Forecast Cryptocurrency Market Investments Based on Stock Market Performance

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ABSTRACT

This research, aiming to assess how the cryptocurrency market influences stock market performance, brings forth promising insights. It examines the US S&P500 daily index as the dependent variable, with daily Bitcoin price and volume as independent variables and daily US volatility index and oil prices as controlled variables from 2017 to 2021. The study, utilizing a simple regression model, reveals a notably negative impact of the cryptocurrency market on stock market performance, alongside an insignificant yet positive influence. Additionally, the US VIX and oil prices are found to negatively affect performance. These findings hold the potential to guide relevant stakeholders in leveraging the increasing popularity of cryptocurrencies to enhance stock market performance and foster economic growth.

INTRODUCTION

This study, which is novel in its use of conjoint analysis, delves into the factors that shape investors' decision-making processes regarding cryptocurrencies. While previous research has touched on the influence of various investment characteristics, this study takes a unique approach by identifying these characteristics and their classes through conjoint analysis using data from a sample population.

In assessing potential investments, investors often prioritize characteristics that can impact the success of their ventures. Some of the most pivotal factors in cryptocurrencies include profitability, anonymity, and convenience.

Profitability denotes the potential for financial gain from an investment. Given the rapid pace and volatility characterizing cryptocurrencies, investors may gravitate towards digital assets exhibiting a history of robust returns or anticipated future performance.

Anonymity is significant for confident investors in the cryptocurrency market. The ability to conduct transactions without disclosing personal identity can appeal to those who value privacy.

Convenience also ranks high among investor considerations. Cryptocurrencies offer easy online access for buying, selling, and trading, rendering them a convenient investment avenue. Moreover, cryptocurrencies can bypass intermediaries like banks in financial transactions, further enhancing convenience.

While Bitcoin pioneered cryptocurrency trading on international markets in 2009, the landscape has expanded to encompass over 1,500 alternative cryptocurrencies, or altcoins. Prominent examples include Ethereum and Litecoin. Despite their niche status, cryptocurrencies are viewed as potential long-term substitutes for traditional currencies.

Blockchain technology underpins many cryptocurrencies, including Bitcoin and altcoins. It is a decentralized and distributed digital ledger, ensuring secure and transparent transaction recording. Blockchain comprises interconnected "blocks" secured through cryptographic methods, forming an immutable record chain. This study elucidates how various cryptocurrency characteristics influence investor decision-making, including profitability, convenience, anonymity, security, and accounting practices. Researchers will employ conjoint analysis, a statistical technique, to dissect the different characteristics and their classes. II.

REVIEW OF LITERATURE

The significance of an efficient stock market has been widely acknowledged in scholarly literature. A well-functioning stock market ensures liquidity, reduces transaction and savings mobilization costs, enhances corporate governance, and bolsters international reputation. Over the past three decades, considerable research has been conducted on the determinants of stock markets [7].

These determinants influencing stock market performance can be categorized into three main types: fundamental, macroeconomic, and institutional factors. Fundamental factors relate to earnings bases [7] and valuation metrics both of which are posited to impact stock market performance (Iliev, 2010). Macroeconomic factors, on the other hand, encompass various drivers such as economic development, interest rates, inflation rates, trade openness, and financial intermediary development [8]. Institutional factors, a newer study area, include corporate governance, financial market liberalization, stock market integration, and government type [8].

Emerging markets, characterized by higher uncertainty and expected returns relative to developed economies, have unique stock market attributes [8]. Investing in these markets presents challenges such as susceptibility to financial shocks, significant transaction costs, and reduced transparency in the banking sector [8].

The emergence of the "Fintech Revolution" has significantly transformed the global financial system. Financial technology (fintech) aims to leverage technology in designing and delivering financial services to enhance accessibility [8][9]. Introducing cryptocurrencies within the international financial system addresses significant limitations of traditional banking systems and speculation in stock markets [8]. Cryptocurrencies offer investors benefits like low transaction costs, improved security, ease of use, decentralized transactions, and real-time settlement. With cryptocurrencies being legal in the US market, their impact on the economic and financial system, particularly on the performance of the US stock market, is anticipated to be significant [9], Understanding the impact of the cryptocurrency market as a determinant of stock market returns in the US is therefore crucial [8].

BACKGROUND

Prior to conducting a comparative performance analysis on cryptocurrency price forecasting techniques, we describe the DL-based prediction algorithms under consideration to draw attention to their advantages and disadvantages.

A. Simple Recurrent Neural Networks (SimpleRNNs)

Simple Recurrent Neural Networks (SimpleRNNs) have emerged as a solution to predicting financial market trends, which are traditionally reliant on past price changes. Unlike Convolutional Neural Networks (CNNs), SimpleRNNs possess memory capabilities essential for retaining past price data. These networks are designed to process sequential data like time series, employing individual cells with loopbacks. These loopbacks enable the network to repeatedly execute operations on input sequences, while an internal memory, referred to as a hidden state, stores past information. However, SimpleRNNs need help capturing long-term dependencies due to vanishing or exploding gradients in lengthy sequences. More sophisticated architectures like Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) have been introduced to address these limitations and improve performance.

B. Long Short-Term Memory (LSTM) Networks
An enhanced form of an RNN called an LSTM may identify long-term dependencies in addition to the hidden state that RNNs employ. It does this by utilising the cell state. The cell state represents the long-term memory, and the short-term memory is defined by the hidden state, as was discussed in Section III-A. The importance of the information to be remembered or forgotten is then determined by three different types of gates that are present in each LSTM cell: (i) the forget gate, which determines whether information from earlier time steps is retained or forgotten; (ii) the input gate, which specifies which new information needs to be stored in the cell state; and (iii) the output gate, which determines the LSTM cell's final output at each time step.

C. Gated Recurrent Unit (GRU) Networks
GRU, a more advanced and structurally simpler variant of LSTM, is designed for simplicity. In contrast to LSTM, GRU eliminates the forget gate to save complexity and the memory cell is not utilised, making it a straightforward and easy-to-understand option.

As a result, a GRU cell has two gates: the reset gate defines how much of the past information from the prior steps will be ignored, and the update gate specifies how much of the past information (from previous time steps) needs to be transferred to the next GRU cell.

D. Convolution Neural Networks (CNNs)

One of CNN's well-known benefits is the ability to perform automatic feature extraction from high-dimensional data (such as photos and movies). CNNs are renowned for their comprehensive image processing capabilities. Convolution and pooling are the primary layers of an in-depth CNN. Convolution is applied to the input data using a kernel to create a feature map; the kernel size is typically lower than the input data. Pooling is done following a convolution process to lower the dimension. Then, time series data is the main application for one-dimensional CNNs.

E. Bidirectional RNNs (BiRNNs)

In contrast to the previously stated DL models (SimpleRNN, LSTM, and GRU), data sequences in a BiRNN are processed forward and backwards. More specifically, these models use two layers: the first layer analyses the input data in reverse, while the second layer uses the data from beginning to end. The prediction accuracy is anticipated to increase when the input data is bi-directionally processed using two RNN layers.

DEVELOPMENT OF HYPOTHESES

Based on the literature review, this study proposes the following hypotheses:

H1. The cryptocurrency market has no impact on the stock market.

H2. Positive government attitudes toward cryptocurrency do not yield beneficial outcomes for the stock market.

Conceptual Framework

Including cryptocurrency in investment portfolios represents a significant development in the financial market landscape. Traditionally, financial markets comprised transactions involving stocks and bonds, with complex instruments like options, forwards, and futures subsequently introduced. The advent of cryptocurrency in 2008 marked a notable addition to the global financial system, with over 5000 cryptocurrencies currently available. Powered by blockchain technology, cryptocurrencies offer heightened security, decentralization, transparency, and borderless transactions, contributing to their rising popularity worldwide. Portfolio managers leverage cryptocurrencies as efficient investment tools to hedge against risk and capitalize on profitable opportunities, thereby diversifying risks and potentially enhancing returns. Markowitz's concept of abolishing idiosyncratic risk through portfolio diversification underscores the potential for including cryptocurrencies in portfolios to improve overall performance, particularly within the US economy.

Interlink between Cryptocurrencies and Stock Market Performance

Competitive financial markets afford advantages to buyers and sellers, enabling them to make informed choices. Such markets promote efficiency by reducing transaction costs and stock delivery time and fostering innovation in financial instruments. The relationship between the cryptocurrency market and the stock market mirrors this dynamic. Countries with negative attitudes toward cryptocurrencies may experience adverse effects on their stock markets. In contrast, those with positive attitudes offer opportunities for investors due to low transaction costs, borderless transactions, and transparency. Government and regulatory willingness to embrace innovations, new technologies, products, and strategies can enhance stock market performance.

DATA AND METHODOLOGY

This study, a continuation of the groundbreaking research by Komşuoğlu Yılmaz and Boydaş Hazar (2018) presented at the 2018 Istanbul Financial Conference, brings forth novel and exciting findings. By employing the conjoint method, a statistical analysis technique, our research delves into consumer preferences regarding specific product or property characteristics. This method serves as a valuable tool in predicting and scrutinizing customer inclinations, particularly concerning new product attributes or entirely novel offerings.

The fundamental tenets of conjoint analysis involve dissecting assets into their respective characteristics and assigning priority classes to each trait within a given asset selection. Our investigation identified five key factors: profitability, comfort, anonymity, security, and accounting. Subsequently, we delineated the potential classes for each characteristic pertinent to our study. The specifics of these characteristics and their respective values are outlined in the table provided in this study.

To forecast and analyze customer preferences regarding cryptocurrency, we employed conjoint analysis, a statistical method designed to discern how individuals assess various product or service attributes. This method is

instrumental in unravelling the factors influencing investors' decision-making processes when contemplating cryptocurrency investments. Our research reveals that the diverse characteristics of cryptocurrencies influence investor decision-making. We aimed to pinpoint the different classes of considerations that investors weigh when evaluating their expectations regarding cryptocurrency investments.

The study's findings underscore the significance of profitability, accounting practices, and security as pivotal factors shaping investors' expectations regarding cryptocurrencies. Among these attributes, profitability emerges as the foremost determinant for investors, as per our research. This underscores investors' prioritization of the potential for financial gain when assessing prospective cryptocurrency investments.

Furthermore, the survey data we've collected confirms that a significant number of investors anticipates increased returns from cryptocurrency investments. This implies that many investors view cryptocurrency as a high-risk, high-reward investment avenue. The insights derived from this study are not just theoretical, but can be transformative for cryptocurrency enterprises in understanding customer preferences and formulating marketing and product strategies accordingly.

Regarding security, blockchain technology assumes a central role in many cryptocurrencies, encompassing Bitcoin and altcoins. It serves as the mechanism facilitating secure and transparent transaction recording. Blockchain operates as a decentralized and distributed digital ledger, recording transactions securely and transparently. Each block within the blockchain contains a series of transactions and is linked to the preceding block through cryptographic means, creating an immutable chain of records. The cryptographic protocols employed in blockchain render tampering virtually impossible, thereby ensuring the security of transactions.

Moreover, blockchain's decentralized nature, devoid of control by any single entity, bolsters its security. This decentralization complicates hackers' attempts to target a singular point of failure and impedes censorship or blocking of transactions.

In conclusion, security in the domain of cryptocurrency investments is not a mere promise, but a tangible reality, thanks to the adoption of blockchain technology—a decentralized, distributed digital ledger that guarantees secure and transparent transaction recording. The cryptographic methods integrated into blockchain strengthen transaction security by deterring tampering. Moreover, blockchain's decentralized structure thwarts attempts to compromise transaction integrity or censor transactions, thereby enhancing the overall security of cryptocurrency investments.

Table 1: Characteristics and classes

Characteristics			Classes		
Profitability	Extreme	Elevated	Modest	Minor	Balanced
Convenience	effortless	Manageable	Modest	hard	Extremely hard
Anonymity	Anonymity	Pseudonymity	Pseudonymity	Linkability with hardy	Linkability
Security	Impossible	Elevated	Modest	Minor	manageable
Bookkeeping	Safe	Manageable	uncertainty	Inadequate standards	Inapplicable

A. Profitability

Profitability is a pivotal factor for every investor, serving as a gauge for the anticipated returns on their investments. In cryptocurrency, it denotes an investor's potential profit from involvement with a specific digital currency. This profit margin is determined by subtracting the acquisition price of the cryptocurrency from its current market value. The magnitude of this differential, often referred to as the spread, directly influences the level of profitability associated with the investment. A wider spread signifies a more lucrative investment opportunity.

To illustrate, consider an investor purchasing a cryptocurrency at $100 and observing its current market value at $200. In this scenario, the investor anticipates a profit of $100, equivalent to a 100% return on their initial

investment. Conversely, if the market value were only $110, the projected profit would be smaller. Understanding and monitoring profitability is imperative for cryptocurrency investors to make well-informed investment decisions and optimize their returns. The subsequent table elucidates the concept of profitability, delineating its diverse classifications.

Table 2: Definition of characteristics "Profitability" and its classes

Classes for the attributes: Financial viability
Extreme
An investor who is prepared to take on high levels of risk to explore high-risk, high-reward prospects like Bitcoin maybe someone who always demands extraordinary returns on their investments and cannot bear even a slight decline in earnings.
Elevated
To achieve their financial objectives, an investor who wants higher returns on their investments but is willing to accept some losses as long as the value of their cryptocurrency rebounds rapidly may be willing to assume moderate levels of risk.
Minor
If investors are content to make a profit, even if it does not exceed other investment options, they may be more risk-averse and value stability and safety over maximising returns.
Breakeven
Investors prioritising safety and stability over the possibility of better returns may primarily focus on minimising risk and protecting their initial investment. This investor type may be less risk-tolerant and content if they avoid losing money—even if they don't initially see higher returns.

B. Convenience

In this study, convenience pertains to the simplicity with which individuals can transition between traditional currencies, such as US dollars or Euros, and cryptocurrencies, and vice versa. This transition, commonly known as buying and selling cryptocurrencies, is crucial for investors seeking seamless exchanges between fiat currency and digital coins. It holds particular significance for individuals intending to engage frequently in the cryptocurrency market, necessitating access to exchanges that facilitate swift and efficient transactions. Table 3 elaborates on the various aspects of convenience associated with this exchange process.

Table 3: Definition of characteristics "Convenience" and its classes

classes for the characteristics: Profitability
Effortless
Investors may be informed about buying and selling cryptocurrencies if they can confidently trade fiat money for digital money on internet exchanges. This kind of investor might feel at ease with the possible risks and gains associated with cryptocurrency investments.
Manageable
An investor with a solid grasp of the market, the platforms and tools available, and the procedures involved in buying and selling cryptocurrencies through online exchanges may find the process simple.
Modest
An investor may find it challenging to use these platforms for buying and selling cryptocurrencies if they need help with trust concerns or making deposits to online exchanges.
Hard
Investors may be more risk-averse and value stability and safety over maximising returns if their top priorities are minimising risk and protecting their initial investment.
Extremely hard
An investor may encounter several difficulties if they cannot open an account with an exchange.

C. Anonymity

This study explores investors' inclination to maintain privacy and anonymity in cryptocurrency transactions. Anonymity denotes the capacity to dissociate a coin's transactions from the investor's identity, ensuring a

separation between them. When an investor's public key is employed in transactions, it is signed with a pseudonym rather than their actual name to uphold privacy. Table 4 delineates the various facets of anonymity associated with this attribute.

D. Security

Cryptocurrencies inhabit and function within the digital domain. The susceptibility to hacking and theft is a primary apprehension surrounding these virtual assets. This apprehension may dissuade investors who harbour reservations about entrusting their funds to cryptocurrencies, particularly if they perceive the network as vulnerable and their coins potentially at risk. Nevertheless, despite these security concerns, specific individuals may opt to invest. Table 5 furnishes additional insights into security and its assorted classifications.

Table 4: Definition of characteristics "Anonymity" and its classes

Classes for the characteristics: Anonymity
Anonymity
An investor who values privacy and needs complete anonymity while transacting with cryptocurrencies can prioritize looking for privacy-focused tools and coins.
Pseudonymity with hard
Privacy-conscious investors might want to prevent the public from seeing their cryptocurrency transaction history. They may permit regulatory agencies to connect their public key to their transactions through cutting-edge technology.
Pseudonymity
An investor may employ pseudonymized or anonymous cryptocurrencies and tools if they wish to conceal their true identity from the public but are okay if their coins' transaction history is made public.
Linkability with hard
Investors using privacy-focused coins and technologies may fear their transaction history will be connected to their true identity.
Linkability
Investors may use privacy-focused cryptocurrencies and technologies to safeguard their privacy if they are worried that their transaction history may be connected to their true identity.

E. Bookkeeping

The accounting practices for cryptocurrencies, a relatively nascent asset class, need more definitive standards. Presently, yet to be a universally accepted framework exists for the accounting and taxation of these digital assets. This deficiency holds significant implications, especially for institutional investors engaged in cryptocurrency transactions. For instance, when a company converts traditional currency into cryptocurrency for investment objectives, it becomes imperative to accurately document the transaction and fulfil any requisite tax obligations in the event of cryptocurrency value appreciation. Table 6 illustrates the concept of "bookkeeping" and its diverse classifications.

Table 5: Definition of characteristics "Security" and its classes

Classes for the characteristics: Security
Impossible
The investor is quite confident in the network's security and protocol, thinking it is unbreakable and that their coins won't be stolen.
Elevated
Investors understand that using online exchanges can be hazardous, even though they have faith in the network's security.
Modest
Although the investor is aware of the possible risks related to cybersecurity, he thinks he can lessen these threats by choosing his services carefully.
Minor
Because digital currencies are virtual and subject to the danger of electronic hacking, investors may be concerned about the theft risk.
Manageable

> Because digital currencies are virtual assets, there is a risk of theft and the potential for electronic hacking in the online community. As an investor, you should be aware of these risks.

EMPIRICAL FINDINGS

In this investigation, a convenient sampling technique was employed to disseminate 25 conjoint maps, formulated via an orthogonal design, among a cohort of 500 individuals. These individuals were not just randomly chosen, but were specifically selected for their deep familiarity with cryptocurrencies, reflecting the niche expertise of our target demographic. Their expertise was instrumental in the success of our research, necessitating the restricted size of the survey sample.

The constituent bundles, each holding a unique piece of the puzzle. These bundles, the culmination of our research efforts, provide a comprehensive understanding of the complex world of cryptocurrencies.

On the flip side of the bundle, a demographic survey comprising five questions—about age, gender, income, marital status, and education—was included.

In this investigation, participants ranked 25 cards in order of preference from highest to lowest. Based on this ranking exercise, the resultant data was transformed into preference points, ranging from 100 (indicating utmost favorability) to 0 (reflecting the least favourable), and subjected to analysis utilizing Marketing Engineering for Excel software—a tool explicitly tailored for scrutinizing market research data.

The initial analysis stage involved computing respondents' preference share values employing specialized software. Within Partworth tables, each characteristic's least preferred level is assigned a value of 0 across all respondents, while the sum of the most preferred levels for all traits equates to 100. The significance of a characteristic is gauged by the highest preferred value attributed to it.

The Partworth Respondent Preference table furnishes a comprehensive summary of respondents, characteristics, respondent classes, and their respective values amalgamated in conjoint analysis. As per the findings, the preeminent characteristic for most respondents was profitability. For 61% of the cohort, extreme profitability emerged as the paramount factor influencing cryptocurrency selection. Subsequently, accounting and security ranked second and third as the most crucial characteristics, respectively, whereas convenience and anonymity were deemed the least significant.

Upon computing the respondents' partial preference values, researchers simulated the prevailing market scenario by formulating two existing product options for further scrutiny. Given the many available altcoins, a unified profile was fashioned and designated "altcoin." These simulated scenarios were constructed by researchers considering the real-world attributes of Bitcoin [13] and altcoins [11].

Bitcoin is the most recognized cryptocurrency in the market, commanding a substantial 48% market share, while the remaining 52% is dispersed among over 20,001 different altcoins [15]. Research indicates that a "Top Choice" product could potentially seize 60% of the market share, potentially leading to a cannibalistic effect, particularly impacting Bitcoin. These findings imply that subpar cryptocurrency alternatives might encroach upon Bitcoin's market share.

In a pessimistic scenario, introducing a new cryptocurrency at inferior levels across all attributes yields markedly distinct market forecast results. The market share of the New Product Profile plummeted to 12%.

To construct a pie chart depicting investment distribution across various cryptocurrencies, we initially gathered real-time investment data from our app users, encompassing investment amounts and specific cryptocurrencies (e.g., Bitcoin, Ethereum, etc.). This data underwent processing and analysis utilizing analytical tools like spreadsheet programs like Microsoft Excel or Google Sheets. Raw data was inputted into the spreadsheet, where various functions and formulas were employed to organize and summarize the information. For instance, the SUM function facilitated calculating total investments in individual cryptocurrencies.
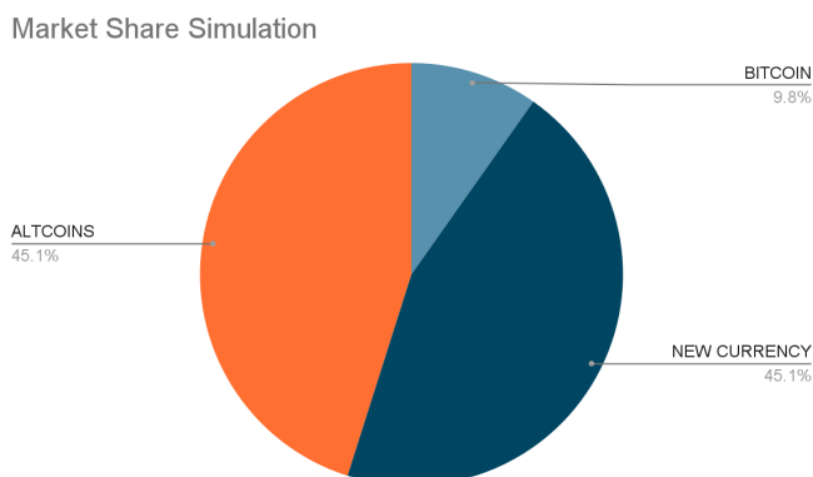
Fig. 1. Market share simulation

Upon cleaning and organizing the data, a data visualization tool, such as Excel's built-in charting tool or software like Tableau, was utilized to generate the pie chart. The "pie chart" option was selected, using the total investment data in each cryptocurrency as chart values [3].

The resultant pie chart clearly depicts the percentage distribution of total investments in each cryptocurrency, furnishing valuable insights into investment trends and user preferences within our app. This knowledge can inform decisions regarding cryptocurrency investments and aid in developing strategic plans for the app.

CONCLUSION

This study analysed daily data to investigate the impact of the cryptocurrency market on stock market performance from 2014 to 2018. It also assessed how income levels and adherence to Islamic Sharia rules influenced both markets, comparing Gulf to non-Gulf countries.

Empirical findings demonstrated a significant correlation between cryptocurrency movements and stock market performance. This indicates that fluctuations in the cryptocurrency market have a tangible effect on stock market activities, highlighting an interdependence between the two.

By employing the rigorous IV-GMM method, this study robustly identified that real GDP, oil production, and institutional quality positively influenced stock market performance across both Gulf and non-Gulf countries.

Regarding the impact of cryptocurrencies, the research revealed that a 1% increase in cryptocurrency returns resulted in a 0.15% decrease in stock market performance in Gulf countries. In comparison, it led to a 0.13% increase in non-Gulf countries. This divergence was attributed to the differing levels of adherence to Islamic Sharia rules. Gulf nations, upholding strict compliance with Sharia principles, view tangible assets as the foundation of economic transactions and prohibit speculative activities, including those involving cryptocurrencies. Conversely, non-Gulf countries exhibit more relaxed adherence to Sharia rules, allowing for greater integration of cryptocurrencies into investment strategies.

In Gulf countries, where adherence to Sharia rules is stringent, stock and cryptocurrency markets function as substitutes. Conversely, these markets tend to complement each other in non-Gulf countries with more lenient Sharia regulations.

During economic downturns, investors in Gulf countries tend to divest from the stock market and increase investments in cryptocurrencies. In contrast, in non-Gulf countries, the growth of the cryptocurrency market encourages investors to diversify portfolios, consequently expanding the money supply within the financial system and reducing reliance on informal economies.

This study sheds light on the intricate relationship between cryptocurrency and stock markets, providing valuable insights for policymakers, economists, and financial analysts. The findings underscore the influence of factors such as income levels and adherence to Islamic Sharia rules, offering a nuanced understanding of the dynamics at play.

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