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Bitcoin in Conventional Markets: A Study on Blockchain-Induced Reliability, Investment Slopes, Financial and Accounting Aspects

Kamer-Ainur Aivaz [1,*], Ionela Florea Munteanu [1,*] and Flavius Valentin Jakubowicz [2]

[1] Faculty of Economic Studies, Ovidius University of Constanta, Aleea Universitatii No. 1, 900470 Constanta, Romania
[2] Accounting Department, Bucharest University of Economic Studies, 1 Tache Ionescu Street, 010352 Bucharest, Romania; flavius.jakubowicz@gmail.com
* Correspondence: kamer.aivaz@365.univ-ovidius.ro (K.-A.A.); ionela_munteanu@365.univ-ovidius.ro (I.F.M.)

Abstract: Based on traditional market theory, this study aims to investigate whether conventional market investment slopes affect the unconventional Bitcoin market, considering both normal conditions and crises. This study examines three main characteristics of the economy-intensive blockchain system, namely reliability, investment slopes, financial and accounting aspects that ultimately determine the confidence in the choice to invest in cryptocurrency. The analysis focuses on the study of the Bitcoin (BTC) investment slopes during January 2014–April 2023, considering the specifics of blockchain technology and the inferences of ethics, reliability and real-world data on investment Tassets in the context of conventional regulated markets. Using an econometric model that incorporates reliability analysis techniques, factorial comparisons and multinomial regression using economic crisis periods as a dummy variable, this study reveals important findings for practical and academic purposes. The results of this study show that the investment slopes of Bitcoin (BTC) are mostly predictable for downward trends, when statistically significant correlations with the investment slopes of conventional stock markets are observable. The moderate or high increase in performance slopes pose several challenges for predictive analysis, as they are influenced by other factors than conventional regulated market performance inferences. The results of this study are of intense interest to researchers and investors alike, as they demonstrate that investment slopes analysis sheds light on the intricacies of investment decisions, allowing a comprehensive assessment of both conventional markets and Bitcoin transactions.

Keywords: trust of blockchain; investment slopes; cryptocurrency; international finance; conventional markets; Bitcoin investment; investment reliability

MSC: 62P20; 91B84

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Citation: Aivaz, K.-A.; Munteanu, I.F.; Jakubowicz, F.V. Bitcoin in Conventional Markets: A Study on Blockchain-Induced Reliability, Investment Slopes, Financial and Accounting Aspects. *Mathematics* **2023**, *11*, 4508. https://doi.org/10.3390/math11214508

Academic Editors: Ioan Batrancea, Ramona-Anca Nichita, Lucian Gaban and Mircea-Iosif Rus

Received: 4 October 2023
Revised: 22 October 2023
Accepted: 30 October 2023
Published: 1 November 2023

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1. Introduction

In today's digital age, blockchain technology is being closely studied from a technical point of view and links to the Internet of Things (IoT) [1] as well as its impact on financial investment [2,3]. A secure blockchain is a distributed network in which information is stored as a chain-connected block. This innovative technology is based on cryptography and decentralization principles, ensuring high data security and integrity. Using cryptographic algorithms, the blockchain can help or face challenges in ensuring privacy and protection against fraud and manipulation [4]. The combination of cryptographic algorithms and consensus mechanisms enables a variety of uses for blockchain technology, such as the development of applications with enhanced security, blockchain distribution networks, intelligent grids or digital financial systems.

Previous studies indicate that blockchain technology reveals new operational opportunities for financial service providers, considering the interest of conventional market agents in adopting the blockchain in operational trade, processing capabilities or reporting financial systems [5,6]. Server-based reporting systems, traditionally used in conventional markets, are under profound transformation [7], and blockchain technology is used not only as a trend, but also as a way forward for traditional market agents to achieve innovative operational advances and increased operational security. However, one of the most evocative immersions of blockchain technology into conventional markets is the innovative use of blockchain to create crypto-assets and the expansive attraction of investors to adopt blockchain currencies for investment portfolio diversification [2,8].

The widespread advances in blockchain technologies have shown that any context can present opportunities for those who focus on obtaining information. The innovative nature of blockchain technology, combined with the world of financial investments, has become fascinating and full of opportunities, risks and challenges [9]. As technology is constantly changing, information can be the key to success. Since the adoption of cryptocurrency, such as Bitcoin, the blockchain has quickly become an economic hotspot [8,10]. The challenge for regulators, financial institutions and the attraction of individuals to invest in blockchain technology has grown rapidly. However, along with the excitement of technological development and the breakthrough in the investment of crypto for portfolio diversification comes the stress of finding the right solutions to secure the gains and mitigate the losses. The search for appropriate solutions for investment requires inspiration and knowledge. Numerous recent research studies on emerging technologies have focused on key aspects of blockchain, such as security, reliability and trust in crypto investments.

Several research studies have addressed different perspectives on blockchain security and have drawn divergent conclusions [11] such as highlighting positive aspects, or elaborating on security concerns, challenges and risks. Studies point to the positive security characteristics of blockchain technology in accounting and corporate financial reporting [12], logistics and supply chain management [13], improving the operational efficiency of the health industry [14], increasing the compliance potential of companies in applied information sharing practices and safeguarding sensitive data [15]. Zamani et al. [16] investigated a series of blockchain incidents based on understanding the root causes, and formulated recommendations for prevention and security consolidation. Such security risks in blockchain technology surpass the widely debated regulatory insufficiencies and address aspects such as the permissionless of blockchain caused by restrictive network hashing power [17], poor design or vulnerability of smart contracts [18], suspicious or malicious breaches of currency blockchains [19] with the purpose of altering wallet addresses and digital wallet breaches [20]. Given the decentralization of blockchain technologies and the large number of parties involved and the association with different Internet of Things capabilities, researchers draw signals that all the risks associated with blockchain security are yet to be discovered.

The choice to invest in cryptocurrencies stimulated research in looking for answers regarding motivation, modernism, sustainable impact or ignorance [21]. Researchers have turned to game theory or capital market theory to understand and to analyze the complex decision-making process of investors in conventional stock markets. According to game theory, stock market choices may be understood similarly to playing a game, when a participant's actions are influenced by the actions of others [22,23]. The actions and the strategic choices of investors to buy, sell or hold certain portfolio assets are interconnected with market dynamics.

When it comes to predicting the flow of the supply and demand of stock markets or the values of future returns, the capital market theory was preferred by many researchers. Predicting a stock's expected return is related to systematic risk and market dynamics. According to the modern portfolio theory, developed by Harry Markovitz [24] and followed by many researchers since [25], an investment portfolio may be considered efficient if potential high returns may be attained at the lowest possible risk exposure. To achieve

efficiency, investors are advised to share common assumptions, borrow at risk-free rates and strive for the highest returns while maintaining a low propensity to risk.

However, the literature shows that conventional market theories seem to lead to divergent results when comparing similar principles to crypto assets investments [26–28]. The complexity of investment trends assessment or prediction is undeniable. Finding unifying methods to assess complex portfolio investment trends, including both conventional assets and cryptocurrency, is a research gap that this study strives to fill.

Considering the complexities of motivation, associated risks and uncertainty attributed to cryptocurrency investments, this study followed a new research path. The diachronic evolution of conventional or unconventional assets included in investment portfolios can be comprehensively tracked using investment slopes.

The investment slope is a useful managerial tool for investment portfolio decisions [29] that can be applied to both traditional market assets and cryptocurrencies. Considering the conventional meaning of the investment line slope, which is the representation of the "rise" (change in investment) over the "run" (change in return), this study investigated whether the marginal propensity to invest in Bitcoin may be associated with conventional market investment scenarios.

Based on past known market trends and conventional market theory, the research question that this study investigated was whether the investment slopes in the conventional markets can influence the unconventional market of Bitcoin transactions, considering both normal market conditions and crisis times.

The novelty of this study is reinforced by the fact that, to the best of our knowledge, it is the first to provide a comprehensive and unified assessment of three major characteristics of the economic-intensive blockchain system in the context of conventional market imperfect conditions: reliability, investment slopes, financial and accounting aspects, ultimately determining confidence or risk in the choice of investing in cryptocurrency. This study of the relationship between investment slopes of BTC and conventional investments contributes to the literature in more than one way. The analysis is calibrated to quantify to what extent investments in BTC would provide economic returns as to observe incentives of the impact of conventional regulated investment trends, complementing the context with empirical assertions on consumers' trust, reliability of the blockchain, regulatory incentives and financial crises. The investment slopes analysis offers a set of practical methods to assess market trends comprehensively and promptly. Additionally, the study actively contributes to building a unifying image of investment markets, whether conventional or unconventional. Evocative empirical assertions are highlighted to deepen the understanding of the intricate context of investment decisions.

An analysis of the evolution of Bitcoin investors' behavior in the market was developed, dividing these evolutions into three investment slopes: (a) the decrease slope reflects investment losses; (b) the moderate increase slope is the period of investment revival for up to 10% in investment returns; (c) the high increase slope represents a high increase in investment profitability (>10% compared to the bottom of BTC investment). By examining the slopes of Bitcoin since 2014 in the context of conventional markets, atypical developments may be observed, with steep rises and falls compared to other conventional investment assets of regulated markets. In these conditions, it is necessary to deepen the analysis of the possible causes, correlations and determinants of cryptocurrency developments in relation to the profitability slopes of other investment assets.

The empirical analyses investigated the following research hypotheses:

Hypothesis 1 (H1). *There is a correlation between the evolution of investment slopes of BTC compared to other conventional market assets.*

Hypothesis 2 (H2). *The evolution of the investment slopes of conventional regulated markets influences the evolution of the investment slopes of the blockchain market represented by BTC.*

2. Literature Review

2.1. Reliability and Trust in BTC Investments

Reliability is an important parameter of the blockchain [30] and a crucial issue in the investment world [31]. Investors are looking for assets or instruments that give them confidence in maintaining their value and performance over time. The secure blockchain brings a new dimension of reliability in the transactions and transfers of digital assets such as Bitcoin. By their nature, secure blockchains eliminate the need for central intermediaries, such as banks or financial institutions, to validate and confirm transactions. Transaction validation is performed by a decentralized network of nodes, which in theory reduces the risk of human errors and fraud. Studies show that these beneficial aspects of decentralization are outweighed by the risks associated with the security of globally dispersed blockchain networks [16]. With no proper centralization of data, i.e., no unitary control system, the principle on which blockchain technology is based is that of trust between participants in the network concerned. Therefore, secure blockchains can be regarded as tools based on investors' trust in the activities of other participants in the blockchain network. Blockchain technology offers a reliable solution for the preservation and transfer of digital assets, with the potential to improve accounting activities [32]. Nevertheless, the absence of unified control over the entire operations between network nodes creates room for ethical deviations and incompatible competitive behavior [33].

As a result, confidence acquires dual importance in the financial investment sphere. On the one hand, the trust in the blockchain system is given based on the principle of transparency and certainty, relying on the users' perception, experience and affectivity towards the blockchain [34]. On the other hand, trust can be quantified by the confidence given by the willingness of many individuals to invest time or capital in cryptocurrencies [35,36]. Trust is dependent on the collective interest of the participants [37]. If the common interest in achieving the financial performance of the entire blockchain system is known and protected by blockchain-specific data protection rules, the common interest of participants may be reflected in the direction of increasing the reliability and performance of the cryptographic investment network. However, if the interests of individuals are channeled towards obtaining their own benefits without considering the common-sense principles of the blockchain, the risk of fraud or security breaches may occur, with the consequence of affecting the security of blockchain systems.

Most of past research focuses on blockchain security and privacy [38], risks and challenges [16]. Few studies have investigated the reliability and trust of data in blockchain technology [37] and even fewer have examined the need for a modern comprehensive theoretical framework in which blockchain technology may be integrated with conventional market understanding in the context of the adoption and development of cryptocurrency [39,40]. Our contribution to the literature is calibrated by an analysis of the relationship between the evolution of Bitcoin's investment slopes in the context of existing asymmetric market information, adding new insights to the literature concerning the choice and the trust to invest in cryptocurrency.

2.2. Cryptocurrency Complementing Traditional Investments Imprint New Challenges to Financists and Accountants

Interest in investigating the adoption of cryptocurrency for investment purposes is growing. Various studies have examined the use of Bitcoin in the diversification of investment portfolios [41–43] and offered divergent results. On the one hand, research finds Bitcoin to be a diversifier in an investment portfolio and not a hedge [26], highlighting BTC's significant influence of the spillover effect in relation to other assets [27,43]. Other studies show that Bitcoin can be considered a hedge over short-time horizons under extreme financial market conditions [42,44]. Corbet et al. [28] have analyzed the investment role of cryptocurrencies and have concluded that cryptocurrencies do not exhibit links with conventional markets.

Previous studies on BTC investments and sustainability impacts turned to agent theory or capital market theory [45] to build on the understanding of crypto investments choice and came to divergent conclusions. Traditional market theories, as we have known and experienced, require modern approaches to adapt and encompass the technological advancements that transpose to innovative new financial tools in investment markets. The rules that conventionally apply to traditional regulated markets seem to need enhancement as well as to incorporate cryptocurrencies.

The reality of recent years seems to show that nothing can prevent the innovation speed unleashed by cryptocurrency systems and their associated distributed ledger technologies being adopted globally by innovative businesses. Financial innovations generated by the expansion of virtual transactions were quickly accepted by individuals and new terms such as cryptocurrencies, stable coins, defi, NFT, CEX, DEX and ICOs were very quickly integrated into daily language [46,47].

Companies that are authorized to trade virtual currencies are obliged to protect the interests and the privacy of their customers. To ensure sustainable economic development [48] and reporting, economic operators are obliged to implement effective corporate governance systems and, thereby, systems to prevent, detect and accurately disclose financial information, nonconformities and financial crime risks [49,50]. Given the general challenges of regulating and defining terms specific to crypto markets, such tasks sometimes become difficult and can make a difference in attracting customers in a competitive environment.

The decision to invest has multiple implications, the financial or accounting being worth considering. Studies relating to the accounting aspects of cryptography systems [51,52] and taxation highlight the need for regulatory implementation or clarification regarding the financial treatment, reflection and reporting of cryptographic assets ownership and use. The rise or fall in investment portfolio returns actively influences financial indicators [53–56]. Conventional markets have strict regulations concerning when or how to reflect value fluctuation in financial reports. Crypto assets, on the other hand, have inhomogeneous regulatory approaches regarding when, who, how or if to reflect value fluctuation in financial reports. Understanding the propensity to invest in cryptocurrency, or comprehending the changes in investment slopes, are emerging topics regarding the relationship between conventional investment markets and crypto markets.

3. Research Overview

3.1. Methodology Framework

Bitcoin (BTC) was the first cryptocurrency, launched in 2009 and originally proposed as an alternative to the fiat currencies [57,58]. It has become a major force in the investment world, attracting the attention of both investors and regulators around the world [59]. At the same time, BTC operates in the financial markets and generates complex and diverse links with other conventional investment asset classes. BTC is independent of sovereign governments, banks and centralized institutions, and is also seen as an alternative to the inefficient economic and financial turmoil in global money markets [60].

This study investigated historical data related to multiple investment portfolio assets and strived to observe whether the traditional understanding of conventional market decisions may be applied to Bitcoin investments.

The investment slope is a useful managerial tool for investment portfolio decisions [52]. Considering the conventional meaning of the investment line slope, which is the representation of the "rise" (change in investment) over the "run" (change in return), the study investigated whether the marginal propensity to invest in Bitcoin may be associated with conventional market investment scenarios.

According to conventional market theory, it is expected that an increase in income should induce an increase in investments, pushing the slope upwards. A drop in aggregate income correspondently induces a reduction in investments and correspondingly imprints a downward trend to the slope. The slope of the investment line helps investors to understand the variations of the marginal propensity to invest. The rises and falls of the slope

indicate valuable insights on the relationship between income changes that might influence investment decisions.

Differently from previous studies, the analysis is carried out by reference to the initial investment period, January 2014. In this way, price changes between subsequent trading periods are given a fixed reference in the calculation of the rate of return.

The analysis flowchart is presented schematically in Figure 1.

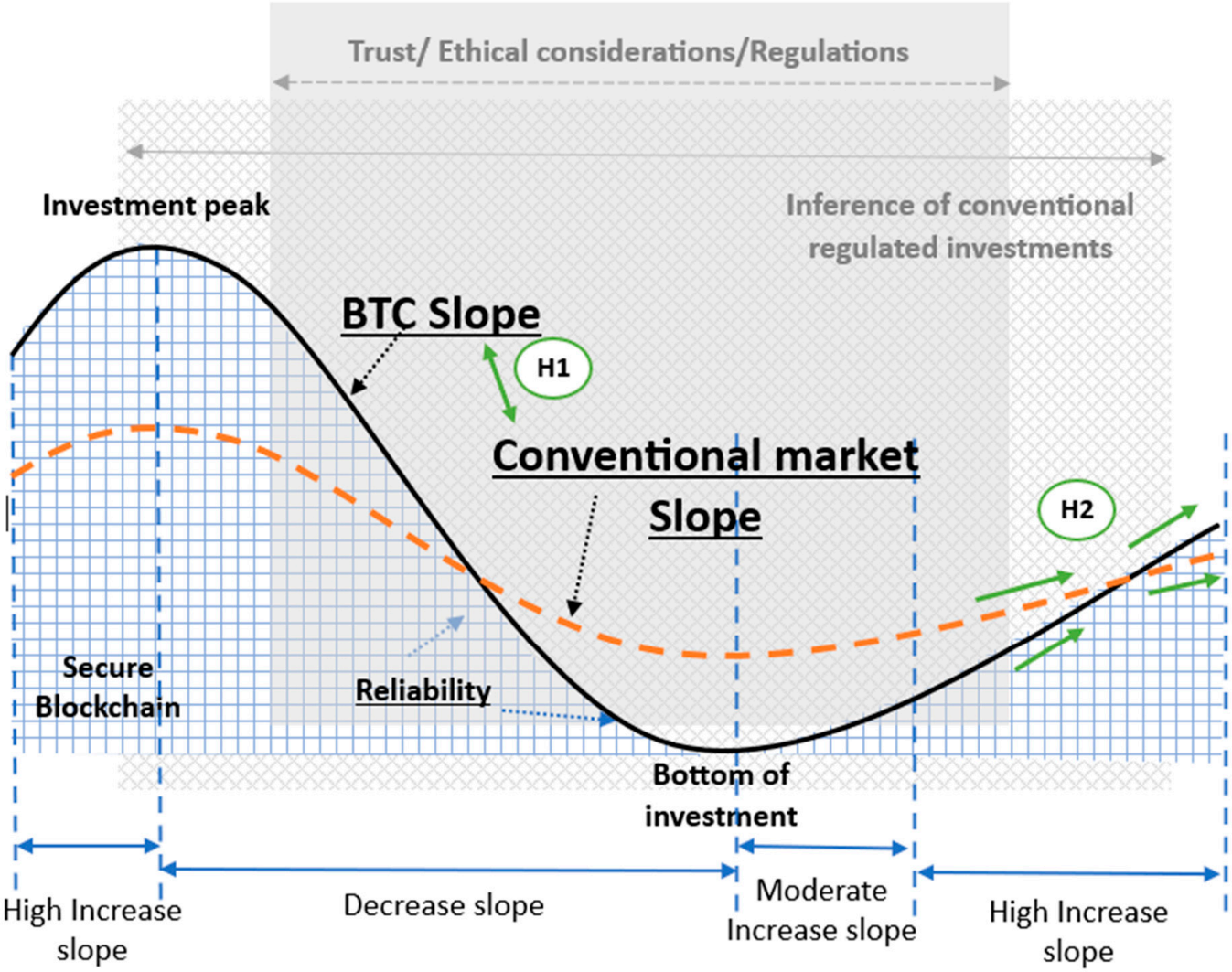


Figure 1. Scenario of investment slopes evolution given the inference of exogenous factors. Source: authors' conception.

In the cryptocurrency market, as in any market, a cyclical evolution can be observed, with a high and a low. The phenomenon known as the "investment peak" refers to a period of exponential growth in the value of a cryptocurrency that is followed by a significant correction. This peak can be generated and can be heightened or lowered depending on several factors, such as: increased demand, novelty, confidence in technological developments, various ethical considerations, regulatory shortcomings, media interest and developments in conventional financial markets. Blockchain's principles of security and transparency are designed to guide the emergence of peak BTC investment by increasing trust and adding a shade of reliability to the cryptocurrency market. To the extent that investors view the secure blockchain as a safe mechanism for storing and transferring BTC, confidence in the future of this cryptocurrency increases.

As more investors adopt BTC to diversify their portfolio and earn potentially high returns, demand for this cryptocurrency may increase significantly. In such circumstances, BTC can experience a rapid rise in value, leading to a peak in investment.

Complementarily, the "bottom of BTC investment" situation refers to the lowest point of a Bitcoin (BTC) investment period in terms of price and market sentiment. This is when the price of BTC reaches a low, and investors see it as an opportunity to buy or invest in the cryptocurrency in anticipation of a possible future increase in its value. The bottom of investing in BTC is often associated with a sense of pessimism in the market. Investors may be discouraged by the continued decline in the price of BTC, and some voices may express concerns about the future of cryptocurrency. This is when most panicked sellers and investors sell their BTC, causing the price to drop to a low. However, the bottom in BTC investments is also perceived as an opportunity by some more confident and experienced investors. They believe that despite the current decline, BTC has the potential to recover and grow significantly in the future. Therefore, they may purchase BTC at a lower price in the hope that it will increase in value over time. Identifying the bottom of BTC investments is a difficult task and there is no universal consensus on exactly how this occurs. The cryptocurrency market is volatile and influenced by a multitude of factors, including geopolitical events, regulations, technological developments and general investor sentiment. Therefore, the bottom of BTC investments can be identified in hindsight, after the price of the cryptocurrency starts to rise significantly.

3.2. Collection of Real-World Data and Preliminary Analysis

For the analysis of the economic impact of conventional investing assets on cryptocurrencies and blockchain algorithms, two datasets were analyzed: conventional investing assets and decentralized blockchain investing assets. The variables included in the representative dataset for conventional investing assets were represented by the weekly returns in commodities (gold and silver), stocks traded on the regulated stock exchanges NASDAQ, SP500 and Dow Jones Industrial Average market (DJIA), as well as fixed-interest securities traded on the Euro Bund. Bitcoin was considered as representative for the analysis of the investment character of cryptocurrencies, given the strong investment preference recorded globally. The analysis of all the slopes regarding the evolution of the assets' investment profitability was carried out by conversion into USD. The sample period was January 2014–April 2023. The data were obtained by accessing several sources, such as coinmarketcap.com, Yahoo Finance, nasdak.com and gold.org.

Data collection faced several challenges. Publicly provided data for conventional investment assets are presented on various platforms only on business days, unlike cryptocurrency information, which is provided daily. This imposes several challenges on comparable analysis, requiring careful filtering of the data. Given the decentralized and unregulated nature of blockchain investment assets, daily value differences were observed by comparing information provided by different platforms. As a result, the data were aggregated at the monthly level and the evolution of the prices of the investment assets analysis is reflected in Figure 2.

As Figure 2 shows, the volatility of Bitcoin is very high, and the trends of evolution of this virtual currency on the market seem very difficult to predict. As a result, the evolution of BTC's investment profitability presents several challenges in terms of analyzing the relationship with the evolution of the investment profitability of other investment assets. Additionally, the investment assets used in the market have different volatility by nature. Therefore, the study aimed to identify a method to standardize data on trends of decreasing, slightly increasing or sharply increasing profitability rates of investment assets, with the aim of developing an analysis of the impact of investment trends in conventional regulated markets on investments in BTC.

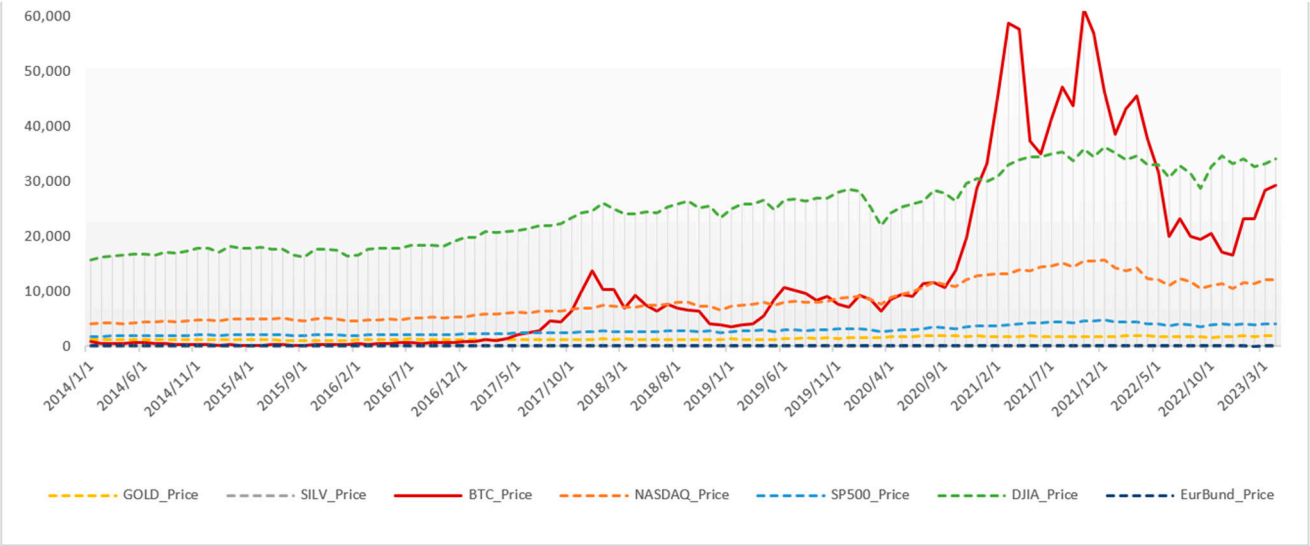


Figure 2. Evolution of investment performance of Bitcoin and regulated conventional investing assets. Source: authors' research.

3.3. Analysis of the Relationship between BTC and Conventional Markets

In an early stage, this study analyzed the relationship between BTC and conventional markets investment slopes, considering a series of economic aspects exogenous to the blockchain-secured trust chain, such as the inference of the evolution of the investment slopes of conventional regulated investments, trust, regulation or various ethical considerations impacting blockchain technologies.

The weekly series of the rates of return of the indicators included in the analysis were transformed into monthly indices of current evolution compared to the previous period, by aggregation steps:

$$I_{EVi_{1/0}} = \frac{\sum \overline{V}_{i1} - \sum \overline{V}_{i0}}{\sum \overline{V}_{i0}} * 100 \quad (1)$$

where $I_{EV_{1/0}}$ is the index of the current monthly evolution (1) compared to the previous period (0), by aggregation steps, calculated for each of the investment assets i included in the analysis; $\sum \overline{V}_i$ expresses the average rates of return-on-investment assets i.

A further stage of the study aimed to identify methods to standardize the information and facilitate the observation of correlations or determining relationships between assets. Starting from theory on investment slopes, the data standardization was achieved by transforming monthly profitability increases or decreases into categorical variables: 1 was assigned for a decrease, 2 for a moderate increase and 3 for a strong increase.

It is significant to mention that the determination of the moderate rise of the slope also underwent a series of intermediary stages to determine a significant threshold. Several scenarios have been tested to determine the range of moderate slope increase, or the upward slope of a relative increase between two subsequent periods when potential impactful decision change regarding portfolio investments could be observed. Multiple thresholds were tested, starting from 1% and going up to 10%.

The results obtained pointed to the use of three categorical variables: 1 was assigned for $I_{EV_{1/0}} < 0$, respectively, for declining slopes; 2 was assigned for $0 < I_{EV_{1/0}} < 10\%$, respectively, for a moderate rise of investment slopes; 3 was assigned for $I_{EV_{1/0}} > 10\%$, respectively, for a slope's increase > 10%. A total of 112 observations resulted for each variable included in the analysis.

The correlations between the categorical investment slopes were further explored, making it possible to identify valuable insights and to further develop a regression analysis of the impact of investment behavior in the regulated market on the blockchain technology used to issue BTC.

The study also considered two crisis periods as a dummy variable, where 1 was assigned for the crisis period and 0 for the economic lull periods. The period June 2015–June 2016 was considered as the first crisis period that massively and negatively influenced the conventional regulated markets globally [61]; the period was known as the Stock Market selloff. The crisis period generated by COVID-19 [62] and continued by the war in Ukraine was the second crisis period included in the analysis, with February 2020 being considered the beginning of the crisis and continuing until the end of the analysis period. A description of the analyzed variables is presented in Table 1.

Table 1. Descriptive statistics for real-world information of investments' performance slopes. Source: authors' research.

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Skewness (SE Skewness)	Kurtosis (SE Kurtosis)
Gold_EV	112	1	3	1.54	0.552	0.312 (0.23)	−0.970 (0.45)
Silver_EV	112	1	3	1.62	0.713	0.718 (0.23)	−0.725 (0.45)
BTC_EV	112	1	3	1.92	0.941	0.162 (0.23)	−1.871 (0.45)
NASDAQ_EV	112	1	3	1.83	0.721	0.267 (0.23)	−1.034 (0.45)
SP500_EV	112	1	3	1.77	0.629	0.221 (0.23)	−0.595 (0.45)
DJIA_EV	112	1	3	1.75	0.622	0.228 (0.23)	−0.584 (0.45)
EuroBund_EV	112	1	2	1.49	0.502	0.036 (0.23)	−2.035 (0.45)
Crises	112	0	1	0.46	0.500	0.182 (0.23)	−2.003 (0.45)

Description of variables: Gold_EV (evolution of performance investment slope for gold), Silver_EV (evolution of performance investment slope for silver), BTC_EV (evolution of performance investment slope for Bitcoin), NASDAQ_EV (evolution of performance investment slope for NADAQ stocks), SP50_EV (evolution of performance investment slope for SP500 assets), DJIA_EV (evolution of performance investment slope for Dow Jones Industrial Average market), EuroBund_EV (evolution of performance investment slope for Euro Bund assets), Crises (nominal variable for the economic crises: (1) the Stock Market selloff during June 2015–June 2016; the economic crisis generated by COVID-19 and the war in Ukraine during February 2020–April 2023).

The evolution of BTC's investment return slopes shows the highest standard deviation values, indicating that this investment asset showed the most pronounced changes in value between the monthly series during the analysis period. However, it can be observed that all indicators show values greater than 0.5 of standard deviations, indicating that all indicators have recorded statistically significant changes in the period under analysis. The skewness measures are positive for all the indicators analyzed, which suggests that, taken as a whole, over the analysis period, the developments of all the financial indicators analyzed showed upward trends. Kurtosis values indicate a flat distribution of the data.

4. Experimental Results and Discussion

4.1. Reliability Analysis

Reliability statistics for the indicators presented in the table above were tested using Cronbach's alpha. The obtained result of 0.704 shows a good applicability of the analysis in relation to the database.

Table 2 shows results on the reliability of the data analyzed using the Cronbach's alpha test, indicating acceptable results for Cronbach's alpha values if deleted, around 0.7.

Reliability statistics continued with the analysis of correlations between indicators, the tests being completed with a factor analysis using the principal component analysis (PCA) method.

Table 2. Item statistics for reliability Cronbach's Alpha test. Source: authors' results.

	Scale Mean If Item Deleted	Scale Variance If Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha If Item Deleted
Gold_EV	10.83	7.854	0.317	0.406	0.691
Silver_EV	10.76	7.266	0.354	0.410	0.686
BTC_EV	10.46	6.502	0.365	0.216	0.697
NASDAQ_EV	10.54	6.358	0.621	0.594	0.619
SP500_EV	10.61	6.619	0.655	0.900	0.619
DJIA_EV	10.62	6.633	0.660	0.881	0.618
EuroBund_EV	10.88	8.500	0.132	0.124	0.720
Crises	11.92	8.597	0.099	0.096	0.725

Source: own research.

4.2. Correlations Analysis of Investment Performance Slopes

The Principal Component Analysis (PCA) method can be used in the evolution analysis of Bitcoin (BTC) investment performance to identify and quantify important relationships and trends in market data [63]. The following paragraphs present some examples of the use of PCA in this context.

Dimensionality reduction: PCA can be used to reduce the dimensionality of the BTC investment performance dataset. By identifying principal components, which are linear combinations of the original variables, PCA can help reduce the number of variables and simplify the analysis.

Identification of key factors: PCA can help identify the key factors influencing the evolution of BTC's investment performance. By identifying the main components with the highest eigenvalues, one can determine the factors that explain the most variation in market data, such as price volatility, trading volume or the influence of macroeconomic events.

Building an optimal portfolio: PCA can be used, complemented by other statistical methods, to build an optimal BTC investment portfolio. By using principal components as explanatory variables, portfolio optimization models can be enhanced by observing the relationships and correlations between different financial assets, including BTC.

Risk assessment: PCA can be useful in assessing the risk associated with BTC investments. By identifying the main components associated with volatility or system risk, specific risks and interconnections with other financial assets can be assessed.

This phase of the study focused on tracking the statistical mismatch between BTC and the rest of the conventional investment assets (Table 3).

Table 3. Correlation matrix of investment performance slopes and crises. Source: authors' results.

	Gold_EV	Silver_EV	BTC_EV	Crises	NASDAQ_EV	SP500_EV	DJIA_EV	EuroBund_EV
Gold_EV	1.000	0.605 **	0.050	0.007	0.166 *	0.134 *	0.138 *	0.229 *
Silver_EV		1.000	0.128 *	0.166 **	0.187 **	0.181 **	0.208 *	0.078
BTC_EV			1.000	0.136 *	0.351 **	0.318 **	0.381 **	0.103
Crises				1.000	0.091 *	0.053	0.051	−0.181 *
NASDAQ_EV					1.000	0.746 **	0.667 **	0.157 *
SP500_EV						1.000	0.931 **	0.079
DJIA_EV							1.000	0.050
EuroBund_EV								1.000

Note: ** indicates statistical significance at $p < 0.05$; * indicates statistical significance at $p < 0.1$.

Gold_EV (monthly increase in gold investment profitability slopes) has a strong positive correlation with Silv_EV (monthly increase in silver investment profitability slopes) (0.605) and a weak positive correlation with Euro-Bund_EV (monthly increase in Eurobund

investment profitability slopes) (0.229). This suggests that there is a direct positive association between gold and silver profitability growth, as well as between gold profitability growth and Euro Bund-traded securities.

BTC_EV (monthly increase in investment profitability slopes of Bitcoin) shows statistically significant correlations with NASDAQ_EV (monthly increase in investment profitability slopes of NASDAQ stocks) (0.351), SP500_EV (0.318) and with DJIA_EV (0.381). Statistically significant correlations were also observed between stock market developments, which were somewhat anticipated by the context of practical reality during the period under analysis.

It has been observed that there is no statistically relevant link between the evolution of BTC and investment assets in precious metals such as gold or silver, nor between BTC and Euro Bund.

To assess the adequacy of the sample variables for the PCA, we used the Kaiser–Meyer–Olkin (KMO) test. The result of 0.639 indicates a moderate adequacy of the sample for the PCA. The Bartlett test was used to test the null hypothesis that the correlation matrix is a unit matrix, indicating the absence of correlations between variables. Since ($\chi^2(21) = 396.303$, $p = 0.000 < 0.05$), we reject the null hypothesis and therefore there are significant correlations between the variables included in the analysis.

The application of the PCA method reduced the sample of variables to two main components, which together explain 63.68% of the total variance of the original variables. The two main components extracted are well represented on the two factor axes, as can be seen in Figure 3.

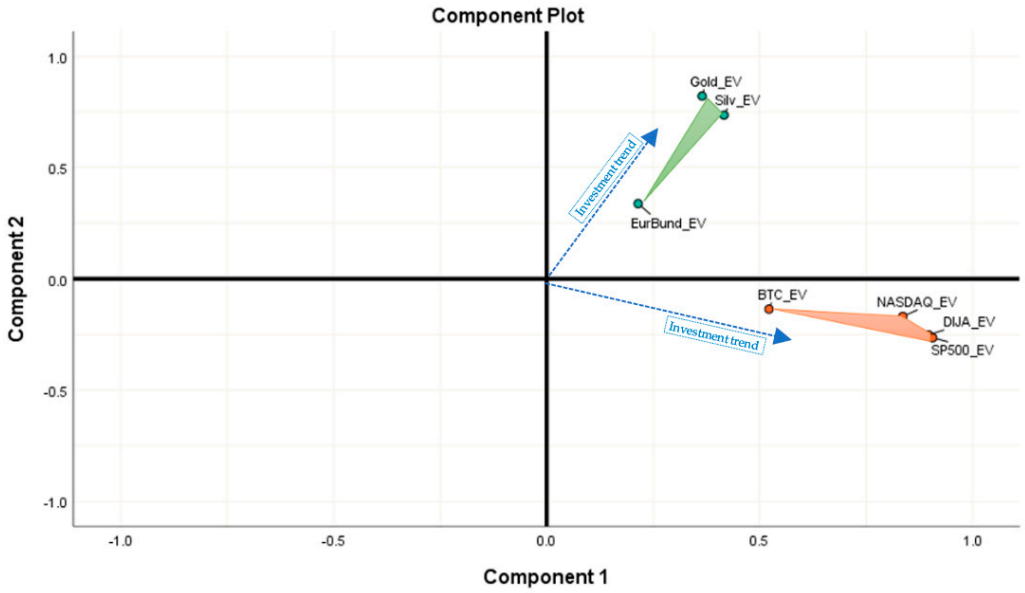


Figure 3. Component plot of investment performance analysis. Source: authors' research.

Although the results of the KMO test indicate moderate sample adequacy for the PCA, they could be improved to ensure better adequacy. Since the first hypothesis (H1) that this study assessed concerned the correlation between the evolution of investment slopes of BTC compared to other conventional market assets, the analysis pointed to interesting results. According to the component plot representation, the variables that showed significant relationships were BTC investment slopes, and the conventional investment slopes of NASDAQ, DJIA and SP500. The other set of variables that indicated no significant relationship to BTC, respectively Gold, Silver, and Euro Bund investment profitability slopes, were removed from the next steps of the analysis. After the elimination of the three variables, a new Cronbach's alpha test was run, and the value obtained of 0.802 showed a very good sample fit.

4.3. Multinominal Regression Concerning the BTC Investment Performance Slopes

The atypical developments of Bitcoin's profitability slopes compared to the rest of the investment assets required the development of a multinomial regression analysis [64,65] where BTC was considered as the outcome variable and NASDAQ, SP500 and DJIA developments were considered as predictor variables. The aim of the analysis was to examine the impact of the evolution of the conventional regulated markets' investment slopes on the evolution of the investment slopes of the blockchain market represented by BTC.

The regression model took as reference value 1 of the BTC evolution, respectively, the decreasing investment profitability slope in the monthly data series analyzed. The study considered the two crisis periods included into one dichotomous variable with two levels: 0 for normal periods, and 1 for crises.

Since multicollinearity is possible to occur in logistic regression, such occurrences should not change the estimates of the parameters, only their reliability [66]. According to the correlation matrix in Table 2, the coefficients showed no serious problem for multicollinearity among the explanatory variables used in the model. To extend the test for multicollinearity, we also verified the tolerance and variance inflation factor (VIF). The tolerance values obtained were close to 1 and the VIF values were less than 10, reinforcing the observation that there is no serious multicollinearity between the predictor variables. The Independence of Irrelevant Alternatives (IIA) assumption was tested with the McFadden Pseudo R^2 test (the result was 0.135), which indicates a very good model fit.

Figure 4 on the descriptive processing summary shows results on the number of cases analyzed and the distribution of the dependent variable, BTC_EV. The total number of cases analyzed is 112. The dependent variable (BTC_EV) has three distinct categories: 1 (decrease of investment profitability slope), 2 (moderate increase of investment profitability slope < 10%) and 3 (significant increase of investment profitability slope). Category 1 (decrease of investment profitability slope) comprises 54 cases (48.2% of the total cases), category 2 (moderate increase of investment profitability slope < 10%) comprises 13 observations (11.6% of the total cases) and category 3 (significant increase of investment profitability slope) comprises 45 observations (40.2% of the total cases). The investment profitability slopes of BTC reflect the high volatility of this cryptocurrency; hence, the very low number of category 2 slopes.

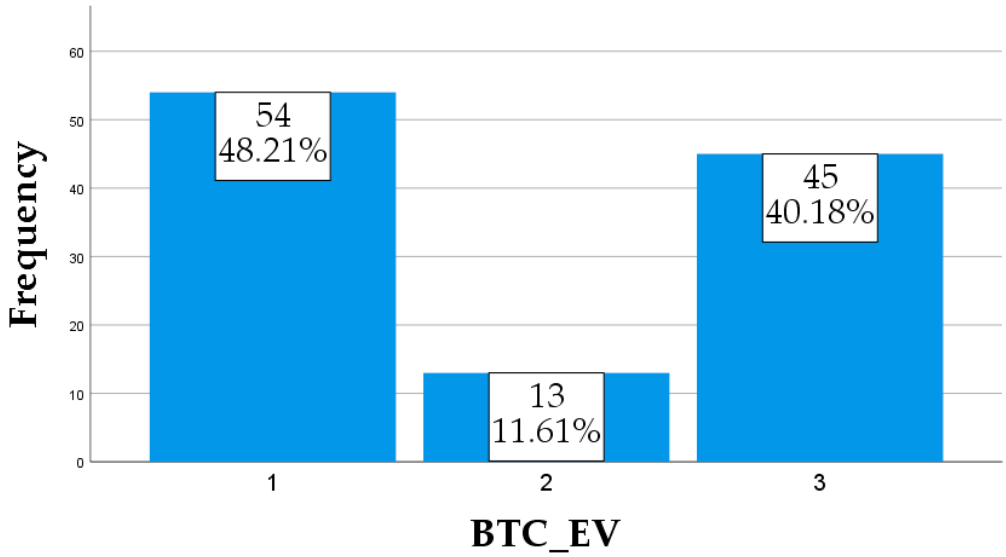


Figure 4. Descriptive summary of the evolution of BTC investment slopes. Source: authors' research.

We used the AIC and BIC criteria to fit the model (according to Table 4). Akaike's Information Criterion (AIC) is a fitting criterion that measures the relative quality of a statistical model, considering the number of parameters and the quality of the fit. The lower

the AIC value, the better the model is. Bayesian Information Criterion (BIC) is another fitting criterion that penalizes complex models more than AIC. Like AIC, a lower BIC value indicates a better model. Chi-square is the result of the likelihood ratio test. The test compares the final model (which includes an independent variable) with a simple model that includes only the intercept (a constant value). The *p*-value associated with the very small chi-square test (0.001) indicates a significant difference between the final model and the model with intercept only.

Table 4. Analysis of regression model fitting. Source: authors' results.

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	−2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	88.341	93.778	84.341			
Final	77.393	104.578	57.393	26.948	8	0.001

The final model (which includes the independent variables) has a lower AIC value and a higher BIC value than the model with the intercept only. This indicates a better fit of the data. The chi-square test also indicates that the final model is significantly different from the model with the intercept only (26.948).

In the goodness-of-fit analysis, the value of the chi-square test assesses how well the model fits the observed data. The Pearson chi-square calculated test ($\chi^2(26) = 17.588$, $p = 0.890 > 0.05$) and Deviance chi-square ($\chi^2(26) = 18.876$, $p = 0.842 > 0.05$) indicate that there is no significant difference between the observed and estimated values of the model. In conclusion, the model fits the observed data well, as chi-square tests find no significant difference between observed and model-estimated values (Table 5).

Table 5. Likelihood ratio tests. Source: authors' results.

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	−2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	95.186	116.934	79.186	21.793	2	0.000
NASDAQ_EV	78.429	100.177	62.429	5.036	2	0.081
SP500_EV	77.811	99.559	61.811	4.418	2	0.110
DJIA_EV	82.066	103.814	66.066	8.673	2	0.013
Crises	74.993	96.741	58.993	1.600	2	0.449

The chi-square statistic is the difference in −2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Likelihood ratio tests were used to assess the overall statistical significance of each effect (independent variable) in the final model. The conventional $p = 0.05$ threshold was used for interpretation. For each effect, the final model is compared with a reduced model omitting that effect. The null hypothesis is that all parameters of the effect are 0.

The output likelihood ratio test indicates the results of the likelihood ratio tests for each effect in the nominal regression. The *p*-values associated with chi-square tests indicate the statistical significance of each effect. For the effect "DJIA_EV", the *p*-value is 0.013, indicating a significant difference between the final model and the reduced model omitting this effect. In contrast, for the "NASDAQ_EV", "SP500_EV" and Crises effects, the *p*-values are 0.081, 0.110 and 0.449, respectively, suggesting that these effects are not statistically significant.

Therefore, in the case of the effects of "NASDAQ_EV", "SP500_EV" and Crises, there is not enough evidence to support that these variables have a significant impact on the dependent variable in the adjusted model. In other words, there is no significant difference between the final model that includes these effects and a simpler model that excludes them.

It is also possible that these effects are influenced by other variables or have a complex and non-linear relationship with the dependent variable.

The estimated parameters of the model provided several interesting results on the monthly profitability developments of BTC relative to the profitability developments of conventional regulated markets.

The first set of coefficients in Table 6 shows the comparison between BTC profitability declines and periods with moderate-to-moderate growth potential, below 10% of blockchain assets. According to the results obtained at this stage of the analysis, none of the developments in the regulated stock markets were identified as significant to make a statistical contribution to change the declining trends of BTC profitability into moderate increasing trends.

Table 6. Parameter estimates calculated for the BTC performance investment slopes. Source: authors' results.

BTC_EV [a]	B	Std. Error	Sig.	Exp (B)	Dependent Category
Intercept	−1.980	1.048	0.059		2 = Moderate increase (<10%)
NASDAQ_EV	0.066	0.695	0.924	1.069	
SP500_EV	−1.542	1.950	0.429	0.214	
DJIA_EV	1.751	1.852	0.344	5.761	
Crises	0.378	0.633	0.550	1.460	
Intercept	−3.481	0.853	0.000		3 = High increase (>10%)
NASDAQ_EV	1.008 *	0.486 *	0.038 *	2.740 *	
SP500_EV	−2.522	1.348	0.061	0.080	
DJIA_EV	3.206 *	1.297 *	0.013 *	24.669 *	
Crises	0.577	0.467	0.216	1.781	

[a] The reference category is: 1 (decrease of BTC rate of return). Note: statistical significance (*) is analyzed at $p < 0.05$.

The second set of coefficients examines the link between downward trends in BTC profitability and pronounced upward trends in BTC profitability, considering developments in conventional stock markets. According to the results, the developments of the NASDAQ (B = −1.069, s.e. = 0.486, $p < 0.05$) and DJIA (B = −3.206, s.e. = 1.297, $p < 0.05$) stock markets were identified as statistically significant predictors of the model, able to create a significant context for the evolution of BTC profitability in the sense of increasing the prospects of positive developments of the blockchain coin. The results of this study suggest that the significant upward developments of the NASDAQ and DJIA stock markets can be determinants of economic investment revival for BTC cryptocurrencies, in the sense of a sharp change in their profitability from downward to upward. Moreover, the comparative analysis of the statistical analysis with the empirical observations of market trends captured in Figure 2 seem to support these conclusions.

As regards to the nominal regression analysis with reference to the decline in the profitability of BTC in relation to its moderate or strong appreciation, the study showed that no statistically significant impact link could be established between them in the context of conventional stock market profitability developments and economic crises.

The classification table of the statistics (Table 7) shows to what extent the membership of one of the model categories could be well estimated. Trends in conventional regulated markets leading to a decrease in the value of blockchain assets represented by BTC received the best estimate in 87% of the cases; respectively, 47 downtrends out of a total of 54 could be correctly predicted. The results pointed to significant results for the second hypothesis (H2) of the study, shedding light on the understanding of the evolution of the investment slopes of conventional regulated markets and on the extent to which it impacts the evolution of BTC investment slopes.

The indicators included in the analysis could not lead to any prediction of moderate increases in BTC profitability, which is in line with the results of several studies that have shown that moderate growth developments of BTC cannot be related to the developments of some financial indicators of conventional regulated markets. As for the sharp increases in blockchain assets, the study could correctly predict only 44% of the situations according

to the factors of the stock markets included in the analysis, meaning that it correctly identified 20 situations out of the total of 45 initial observations. However, 87% of the predicted scenarios of a decrease in BTC profitability match the observed contexts, which indicates that a connection between the decreasing profitability of BTC can be linked to the downward trend of conventional market investments.

Table 7. Classification of predicted results. Source: authors' results.

Observed	Predicted			
	1	**2**	**3**	**Percent Correct**
1	47	0	7	87.0%
2	11	0	2	0.0%
3	25	0	20	44.4%
Overall Percentage	74.1%	0.0%	25.9%	59.8%

4.4. Related Works

The analysis developed by the present study provides new insights into the investigation of economic impact issues in the blockchain, by conducting a deep investigation of cryptocurrencies performance investment slopes in the global investment context. The results of the analysis of investment portfolios investigating the behavior of Bitcoin in relation to other investment assets are extensive. Complementing the studies by Klein et al. [3] or Dyhrberg [41], this paper extends the correlation analyses of Bitcoin with other investment assets, augmenting the analysis with real information from the NASDAQ, SP500, DJIA and Euro Bund financial markets. Our analysis focuses on investment slopes and supports the previous research findings of the diversifying nature of cryptocurrencies in investment portfolios [3].

The results of the present study are consistent with analyses showing that trust in cryptocurrency transactions is encouraged by the existence of government regulations [36]. The assumption that confidence in Bitcoin investments would be encouraged by government regulations, as is the case in conventional regulated markets, is validated by the observation of positive correlations between the evolution of Bitcoin investment slopes and those of conventional regulated stock markets.

Differently from other results obtained prior to the crisis generated by COVID-19 [28], our study identified statistically significant links between Bitcoin's investment slopes and the investment slopes of conventional regulated stock markets. Our analysis has prominently identified that in periods of declining profitability slopes, the degree of correlation with stock markets is more pronounced. Similarly, Dyhrberg [41] concludes that Bitcoin can be useful in managerial risk analysis, being a good predictor of negative financial market shocks.

The novelty of this study is complemented by the analysis of investment slopes of cryptocurrency in close relationship with those of several regulated conventional investment assets, with additional focus on the impact of economic crises. The results of the study did not identify a strong statistical link between the evolution of Bitcoin investment slopes and the context of the economic crises included in the analysis over the period January 2014–April 2023. The situation brings a new perspective compared to the peer-to-peer economic alternative or hedge approach of Bitcoin analyzed in periods prior to the global crisis generated by the COVID-19 pandemic which identifies this cryptocurrency as a viable alternative in times of economic crises [42,44].

4.5. Reflections on the Implications of the Study

This study is not focused on providing an all-encompassing cryptocurrency market context, but to highlight keyways to understand, explore and assess the evolving directions

for the investment profitability of BTC. The contribution of the study can be seen on three levels: theoretical, methodological and practical.

As the world of cryptocurrencies offers significant opportunities for entrepreneurs and investors, understanding how they can be used in the business environment can help entrepreneurs grow their businesses and maximize their profits. The literature review covered in this study aims to develop a theoretical framework capable of improving entrepreneurship education and understanding of the advantages and disadvantages of cryptocurrency and conventional market investments. Making informed decisions is critical for business and investments. Entrepreneurs can also identify sources of information on the use of blockchain technologies, which underpin cryptocurrencies, to improve business operations such as inventory tracking and supply chain management. Understanding market trends and developing unified assessment methods for reliability and risks associated with conventional or unconventional investments are extremely important for investors and the creation of empirical knowledge. The findings of this study alleviate investment stress, by highlighting significant relations between various traditional investment assets and Bitcoin, and by recommending unifying comprehensive methods to assess such relations and market trends, with a distinct focus also being set on crises. The analysis of market trends with investment slopes, the identification of a 10% threshold that allows the observation of significant relationships between the increase in Bitcoin slopes compared to conventional market slopes, accounting assessments that complement the study, contribute to building on the system of knowledge in financial markets.

From a methodological point of view, this study provides the identification of reliable statistical results verified with several statistical tests, complemented with empirical assertions and other research analogies. Due to the serious private nature of operations, the unpredictable evolution of the crypto market and the current lack of unified regulations, investing in crypto assets does not offer sufficient reassurance to offset the risks resulting from their purchase. The results of the study are consistent with previous studies that have developed different perspectives of analyzing crypto assets [67].

At a practical level, the study examines several challenges that cryptographic asset investments raise, both in terms of motivation, trust or decision to invest, and how or when to reflect on them in accounting. In business practice, accounting information is a business card, and therefore expanding empirical research can bring significant benefit to professionals and accounting practitioners in their need to adapt to the rapid advances in innovative technologies [52]. The results of this study are consistent with previous studies demonstrating that the high level of blockchain innovation and the dynamics of new asset transactions do not follow traditional economic patterns, consequently requiring accounting professionals to quickly improve their skills and knowledge [68] to anticipate and report accurately new client requirements. Additionally, practical problems are raised in relation to transactions with crypto assets, which pose various challenges in the calculation of fees and reporting obligations.

4.6. New Accounting and Financial Challenges of Cryptocurrencies in the Business Performance Context

This paper develops a quantitative approach based on real data from both conventional regulated markets and decentralized blockchain investment markets. The empirical findings of this study provide new insights into the determinants of the remarkable evolution of Bitcoin investments. Policy-makers must adapt to emerging economic phenomena and create legal frameworks for the definition, understanding and financial management of new concepts [69–72].

Since accounting's role is to accurately represent reality, the need to recognize new innovative virtual ecosystems is compelling and challenging [73]. Financial concepts that are considered universally valid and applied in practice require new definitions in recent years. The need for regulation has become a determining factor both for authorities and innovative businesses. Governments need to create and adapt the legal framework to new

monitoring and controlling requirements, concerned with the legality of market activities and the correctness of taxation. The increase in investment slopes may lead to an obligation to recognize taxable income in the accounts, which imposes payment obligations on the taxpayer. The timing, location or manner of taxation remains a challenge that governments face and are still trying to find solutions for. The impetus for profitability maximization leads innovative enterprises to implement new procedures to diversify their investment portfolio or financial operations by experimenting with new opportunities outside the conventional markets, such as crypto markets.

From a financial point of view, it is interesting to analyze the extent to which the accounting regulations for virtual currencies differ between their investment or exchange characteristics. The structure of crypto portfolios in accounting depends on the business understanding and attitude towards risks, trust and reliability in the blockchain technology.

The link between the development of crypto markets and the stimulation of new job creation, the potential of blockchain technologies to stimulate innovation and business competition or its potential to improve or challenge green finance opens new research themes.

5. Conclusions

Blockchain technology has reshaped the conventional understanding of investments and proposed a shift from centralized regulated investment networks to a decentralized, collaborative dimension encrypted by technology.

This paper examined the evolution of the investment slopes of Bitcoin in relation to the evolution of the investment slopes of gold, silver, the regulated financial markets NASDAQ, SP500, DJIA and the fixed-asset trading market of Euro Bund, during January 2014–April 2023. The analysis on factorial correlation and multinominal regression was complemented with empirical assertions on the evolution of Bitcoin investment slopes in the context of economic crises. Cryptocurrency investments are not necessarily a focal point for experienced or traditional investors, but more likely they attract new investors or technology-passionate individuals or companies. In such context, this study offers a set of comprehensive analysis tools to promptly assess the intricate potential connections between complex and variate investment opportunities.

The development of this study was spurred by the need to deepen the understanding of cryptocurrency investment slopes in the context of conventional regulated markets and economic crises. The paper provides new insights into understanding investor actions related to blockchains and offers practical perspectives for evaluating trust-based investment decisions. Findings guide the adaptation of motivational permissiveness in cryptocurrency investing.

The results of our study indicated that the trend in BTC investment presents a wide range of challenges in forecasting trends of the investment slopes. The present study was able to observe statistically relevant incentives and correlations of the propensity to invest in BTC compared to other conventional investment opportunities.

The economic need for green investments and the constant technological advancements show a continued need for the development of quantitative studies based on real data on both the evolution of regulated markets and the interaction between these markets and blockchain technologies or the adoption of cryptocurrencies. The need for regulation, understanding the principles of trust in blockchain, the financial implications and the technological or environmental limitations that blockchain raises are also future directions of study that need to be further developed.

Author Contributions: Conceptualization, K.-A.A. and I.F.M.; methodology, K.-A.A. and I.F.M.; validation, K.-A.A., I.F.M. and F.V.J.; formal analysis, K.-A.A. and I.F.M.; investigation, K.-A.A. and I.F.M.; resources, F.V.J.; data curation, I.F.M. and F.V.J.; writing—original draft preparation, I.F.M.; writing—review and editing, K.-A.A. and I.F.M.; visualization, K.-A.A., I.F.M. and F.V.J.; supervision, K.-A.A. and I.F.M.; project administration, K.-A.A. and I.F.M.; funding acquisition, F.V.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here: coinmarketcap.com, Yahoo Finance, nasdaq.com, gold.org.

Conflicts of Interest: The authors declare no conflict of interest.

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