods (Bitcoin is no gold commodity money), fiat theory (Bitcoin is trust without a state) and credit theory (Bitcoin is credit money with no debt). The Bitcoin constitution is analyzed by comparing the coin with each of these theories.

Based on preliminary discussions about studies that address different contexts of Bitcoins, you can understand that Bitcoin has represented an ideological challenge to conventional forms of money as well as financial transactions itself, in that it not only causes sedimented beliefs about money, but also exposes the forms of exploitation and risk inherent in the existing system of credit authorized by state money (Nakamoto, 2008). It is important to note that the context and reality of cryptocurrencies influences and impacts far more than Bitcoin itself. These impacts may be reflected in the investor market and the state.

The cryptocurrencies are digital currency using encryption techniques embedded in their algorithms, keeping them safe in their control protocols in global transactions, allowing thus the generation of new digital currencies (BENICIO; CROSS; SILVA, 2014). Currently there are two types of virtual currencies: (a) digital currencies that are usually restricted to controlled environments such as social networks and online games, where you have a centralized authority that governs the delivery and validation depends on the issuer, not using thus the blockchain system; and (b) cryptocurrencies, which can be used to purchase items and their acceptance is not restricted or controlled by central authority, which make them attractive (FANNING; CENTERS, 2016).

In the early twenty-first century, modern technology and most advanced innovative in economic and computational branch were established. They are known as encrypted currency, which were instituted after the creation of Bitcoin, the initiative of Satoshi Nakamoto, in 2008 (Ulrich, 2014). There have been several attempts to create virtual or actual payment system money, but they were not legitimate or effective until the moment of Bitcoin creation, which revolutionized the world order and has unknown consequences for the law (Martins, 2016; CAMPOS, 2015).

Encrypted currencies hold a concept that encompasses virtual currency that act before full decentralization of the monetary system that does not rely on intermediaries to carry out the transactions, ensuring transaction costs close to zero or even zero, for any buying and selling over the Internet. Moreover, encrypted coins understand the concept of protection by complex computer codes, called encryptions, which are considered impossible to open without the password

belonging to the owner of the coin, which also ensures no exposure of users and their transactions, not be when authorizing them (Martins, 2016).

The cryptocurrencies also suffer criticism, according to Damodaran (2017), the cryptocurrencies like Bitcoin can not be considered assets not generate cash flows to their holders only after the time of sale. Additionally, for Bölver et al. (2015), the cryptocurrency has distinct risks that differentiates it from other payment methods. With cryptocurrency, the investor faces market risk by fluctuations in exchange rates, counterparty risk, transaction risk, operational risk, related to privacy risk, legal and regulatory risks. To understand the payment system through cryptocurrencies we must show the relationship with the electronic payment system used by banks, as Table 1.

Table 1 - Differences between payment systems

Bank payment system	Payment system of cryptocurrency
<ol style="list-style-type: none"> <li>1. Demands account number in a bank.</li> <li>2. Is there a way to prove that there is a control on each account number, for example, a PIN code.</li> <li>3. The bank, in turn, has a record of data on how much money is attributable to this account number, thus keeping the score of a person's money on a database or private internal accounting.</li> <li>4. A person may use a system of electronic communications to identify your bank as holder of the authentic account and may request that the money associated with your account number be transferred to another person's account at a different bank.</li> </ol>	<ol style="list-style-type: none"> <li>1. A person who wishes to make a payment has a public address (like an account number).</li> <li>2. She has a way to control this public address by using a private key (approximately similar to a PIN number).</li> <li>3. She then uses a system of electronic communications (Internet) to identify the network and request that digital tokens - associated with its public address - to be moved to the public address of another person.</li> <li>4. This then takes place by a change made to the book blocks chains by a group of participants colloquially known as miners. It is beyond the scope of this article to describe the exact means by which this happens, but the process involves the miners using their computing power to validate transactions.</li> <li>5. The two parties that control the public addresses can then see these changes, proving that the tokens passed from one address to another.</li> </ol>

Source: Adapted from Scott (2016).

Among the main advantages of cryptocurrency, one is inflation zero property, limit account included in their algorithm. Table 1 presents the largest cryptocurrencies in market value at September 11, 2017.

Table 1 - Major cryptocurrencies in market value

	Name	Symbol	market value (R \$)	Volume (R \$)
1	Bitcoin	BTC	236,530,125,888	5,726,646,871
2	Ethereum	ETH	96,076,739,095	2,299,408,606
3	Bitcoin Cash	BCH	33,439,434,055	3,237,788,199
4	Ripple	XRP	26,674,461,425	344,777,858
5	Litecoin	LTC	12,967,732,045	1,781,183,344
6	NEM	XEM	8,242,672,564	12,454,863
7	Dash	DASH	8,013,758,943	80,400,435
8	IOTA	MIOTA	5,721,217,390	86,878,367
9	Monero	XMR	5,535,589,424	168,596,084
10	Ethereum Classic	ETC	5,313,120,845	478,542,505

Source: Coinmarketcap (2017).

It is worth noting that in Accounting literature, there is not an exact definition of what are the cryptocurrencies, even uses this either as currency and payment system or even investment. In Table 2 the main characteristics of the cryptocurrencies with higher market values are presented.

Table 2 - Characteristics of the main Cryptocurrencies in market value

Name	Features
<b>Bitcoin</b>	It was defined by its creator as "a peer-to-peer electronic cash system," which replicates the properties of physical money in a digital environment. Your offer and issued amount (maximum 21 million) is predetermined by the rules set in software and is provided by participants in the network without a central bank, as the traditional currencies.
<b>Bitcoin Cash</b>	The Bitcoin Cash was established in August 2017 as a "hard fork" (division) of Bitcoin. It is basically a new version of Bitcoin, created because some users were frustrated with the high fees and slow processing of the original currency. As Bitcoin Cash has a larger block size limit, its creators say the currency has more ability to handle transactions with lower rates and faster confirmations.
<b>Ethereum</b>	The Ethereum is a platform based on technology blockchain, decentralized and focused on the execution of so-called intelligent contracts (operations are made automatically when certain conditions are met). Its structure is very similar to Bitcoin, with blockchain that records all operations done safely in a kind of public spreadsheet and can not be changed. To create new coins is also used the mining process, where the users verify and validate operations.
<b>ripple</b>	The Ripple software company was launched in 2012. Its digital currency, XRP, is seen by some industry insiders as the logical successor of Bitcoin. The New York Times described the ripple as "a cross between Western Union [company of global money remittance] and exchange without the high rates" because it is not just a cryptocurrency, but also a system in which any currency, including Bitcoin, It can be negotiated. Your version of blockchain has been licensed to more than 100 banks.
<b>litecoin</b>	If the Bitcoin was appointed digital gold, litecoin was described as silver digital. Was created in 2011 by former Google employee Charlie Lee and is considered an alternative to Bitcoin. Lee sought to reduce the time required to confirm new transactions and adjust the way the currency is mined to ensure that anyone could participate. "My view is that people would use litecoin every day to buy things. It would be only the chosen payment method," said Lee once.
<b>DASH</b>	The DASH aims to be the first currency cryptographic focused on privacy with fully encrypted transactions and transactions of anonymous blocks - named resource PrivateSend. The DASH (DigitalCash) uses a hashing algorithm approach chain, with many new scientific algorithms for working trial.
<b>monomer</b>	The wide appeal of Monomer is the fact that it is anonymous. With it, the details of each transaction, including the sender, recipient and size, are recorded in a public system, but are overshadowed to make them untraceable. The currency would be attractive to companies that want to move money without competitors know, or who simply do not want your balance and transactions are disclosed.
<b>IOTA</b>	The Iota has no trading fees, mining or blocks. For each transaction you make, its processing power is used to validate two other transactions, making every Iota owner also a "miner". Essentially, Iota focuses on becoming the backbone for machine insurance payments the machine, on the Internet called the CoCoS. It is hailed as the first cryptocurrency created without the use of a blockchain. Instead, it is based on an architecture of "accounting books" distributed in the "The Tangle", an innovation that may ultimately allow three encryption landmarks: cost of transactions zero, offline transactions and infinite scalability.

Source: Adapted from Infomoney (2018).

Studies on the Bitcoins have shown greater disclosure, especially from the year 2015, which can emphasize a concern of researchers with applicability as well as the meaning itself of Bitcoin as a reality (CIAIAN et al., 2016).

In view of the latest studies on the cryptocurrency Bitcoin, we can highlight the study Ciaian et al. (2016), which demonstrated the volatility of the price relative to other currencies and identified and analyzed the cryptocurrency characteristics that may contribute to the Bitcoin to become a global currency and characteristics contrary to this perspective, ie that can prevent using Bitcoin as a medium of exchange and also as an investment, and have compared the cryptocurrency with standard currencies in relation to the functions of money.

Among all Bitcoin characteristics analyzed, the volatility of extreme price stands out more clearly in comparison with the standard currencies. The search Ciaian et al. (2016) suggests that Bitcoin attractiveness indicators are the strongest drivers of cryptocurrency price, followed by market forces. In contrast, financial developments were not singled out as decisive as the price of Bitcoin in the long run. Other findings of this research suggest that while the Bitcoin price is driven mainly by speculative investments, cryptocurrency will not be able to compete with traditional currencies.

### **2.3 Regulation of cryptocurrencies in Brazil**

According to Campos (2015), the creation of virtual currencies, arising from globalization and increased interpenetration of national markets, brought several legal consequences of great importance and may not be ignored. There are few regulations applied to Bitcoin (software) and their respective currency, and there is still a shortage of in-depth studies on the considerable legal consequences of its creation.

The Treaty of Asuncion presupposes, in arts. 13 to 15, the institution of executive organs of the Common Market, which are divided into working groups for strategic sectors. They are present in Annex V of the treaty subgroups of Fiscal and Monetary Policies Related to Trade, and Electronic Commerce, demonstrating the importance of regular on encrypted currencies (MARTINS; VAL, 2016).

The settings of the encrypted coins bring essentials such as, for example, the tax classification provided by the state, with a relevant systematic both to prevent tax evasion and to obtain a more exact picture to the State of the investments made by citizens. Thus, one can attest necessary positivization of tax rules related to virtual money (CAMPOS, 2015).

According to Campos (2015), the Bitcoin is subject to supply and demand. Consequently, it can become a source of criminals who aim to escape state control, trying to hide their financial reserves practicing thus, money laundering and trading, through e-commerce, the sale of illicit goods, because only the value of transactions that becomes public. The requirement of a license to companies that exchange Bitcoins for national currencies, similar to the permits required for foreign exchange companies, could be a possible solution.

As the International Revenue Service (2014), it is the tax authority of the United States, the currency not only serves as the payment system, but as a property, launching inquiries related to property rights. Similarly, Canada also declared the consideration of money as property, making it mandatory for companies the declaration of sales made through Bitcoins and profits with currency speculation.

However, Germany has acted contrary, classifying the currency to private money and not owned. However, it is believed that most countries possibly prevent the classification of Bit-

coin as a virtual money because this categorization can bring unknown consequences, and these countries may prefer to rely on safer terms (Descoteaux, 2014; CAMPOS, 2015).

According to Campos (2015), the law should also indicate withdraw your Bitcoins original user and law would be regarded as theft, according to art. 155 of the Brazilian Penal Code, or would be classified as a computer device with invasion penalty increase, as § 2 of the same article. The author states that another important factor to be considered in relation to the currency with respect to the possibility of censorship break imposed by some states since the site can be accessible as programs that guarantee the identity secrecy, even if a country declares the prohibition of access to the software.

For a better determination of the key points about regulation, it is necessary that the state establish its priorities. When a new technology emerges, usually the first regulations are more comprehensive, while other laws to follow, specifying or detailing behaviors that are deemed appropriate by the State (LORENZETTI, 2014).

The Central Bank of Brazil (BCB), in its Communication No. 25,306 / 2014 does not attest illegality of encrypted coins, only warns of volatility, stating that they do not offer even risks to the financial system, not fitting in the system described in the art. 6 of Resolution No. 4,282 / 2013, possessing thus regulatory rules issued by the Central Bank (BRAZIL, 2013, 2014).

The difficulty of categorization of encrypted currency as a tool in the legal category is existing, taking into account the absence of an authority responsible for their issue. Therefore, there is still no official regulation dealing with encrypted coins, only a note of the Bank about its risks and expectations of further studies for a possible regulation (Martins, 2016).

Thus, it can be noted that there were already several innovations that have emerged in a setting not yet regulated by law due to the fact the norm unable to remain above the human creations that it regulates, especially those dealing with technological innovations. Discussions that the regulation of currency would cause its end is denied with examples of other controlled digital innovations such as the Internet, since the regulation is expected by users, which, through it, would gain greater confidence in Bitcoin as payment (Campos, 2015).

According to Johnson and Post (1996), some legal experts recommend the creation of specific universal norms of the virtual world due to the global nature of the Internet. Thus, there would be an international body to regulate and to control all activities of virtual currencies and other currencies that may arise in the future. This approach would facilitate the possibility of claims of consumers' rights, but it is necessary to analyze the practicality of this assignment, it would not be a unanimous decision among the countries to surrender the power to legislate on this subject (CAMPOS, 2015).

### 3 METHODOLOGY

In this work, we broke the population of the 10 largest cryptocurrencies in market value between the period of August 7, 2015 on September 11, 2017, using 766 collected daily data on the site CoinMarketCap totaling 5,632 returns. It was used a few filters, excluding the following cryptocurrencies: Bitcoin Cash, Ripple, litecoin and Ethereum Classic, being cryptocurrencies that are new in the trading market. Thus, the final sample was 7 cryptocurrencies with higher market value as shown in Equation 1.

$$BTC = \alpha + \beta_1.ETH + \beta_2.XRP + \beta_3.LTC + \beta_4.XEM + \beta_5.DASH + \beta_6.XRM + \varepsilon \quad (1)$$



Where:  $\alpha$ : refers to the intercept parameter;  $\beta$  corresponds to the slope of the control variables; BTC = Bitcoin; ETH = Ethereum return; U = XRP Ripple; LTC = Litecoin return; DASH = Return Dash; XEM = Not Return; XRM = return monomer;  $\varepsilon$  = disturbance (error or residue) model.

For the calculation of the selected cryptocurrencies returns, the return is used in the form of logarithm, which is the natural logarithm of the arithmetic return. The choice of this methodology is justified due to their statistical properties, such as stationary and ergodic, which are most of the time-series returns (MORETTIN; TOLOI, 2006). Based on this assumption, the calculation for the return of cryptocurrencies will be:

$$R_j = \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln(P_t) - \ln(P_{t-1}) \quad (2)$$

Where:  $R_i$  = the cryptocurrencies return;  $P_t$  = number of daily closing cryptocurrencies in period  $t$ ;  $P_{t-1}$  = number of daily closing cryptocurrencies in period  $t-1$ .

In addition to the above, the logarithm returns may provide the time series of cryptocurrencies an approximation of Gaussian distribution (normal), equaling the weight of positive and negative returns.

## 4 RESULT ANALYSIS

Initially, it was performed the descriptive statistical analysis of test variables selected according to Table 2. All the average returns of the variables meet the basic assumption of finance theory, in which the return is close to zero. As for the standard deviation as a total risk measure, the BTC showed lower standard deviation, that is, even with the high volatility of the asset, it presents a low risk, based on the sample size of this study. As for the assumption that the greater the risk taken, the higher the average return, the BTC showed lower average return, based on the logarithm of returns. The cryptocurrency with the highest average return was XEM, which consequently showed the highest standard deviation. The major peak was the return XRP and cryptocurrency that showed the greatest decrease was ETH.

Table 2 - Descriptive statistical analysis

Variable	Average	Standard deviation	Minimum	Maximum
BTC	0.00411	0.0340	-0182	0239
ETH	0.00972	0.0822	-0728	0510
XRP	0.00734	0.0929	-0460	1,794
LTC	0.00500	0.0555	-0206	0666
DASH	0.00762	0.0586	-0173	0446
XEM	0.01400	0.0980	-0251	0786
XRP	0.00940	0.0795	-0216	0794

note: The dependent variable is the BTC Bitcoin. The independent variables are: ETH - Ethereum; XRP - Ripple; LTC - Litecoin; DASH - Dash; XEM - Not; XRM - Monomer.

Source: Prepared with data obtained via Gretl software.

Upon reception of the descriptive analysis of cryptocurrencies it was possible to perform the correlation test between the variables according to Table 3.

Table 3 - Correlation Matrix

Variable	BTC	ETH	XRP	LTC	DASH	XEM	XRM
BTC	1.000						
ETH	0.230	1.000					
XRP	0.141	0.032	1.000				
LTC	0.475	0.140	0.192	1.000			
DASH	0.344	0.207	0.003	0.217	1.000		
XEM	0.314	0.110	0.086	0.194	0.189	1.000	
XRM	0.325	0.197	0.088	0.219	0.281	0.141	1.000

note: The dependent variable is the BTC Bitcoin. The independent variables are: ETH - Ethereum; XRP - Ripple; LTC - Litecoin; DASH - Dash; XEM - Not; XRM - Monomer.

Source: Prepared with data obtained via Gretl software.

It may be noted that the return of the logarithm of cryptocurrencies exhibit low correlation (below 0.70), which may be a low signal multicollinearity between variables. The BTC return with the highest correlation was the variable LTC. The correlation was lower among the explanatory variables, showing a degree of dispersion of cryptocurrencies and a certain dependence only variable BTC, where possible to denote the highest correlation indications. Among the explanatory variables, the lowest correlation was between XRP and DASH variables, this result demonstrates that low correlation may result from high speculation that exists in the market cryptocurrencies, as outlined by Ciaian et al. (2016).

Another aspect considered is multicollinearity, ie the extent to which a variable can be explained by other explanatory variables (HAIR JR. Et al., 2009). Another way to measure the presence of multicollinearity is through the test Variance Inflation Factor (VIF) wherein variables with values greater than 10 should be disregarded model. The results are shown in Table 4.

Table 4 - Test multicollinearity

Variable	VIF	1 / VIF
DASH	1,160	0859
XRM	1,150	0873
LTC	1140	0874
ETH	1,080	0928
XEM	1,070	0930
XRP	1,050	0955
<b>average VIF</b>	<b>1,110</b>	

note: The dependent variable is the BTC Bitcoin. The independent variables are: ETH - Ethereum; XRP - Ripple; LTC - Litecoin; DASH - Dash; XEM - Not; XRM - Monomer.  $FIV (j) = 1 / (1 - R (j) ^ 2)$ , where R (j) is the multiple correlation coefficient between the variable j and the other independent variable.

Source: Prepared with data obtained via Gretl software.

To test the normality of the residuals, we used the Shapiro-Francia test which returned a p-value of 0.000, a chi-square statistical test (2) = 322968, rejecting the null hypothesis normal distribution of waste, namely waste does not follow a normal distribution, demonstrating a greater standard error. According Jarque and Bera (1987), not normally present a daily returns leptocurtose, ie not independent identical distribution of the returns. But the Durbin-Watson test a p-value of 0.462, has shown that there is no serial correlation between the residuals.

Using the method of ordinary least squares (OLS) presupposes the absence of heteroscedasticity (Brooks, 2014). The Breusch - Pagan test for heteroscedasticity returned a p-value of 0.000, rejecting the null hypothesis of data homogeneity, demonstrating that the error does not have a constant variance, it has heteroscedasticity. Thus, it is presented in Table 5, the model OLS with heteroskedasticity corrected.

Table 5 - OLS model with heteroscedasticity-corrected

Variable	Coefficient		standard error		G-T		p-value		
const	0.00262		0.00087		2.9875		0.0029	***	
ETH	0.02718		0.01249		2.1751		0.0299	**	
XRP	0.00937		0.00908		1.0312		0.3028	NS	
LTC	0.31217		0.02339		13.3415		0.0001	***	
DASH	0.06191		0.02066		2.9965		0.0028	***	
XEM	0.04641		0.01150		4.0341		0.0001	***	
XRM	0.06664		0.01470		4.5317		0.0001	***	
Sum of squared residuals		4569.60		Regression Standard error		2453			
R <sup>2</sup>		0322		R <sup>2</sup> adjusted		0316			
F (6, 759)		60.09		P value (F)		0000			
Log likelihood		-1770.94		Akaike		3555.89			
Schwarz criterion		3588.37		Hannan-Quinn criterion		3568.39			
rho		0.00103		Durbin-Watson		1,997			

note: \* Significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. NS indicates that the variable no significant statistical impact. The dependent variable is the BTC Bitcoin. The independent variables are: ETH - Ethereum; XRP - Ripple; LTC - Litecoin; DASH - Dash; XEM - Not; XRM - Monomer. FIV (J) = 1 / (1 - R (j) ^ 2), where R (j) is the multiple correlation coefficient between the variable j and the other independent variable.

Source: Prepared with data obtained via Gretl software.

The adjusted coefficient of determination (R<sup>2</sup> adjusted) demonstrates that the model independent variables explain 31.6% of BTC variable. The F test resulted in a statistical 60.09, which, in a distribution F (6, 759) returned a p-value less than 0.000. This result leads to rejection of the null hypothesis that all parameters are statistically equal to zero, ie, that there is at least one coefficient of the explanatory variables is statistically significant at 5%.

Regarding the results of each independent variable, it is observed that the p-values of ETH, LTC, DASH, XEM, XRM are significant and contribute in explaining the fluctuations of the BTC dependent variable returns, greater as that demonstrating for the return of BTC variable, the greater will be the average return of these variables, since the variable XRP does not suffer or influences the results of BTC variable. Thus, for an investor riding his wallet with cryptocurrencies positively related, the higher your ratio, the greater may be the loss or gain, according to the volatility of the day. For investors seeking to invest in cryptocurrencies that do not relate positively, diversification between BTC and XRP becomes a way to diversify and reduce risk.

In short, the results this work show that the variable BTC influences or is influenced

from other cryptocurrencies analyzed in this study. Additionally, it is valid to point out that the coefficients obtained in these variables were consistent with what occurs in the practice of buying and selling of cryptocurrencies, ie investors who work with speculation or long-term purchase will be able to rely on the return of BTC to make their decisions. It is noteworthy that the research has an academic nature, not being informational source for decision-making based on this information practice.

## 5 CONCLUSION

The aim of this study was to determine if the return on Bitcoin and major cryptocurrencies are correlated or behave in a dispersed manner. The results showed that there is a correlation and association of major cryptocurrencies returns at market value with Bitcoin, which is the best known and also with the highest market value.

Therefore, these results allow the behavior of cryptocurrencies can be explained together. So in up or down fluctuation scenarios, similar show whether behavior, but in scenarios of portfolio diversification of cryptocurrencies, in an attempt to minimize the risk of Bitcoin falls, it would not be possible, since the regression coefficients were all positive.

A caution to consider is that other cryptocurrencies may not have sufficient liquidity so they can be considered in fact as a diversification alternative. It is noteworthy that these considerations are based on a scenario that considers the cryptocurrencies also as a kind of investment without going into the merits of what the purpose if it is to have as a conventional currency for the payment of debts, contracting of services and procurement of goods and products, or if only speculatively.

In the absence of research within the scope of finance in Brazil applied to Bitcoin, this study provides an important discussion to the national reality. Nor is it possible to make larger generalizations, for the period under review could not be higher, since part of other cryptocurrencies are recent and the data source, which was the site CoinMarketCap, considers the cryptocurrencies performance with a basket of brokers called exchanges worldwide.

For future research this study can have its gaps filled as well as advance the theme of finance applied to Bitcoin and the other cryptocurrencies involving aspects of volatility, combined use with other traditional forms of investment as well as an opportunity to form insurance in hedge transactions.

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Contribution	[Author 1]	[Author 2]	[Author 3]	[Author 4]	[Author 5]
1. Definition of research problem	√			√	√
2. Development of hypotheses or research questions (empirical studies)	√			√	√
3. Development of theoretical propositions (theoretical work)	√			√	√
4. Theoretical foundation / Literature review	√	√	√	√	
5. Definition of methodological procedures	√			√	√
6. Data collection					
7. Statistical analysis	√	√			
8. Analysis and interpretation of data	√				
9. Critical revision of the manuscript				√	
10. Manuscript writing	√	√	√	√	
11. Other (please specify)					