

# Mapping influential factors in Bitcoin adoption: ISM and MICMAC study

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## Abstract

**Purpose:** The purpose of this study is to explore the factors that influence the acceptance of Bitcoin as investment among individuals and to construct a framework with the help of Interpretive Structural Modelling (ISM).

**Methodology:** The methodology is divided into three parts, firstly the determination of factors, consultation with experts, and the subsequent creation of a hierarchical model that is further classified by establishing the interconnectedness between these elements applying Interpretive Structural Modeling (ISM). This is then validated by Matriced Impact Croises Multiplication Appliquee a un classement (MICMAC) analysis.

**Findings:** The MICMAC analysis identifies Gender (G), Financial Knowledge (FK), Policy Support(PS), and Facilitating Conditions (FC) as key driving factor with significant influence. Conversely, Performance Expectancy, Personal Innovativeness, Perceived Trust, Perceived Value, and Attitude emerge as the top-level factors expressing the highest dependence power. The MICMAC analysis reveals that Gender, Financial Knowledge, Policy Support and Facilitating Conditions are driving factors, Personal Innovativeness emerged as dependent factor, while User Friendliness, Perceived Trust, Attitude etc. are among linkage factors highlighting their interconnectedness roles and influence within their framework.

**Originality/Value:** This is the first study to find out the factors influencing the adoption of Bitcoin. The model is developed using ISM and MICMAC which contributes to the originality.

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## 1. Introduction

“Invest” is described as allocating funds into financial plans, stocks, or real estate with the anticipation of gaining a return to dedicate one’s time or effort to a project with the anticipation of a beneficial outcome (Hwang & Fong Lee Cheng, 2011). The asset classes that are available to an investor are numerous from equity stocks to mutual funds to real estate and latest cryptocurrencies (Bekkers & Doeswijk, 2009). The rapid development of Digital technology has profoundly transformed global financial ecosystem, paving the way for innovative investment opportunities (Firmansyah & Agung Martono, 2023).

Among these Bitcoin and other cryptocurrencies have emerged as a revolutionary asset class, reshaping the investment scenario with their decentralized and transparent architecture (Mendoza-Tello et al., 2019). Cryptocurrency, also known as the virtual currency supported by Distributed Ledger Technology of the twenty-first century, operates through cryptographic codes and facilitates the transfer of funds between individuals or institutions via peer-to-peer networks (D. K. C. Lee et al., 2018; Zohuri et al., 2022). At the foundation of bitcoin is Distributed Ledger Technology, a decentralized and immutable system that depends on a peer-to-peer network of computers without solitary ownership (Guo & Yu, 2022). Miners are essential for certifying and authenticating transactions, and upon successful verification, they receive rewards in the form of currencies like Bitcoin (Niranjanamurthy et al., 2019). Blockchain has various uses, with cryptocurrency being a significant one that arose alongside Bitcoin in 2009 (Fang et al., 2022).

The literature indicates that since the inception of Bitcoin in 2009, it has evolved from a niche technological concept to an innovative financial instrument attracting investors seeking diversification with high risk and high return opportunities (Chaim & Laurini, 2018; Koutmos, 2020). Following Bitcoin, many tokens exist inside the cryptocurrency realm, including

Ethereum, Ripple, and others, which are widely considered essential investment vehicles that facilitate wealth building (Liu & Tsyvinski, 2021).

While Bitcoin's rise as an investment vehicle has been extensively documented, the factors influencing its adoption remains unexplored, specifically in terms of their interrelationships. Existing studies often address individual determinants such as risk perception, technology affinity but unable to provide a comprehensive framework that map these factors holistically. This gap limits the ability of financial stakeholders, policymakers and crypto-exchanges to frame strategies promoting investment in Bitcoin.

This study seeks to fill this gap by investigating the interplay of key factors that drive Bitcoin adoption as an investment tool. By employing Interpretive Structural Modeling (ISM) and MICMAC Analysis, the research constructs a multi-level framework that depicts the interdependence among dependent, independent, autonomous, and linkage variables. This framework offers a nuanced understanding of how individual, technology and institutional factors collectively shape investment decisions.

The contributions of this manuscript are multifaceted, offering novel insights. First, unlike prior studies that predominantly focus on theoretical constructs, this research integrates expert insights to construct a comprehensive framework. Secondly, the research introduces a systematic approach to analyze these factors by constructing a hierarchical model through Interpretive Structural Modeling (ISM) and thereby validating the results through MICMAC Analysis. Finally, the findings contribute to the discussion surrounding the classification of Bitcoin as a medium of exchange or speculative assets. Bitcoin is viewed as an investment asset, thereby reinforcing the assertion that Bitcoin is primarily utilized as a speculative investment. This calls for its underlying role in financial markets and highlight its potential as a high-risk, high-reward asset for portfolio diversification.

The paper is organized in the following manner. Firstly, the initial stage in this section is the introduction. Following that, the subsequent component of the article consists of the literature review (Section 2). Section 3 outlines the specific research methodology that was employed to obtain the study's conclusions. Section 4 focuses on the examination and interpretation of the data, as well as the outcomes obtained from the analysis. Section 5, covers the findings and their discussion. Section 6 of this work is dedicated to a conclusion, the limits of this study, and future research areas.

## 2. Literature review

### 2.1. Defining investment

The conventional interpretation of investment is characterized as “the act or procedure of investing an item deemed valuable for potential profitability”. “Invest” is described as allocating funds into financial plans, stocks, or real estate with the anticipation of gaining a return to dedicate one’s time or effort to a project with the anticipation of a beneficial outcome (Hwang & Fong Lee Cheng, 2011). The asset classes that are available to an investor are numerous from equity stocks to mutual funds to real estate and latest cryptocurrencies (Bekkers & Doeswijk, 2009). An investor considers rate of risk, return and liquidity of prime importance while investing. The risk of losing money on account of financial instability through investment is financial risk which is usually considered in financial services (Aren & Nayman Hamamci, 2020). Risk tolerance is the capacity to bear loss, harm or negative consequences in case of any event (Grable, 2000). Hanna (1996) stated that an investor’s capacity to manage risks could potentially be associated with personal attributes such as gender, age, investment time frame, liquidity requirements, portfolio magnitude, income level, investment expertise, and stance on market price variations. The difference between bid and ask prices in the capital market is return to the investor (Amihud & Mendelson, 1986b). Consequently, an investor must know the factors influencing the returns of any asset class such as inflation, liquidity, investment risk, and investment opportunity set (Marjohan et al., 2023). Liquidity is the ability of a firm to meet its short-term obligations allowing the sale of assets into the market at foreseeable price (Marjohan et al., 2023). Return, risk and liquidity are interdependent and are dominant while considering any investment instrument for portfolio. The role of liquidity in influencing asset pricing, market efficiency and corporate finance has been widely recognized. The vast majority of research on the liquidity of assets and the risks related to liquidity in asset returns focuses on the US market, widely acknowledged as the most liquid market globally, exhibiting a lower liquidity impact compared to other markets, notably emerging markets (Vo & Bui, 2016). The elevated yields demanded on stocks with greater spreads provide companies with a motivation to enhance the tradability of their assets, thereby diminishing the cost of capital, aimed at boosting liquidity could potentially enhance the firm’s worth (Amihud & Mendelson, 1986a). Pastor and Stambaugh (2001) found a correlation between projected stock returns and how individual stocks react to changes in overall market liquidity. Acharya and Pedersen (2004) in their

study demonstrates the impact of a detrimental disruption to the liquidity of a security, which, when enduring, leads to diminished current returns and elevated anticipated future returns.

## *2.2. Describing cryptocurrency and bitcoin*

Cryptocurrencies have undergone unprecedented growth since the introduction of Bitcoin by Nakamoto in 2008 transferring from a niche technology to the prominent financial asset class (Beretta, 2023). As of 2024, there are over 9000 active cryptocurrencies globally, reflecting the sectors' growth (Statista, 2024). Bitcoin and other cryptocurrencies have gained popularity as alternative investment vehicles offering opportunities for both passive and speculative trading (Hong, 2017). This is driven by the potential for significant returns which far exceeded offered by traditional investment instruments (Brière et al., 2015). Dasman (2021) found that Bitcoin demonstrated the highest rate of return at 18%, accompanied by a standard deviation (risk) of 61%, surpassing the returns from traditional assets like gold and stocks.

Despite the potential for lucrative returns, the cryptocurrency market is characterized by extreme volatility and operational risks, posing challenges for investors' seeking stability (Chaim & Laurini, 2018). Research indicates an inverse relationship between liquidity and expected returns. While Bitcoin exhibits similar features to High-Quality Liquid Assets (HQLA) in terms of accessibility and liquidity (Henriques & Sadorsky, 2018), its legal status remains contentious in many jurisdictions. As Bitcoin gained recognition for its intrinsic value and diverse application, their integration into mainstream financial markets may offer investors both opportunities and challenges.

Cryptocurrency and stablecoins both are digital assets. The examination of high-frequency and low-frequency stablecoin returns demonstrates that stablecoins do not exhibit consistent and reliable stability across all times, precisely, during instances when Bitcoin undergoes significant negative returns, stablecoins typically respond to these fluctuations, resulting in their instability during such intervals (Baur and Hoang 2021). According to Bouri et al., (2017) Bitcoin demonstrates considerable potential as a portfolio diversifier under most market conditions, offering investors unique avenue for reducing risk through uncorrelated returns. Bitcoin also exhibits hedging and safe haven characteristics although these attributes are not consistent across all time horizon. During significant market distress, Bitcoin served as a safe haven for specific currencies such as CAD, CHF, and GBP, yet it fails to provide safe haven attributes for other currencies (Urquhart and Zhang 2019). Additionally, (Urquhart and Zhang

2019) highlight Bitcoins' dual role at the intraday level, functioning both as a hedge against currency volatility and as a diversifier, providing investors with strategic flexibility within their portfolios. In comparison to other financial assets, cryptocurrency is highly volatile and, thereby, a highly risky instrument (Tetiana et al., 2022). Aliu (2020) found that Crypto-Index 20 has a stronger positive correlation and is exposed to higher volatility than European equity indices. Further, Urquhart and Zhang (2019) suggest deeper research into the relationship between Bitcoin and other financial assets. Unlike traditional fiat currencies regulated by central banks, cryptocurrencies operate independently making their value highly-susceptible to market fluctuations. Due to this fact, cryptocurrencies are considered as a kind of investment tool.

The global adoption of cryptocurrency continues to rise, with projections estimating 992.5 million users by 2028 (Statista 2024). Bitcoin in particular remains the dominant player, with ownership increases from 183 million to 210 million in 2023, accounting for 52% of global crypto ownership (Barbier 2024). Bitcoin holds a market dominance of 50.2% establishing itself as the most traded cryptocurrency (Live cryptocurrency charts & market data/coinmarketcap,2024). Given this prominence, it is essential to comprehend the nuanced factors influencing Bitcoin investments.

### 2.3. Research gap

Existing literature has primarily examined the Bitcoin adoption either as payment mechanism, an investment asset or in a broader context encompassing its multiple uses. However, a significant gap remains in understanding the interrelationships among the variables that influence Bitcoin adoption. These factors interact in complex ways, creating a web of dependence and driving forces that have yet to be systematically explored. Although empirical studies provide plethora of information on individual factors, a comprehensive framework that integrates these variables into a proper structure is lacking. This research is motivated by the need to bridge this gap by exploring the interplay of identified factors, thereby offering a holistic perspective on Bitcoin adoption.

This study seeks to achieve the following three research objectives:

**RO1.** To identify the key factors impacting the adoption of Bitcoin as an investment tool, leveraging insights from experts.

**RO2.** To measure the interrelationship among identified factors using Pairwise comparison and creating Structured Self Interaction Matrix (SSIM).

**RO3.** To develop a multi-hierarchical model of factors through Interpretive Structural Modeling (ISM).

**RO4.** To Classify the identified factors into distinct categories based on their Dependence and Driving power using MICMAC analysis.

### 3. Research methodology

The study begins with the identification of relevant factors influencing the adoption of Bitcoin. A deep reading of the finalized set of articles resulted in various factors that had a significant impact on the adoption of Bitcoin. The study adopts three-step research methodology:

- Finding out factors influencing the adoption of Bitcoin and concluding the list of factors by consulting experts.
- Developing the interrelationship among factors using pairwise comparison which was done by all the experts.
- Lastly, validation of model and evaluation of each factor using MICMAC analysis.

#### 3.1. Document selection method

The article selection process for this study focused on identifying high-quality research related to Bitcoin. The search was conducted using well-established databases namely 'Web of Science' and 'Scopus' which are renowned for their peer-reviewed publications. Keywords such as ("Bitcoin" OR "Crypto" AND "Adoption" OR "Acceptance") were used to filter relevant literature. To align with research objective, the search was restricted to peer-reviewed articles published in the English within the discipline of 'Business, Management and accounting'; 'Economics'; 'Finance' and 'multi-disciplinary' studies. This systematic approach initially yielded 120 articles. After an initial screening of title, a total of 60 articles were left. The inclusion criteria required that article specifically address the investment nature of Bitcoin; excluding studies focusing on other uses such as payment systems Full paper reading gave us final article 40 based on research questions.

#### 3.2. Factor selection scheme

The articles gathered for this study were analysed to find out the key antecedents influencing the adoption of Bitcoin as an investment instrument.

Given that cryptocurrency investment is a significant application of Blockchain Technology, and Bitcoin being the first and most widely traded cryptocurrency, expert opinions were incorporated to refine and finalizing the list of variables. A structured approach was adopted, beginning with the construction of a questionnaire based on the factors identified. This process was completed in two phases. The first phase involved a detailed discussion of the study's objectives and its importance. In the second phase, relevant factors were finalized by eliminating redundancies and merging components with similar meanings. Perceived expectancy, Profitability expectancy, and perceived usefulness were merged into Performance expectancy. Similarly, User-Friendliness, Ease of Use are merged into User Friendliness. Technology awareness, technological skills and affinity for technology interaction were merged into Personal innovativeness. Word of mouth, Peer Recommendation, Social media is merged into Social Influence. Financial literacy and education were considered into the Financial knowledge. Regulatory uncertainty and perceived government control were termed as Policy support. In the realm of Bitcoin, age may be perceived as less pertinent due to the market's accessibility, the learnability of the technology, and the fact that investment choices are primarily influenced by individual risk tolerance rather than age alone. Subsequently, it is found that research has specifically focused on the sample predominantly consisting of younger individuals; thus, the findings may not adequately represent the older demographic (Alaklabi & Kang, 2024; Bhilawadikar & Garg, 2020). Thereby, the role of age in the adoption of Bitcoin has not been studied well concerning all age groups. Research being more skewed towards the younger generation creates an unparalleled situation. Hence, the experts decided not to consider age in this study.

In all 11 factors were finalized for the study.

### *3.3. Identified factors of bitcoin investment*

Table 1 below describes identified factors impacting the adoption of Bitcoin as an investment tool.

Table 1 – Identified factors of Bitcoin Investment

Code	Factors impacting the adoption of Bitcoin as an investment	Description	Literature support
1.	Gender (G)	Gender disparities in technical education and computer science domains contribute to a dearth of familiarity with the technology known as blockchain. The perception of cryptocurrency investments as being highly volatile and risky leads to decreased adoption rates among women.	(Sukumaran et al., 2022; Smutny et al., 2021)
2.	Financial Knowledge (FK)	It indicates the ability to understand the financial terminologies which leads to better subjective financial knowledge. Better literacy improves the adoption rate of investing in blockchain-based cryptocurrency.	(Li et al., 2023; Marikyan et al., 2022; Bhimani et al., 2022; Aw & Chuah, 2023)
3.	Performance Expectancy (PE)	The extent to which a user receives benefits from adopting a specific technology. Blockchain features such as decentralization, anonymity, and investment performance are perceived as improving the performance of consumers.	(Bakri et al., 2023; Jegerson et al., 2023; Gupta et al., 2020; Del & Lopez, 2023)
4.	User-Friendliness (UF)	The ease with which users use new technology. Cryptocurrencies require technical knowledge and expertise to deal with wallets and exchanges. User-Friendliness significantly influences consumers' intention to invest in cryptocurrency.	(Del & Lopez, 2023; Bakri et al., 2023; Sukumaran et al., 2020; Gupta et al., 2020; Ali et al., 2021).
5.	Social Influence (SI)	The degree of influence an individual perceives from friends, family, and social media impacts their intention to adopt any specific technology. Positive feedback from friends and experts from social media highly influences the users' intention to invest in cryptocurrency.	(Scholarworks et al., 2022; Bakri et al., 2023; Anser et al., 2020; Gupta et al., 2020; Kumari et al., 2023).
6.	Personal innovativeness (PI)	The willingness of an individual to try new technology, an affinity for technology interaction, high awareness about technology, and technological skills are personal traits of user. Consumers with high innovativeness are more inclined towards the adoption of blockchain technology.	(Jegerson et al., 2023; Ali et al., 2021; Li et al., 2023; Namahoot, 2022; Sobhanifard & Sadafarizani, 2019).
7.	Facilitating conditions (FC)	The availability of required infrastructure and necessary resources to use new technology for the user act as a driving force. Facilitating conditions highly influence the users' intention to adopt technology.	(Bakri et al., 2023; Gupta et al., 2020; Jegerson et al., 2023; Kumari et al., 2023; Ali et al., 2021)
8.	Perceived Trust (PT)	The extent to which a user believes that the service provider is safe and secure to make any transaction. Trust in the technology or institution providing given services improves their intention to use that technology.	(Del & Lopez, 2023; Bakri et al., 2023; Gupta et al., 2020; Gupta et al., 2023; Lee et al., 2018).
9.	Perceived value (PV)	Perceived value is an evaluation of potential benefits or losses from using a certain product or service. Consumers' belief in the value provided by blockchain increases their intention to use that technology. Perceived value is considered as the perception of value by users associated with adopting cryptocurrency investment.	(Sukumaran et al., 2022; Bakri et al., 2023; Jegerson et al., 2023).
10.	Policy Support (PS)	Regulatory policies to direct and monitor cryptocurrency use impact its adoption. Adequate regulatory support reduces the mistrust caused by a lack of regulation. The speculative and unregulated nature of cryptocurrency reduces consumer adoption of specific services. Proper standards and guidelines regarding cryptocurrency in domestic countries can improve its adoption.	(Aw & Chuah, 2023; Frederiks et al., 2022)
11.	Attitude (ATT)	The belief that adopting a specific technology is favorable to users, a positive attitude develops. A positive attitude towards adopting cryptocurrency will lead to a higher intention of adopting it as an investment.	(Anser et al., 2020; Namahoot, 2022; Mazambani & Mutambara, 2019).

### 3.4. Expert profile

Individuals possessing a background in finance, in conjunction with those who engage in cryptocurrency investments, are acknowledged as experts for this research study. In the first round, 45 experts were shortlisted via LinkedIn (Al, 2024; Mishnick & Wise, 2024) based on their profiles and expertise in finance and cryptocurrency. Later on, a formal request was made to them to become a part of this study. Finally, 20 experts agreed to be part of this study. In the second round, a questionnaire was constructed (Figure 1 Questionnaire sample) and video conferencing was done via Google Meet where expert observations and critiques were collected. Using aggregate individual judgement inconsistencies in an individual's set of judgments were examined and the group asked an individual to consider revising one or more judgments when the inconsistency was deemed to be too high (Forman & Peniwati, 1998). Further, the heterogeneity observed in the responses of experts was systematically addressed through a series of iterative discussions, during which deviations were scrutinized and a consensus was pursued by means of majority opinion (Louisa Lam and Ching Y. Suen, 1997). On completion of the list of variables, input from experts was requested to demonstrate the interactive link among components using pairwise comparisons. The experts include 10 academicians, 5 financial experts, and 5 blockchain developers who are also the actual investors of cryptocurrency as mentioned in Table 2.

Table 2 – Expert Profile

Experts	Financial/ academia/ Blockchain developer	Position of Expert	Professional experience (Years)	Investment experience(years)
1	A	Finance researcher	5	7
2	A	Professor in Finance	12	5
3	A	Professor in Finance	10	5
4	F	Financial advisor	18	8
5	B	Wazir X-Trader & Investor	4	6
6	F	Financial counsellor	8	6
7	F	Financial counsellor	10	4
8	A	Finance researcher	6	2
9	A	Finance researcher	7	3
10	B	Marketing manager at Web3	5	8
11	B	Crypto asset manager	10	12
12	F	Financial counsellor	8	3
13	A	Professor in Finance	15	3

14	A	Finance researcher	4	2
15	A	Finance researcher	3	2
16	A	Professor in finance	10	4
17	F	Financial advisor	8	5
18	B	Crypto Investor and mentor	3	6
19	B	Fund manager	8	3
20	A	Finance researcher	7	3

### 3.5. Interpretive Structural Modeling (ISM)

Interpretive Structural Modeling is one of the multi-criteria decision-making techniques which is used to determine and explain relationships between specific variables. The ISM technique was established by Warfield, 1979. ISM is an interactive learning method that aids in discovering significant relationships among specified variables with the help of expert opinion in that specific field (Dube & Gawande, 2016a). Based on the inputs from expert knowledge and expertise, the matrix is constructed. ISM results in construction of a structured model expressing relationship among variables with the setting of a significant study construct. This evolves into a Structured Self Interaction Matrix (SSIM) which further leads to a reachability matrix (RM) and conduct level segmentation. After this, a digraph model and structural model are constructed to depict the identified relationships. Further, MICMAC analysis serves to validate the conclusions based on dependence and driving strength of components derived from the reachability matrix. The results of this analysis are used to make decisions to improve or solve any issue. Given the existing literature, the ISM approach has been used by researchers to identify core variables in their field. Sonar et al., (2020) applied ISM to identify factors that influence the additive manufacturing implementation in the Indian manufacturing sector. ISM technique has been applied in numerous research fields such as sustainability with innovation in small medium scale manufacturing (Mannan et al., 2016), individual financial well-being (Kaur et al., 2023), enablers of green supply chain management (Dube & Gawande, 2016a) and CSR in manufacturing industry (Bux et al., 2020). These research works have employed the ISM technique to discover the association among certain factors and create the structural model for decision-making.

### 3.6. MICMAC analysis

MICMAC stands for “matrix of cross-impact multiplication applied to classification”. The MICMAC approach is a technique employed in the realm of strategic management and decision-making, specifically within the domain of prospective analysis and scenario planning. It aids in the examination of interconnections and interdependencies among distinct variables within a given system (Bux et al., 2020; Dube & Gawande, 2016b). The primary aim of this technique is to categorize the components according to their influence and reliance. The driving power is calculated by summing the values of each element in the row, while the dependence power is calculated by summing the values of each factor in the column. The concept of driving and dependency power has been subdivided into four distinct components. The categorization of these four potential results is: (1) Independent factors which are represented by high driving power and low dependence power, (2) Autonomous factors represent low driving and dependence power, (3) Dependent factors represent high dependence power and low driving power, (4) Linkage factors represent high dependence and driving power. These four quadrants depict the influence of driving and dependence aspects of different variables on one another.

## 4. Results

### 4.1. Building Structured Self Interaction Matrix (SSIM)

By utilizing the factors identified in the previous stage, a contextual link is built for every pair of factors. An SSIM matrix is created using pairwise contextual linkages to illustrate the interconnections among the enabling variables of Bitcoin adoption. The matrix employs symbols V, A, X, and O. These four symbols represent the pairwise relationship between *i* and *j*, depending on the direction of the relationship.

- V: if ‘*i*’ leads to ‘*j*’, but not vice versa.
- A: if ‘*i*’ doesn’t lead to ‘*j*’ but ‘*j*’ leads to ‘*i*’.
- X: if both ‘*i*’ and ‘*j*’ are responsible for each other.
- O: if no relation exists between ‘*i*’ and ‘*j*’.

The SSIM Matrix was developed using the above symbols as given below in Table 3.

Table 3 – SSIM Matrix

Constructs	G	FK	PE	UF	SI	PI	FC	PT	PV	PS	ATT
G-Gender	X	O	O	V	V	V	V	O	O	O	V
FK-Financial Knowledge		X	V	V	O	V	V	V	V	O	V
PE-Performance expectancy			X	A	X	X	A	X	X	O	X
UF-User Friendliness				X	A	V	A	V	V	A	A
SI-Social influence					X	O	O	V	V	O	V
PI-Personal innovativeness						X	A	V	V	A	V
FC-Facilitating conditions							X	V	V	A	V
PT-Perceived trust								X	V	A	V
PV-Perceived value									X	A	V
PS-Policy support										X	V
ATT-Attitude											X

#### 4.2. Construction of Reachability Matrix (RM)

The table below presents an initial reachability matrix obtained from the SSIM matrix. This is achieved by transforming the values V, A, X, and O into binary digits 1s and 0s, following the specified rule.

	Marked	i leads to j	j leads to i
From I to j	V	1	0
From I to j	A	0	1
From I to j	X	1	1
From I to j	O	0	0

The final reachability matrix is developed using the transitivity rule. The rule of transitivity states that in a relationship between three parameters A, B, and C; if A leads to B and B leads to C, Then A must be related to C. An Indirect effect exists between A and C (Tables 4, 5).

Table 4 – Initial Reachability Matrix (RM)

Constructs	G	FK	PE	UF	SI	PI	FC	PT	PV	PS	ATT
G	1	0	0	1	1	1	1	0	0	0	1
FK	0	1	1	1	0	1	1	1	1	0	1
PE	0	0	1	0	1	1	0	1	1	0	1
UF	0	0	1	1	0	1	0	1	1	0	0
SI	0	0	1	1	1	0	0	1	1	0	1
PI	0	0	1	0	0	1	0	1	1	0	1
FC	0	0	1	1	0	1	1	1	1	0	1
PT	0	0	1	0	0	0	0	1	1	0	1
PV	0	0	1	0	0	0	0	0	1	0	1
PS	0	0	0	1	0	1	1	1	1	1	1
ATT	0	0	1	1	0	0	0	0	0	0	1

Table 5 – Final Reachability Matrix

Constructs	G	FK	PE	UF	SI	PI	FC	PT	PV	PS	ATT	Driving Power
G	1	0	1	1	1	1	1	1*	1*	0	1	9
FK	0	1	1	1	1*	1	1	1	1	0	1	9
PE	0	0	1	1*	1	1	0	1	1	0	1	7
UF	0	0	1	1	1*	1	0	1	1	1*	0	7
SI	0	0	1	1	1	1*	0	1	1	0	1	7
PI	0	0	1	0	1*	1	0	0	1	0	1	5
FC	0	0	1	1	1*	1	1	1	1	0	1	8
PT	0	0	1	0	1*	0	1*	1	1	1*	1	7
PV	0	0	1	1*	1*	1*	0	1*	1	0	1	7
PS	0	0	1*	1	1*	1	0	1	1	1	1	8
ATT	0	0	1	1	1*	1*	0	0	1*	0	1	6
Dependence Power	1	1	11	9	11	10	4	9	11	3	10	80

\* shows the transitivity link between two constructs.

### 4.3. Level partitions

The final reachability matrix is used to determine the reachability set and antecedent set for each factor. The reachability set of an individual factor encompasses other elements as well as itself, which it may contribute to achieving. Similarly, the antecedent set comprises the factor itself and other factors that may aid in its creation. Consequently, the overlap between these sets is computed for all factors. The factors for which the reachability and intersection sets coincide are identified as level 1 in the ISM hierarchy. Variables about level 1 are discarded and the process is repeated until all levels are determined to establish a multi-level hierarchical structure (Tables 6-9).

Table 6 – First iteration (Partition of reachability matrix)

C	Reachability set R = Ci	Antecedent set A = Cj	Intersection set I = R(Ci) ∩ A(Cj)	Level
G	G,PE,UF,SI,PI,FC,PT,PV,ATT	G	G	
FK	FK,PE,UF,SI,PI,FC,PT,PV,ATT	FK	FK	
PE	PE,UF,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,PI,FC,PT,PV,PS,ATT	PE,UF,SI,PI,PT,PV,ATT	1
UF	PE,UF,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,FC,PT,PV,LS,ATT	PE,UF,SI,PT,PV,ATT	
SI	PE,UF,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,FC,PT,PV,ATT	PE,UF,SI,PT,PV,ATT	
PI	PE,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,PI,FC,PT,PV,PS,ATT	PE,SI,PI,PT,PV,ATT	1
FC	PE,UF,SI,PI,FC,PT,PV,ATT	G,FK,FC,PS	FC	
PT	PE,FK,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,PI,FC,PT,PV,PS,ATT	PE,UF,SI,PI,PT,PV,ATT	1
PV	PE,UF,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,PI,FC,PT,PV,PS,ATT	PE,UF,SI,PI,PT,PV,ATT	1
PS	PE,UF,PI,FC,PT,PV,PS,ATT	PS	PS	
ATT	PE,UF,SI,PI,PT,PV,ATT	G,FK,PE,UF,SI,PI,FC,PT,PV,PS,ATT	PE,UF,SI,PI,PT,PV,ATT	1

Table 7 – Second Iteration (Partition of reachability matrix)

Constructs	Reachability set $R = C_i$	Antecedent set $A = C_j$	Intersection set $I = R(C_i) \cap A(C_j)$	Level
G	G,UF,SI,FC	G	G	
FK	FK,UF,SI,FC	FK	FK	
UF	UF,SI	G,FK,UF,SI,FC,PS	UF,SI	2
SI	UF,SI	G,FK,UF,SI,FC	UF,SI	2
FC	UF,SI,FC	G,FK,FC,PS	FC	
PS	UF,FC,PS	PS	PS	

Table 8 – Third iteration (Partition of reachability matrix)

Constructs	Reachability set $R = C_i$	Antecedent set $A = C_j$	Intersection set $I = R(C_i) \cap A(C_j)$	Level
G	G,FC	G	G	
FK	FK,FC	FK	FK	
FC	FC	G,FK,FC,PS	FC	3
PS	FC,PS	PS	PS	

Table 9 – Fourth iteration (Partition of reachability matrix)

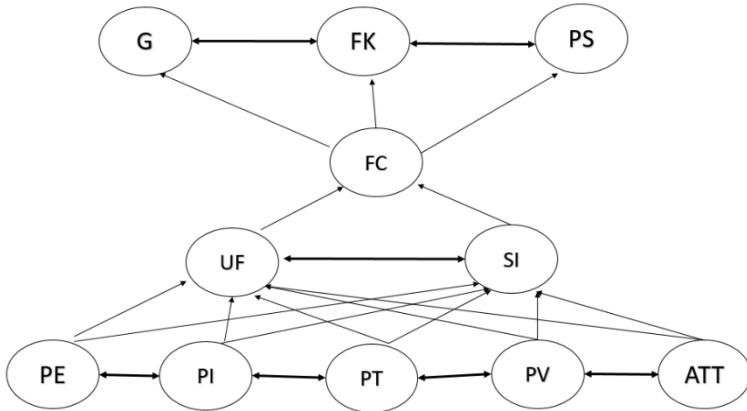
Constructs	Reachability set $R = C_i$	Antecedent set $A = C_j$	Intersection set $I = R(C_i) \cap A(C_j)$	Level
G	G	G	G	4
FK	FK	FK	FK	4
PS	PS	PS	PS	4

#### 4.4. Construction of Digraph and ISM hierarchical model

An initial digraph was generated using the final reachability matrix and level partitioning (Figure 1). The digraph has been prepared by method of nodes, vertices, and edge lines. In a digraph, an arrow from ‘i’ to ‘j’ denotes the relationship between ‘i’ and ‘j’ variables. The final digraph is converted into a hierarchical model based on the ISM framework. In Figure 2, we can observe the structural model that is derived from ISM, which represents the critical factors influencing the acceptance of cryptocurrency investment. From the ISM model (Figure 2); it is evident that Gender, Financial Knowledge, and Policy Support are situated at the foundational layer of the model (level 4), which signifies a substantial impact on the adoption of Bitcoin. This phenomenon can be ascribed to an unbiased methodology, an augmented level of financial Knowledge associated with higher educational achievement, and the continual requirement for legal backing from governmental institutions, all of which motivate investors to partake in Bitcoin ac-

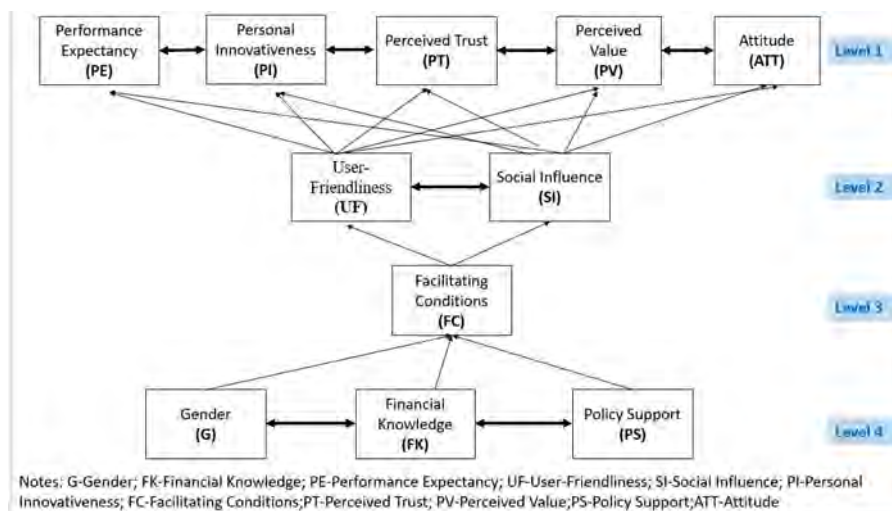
quisition. Scholarly literature has further underscored that Gender, Financial Knowledge, and Policy Support serve as pivotal determinants for the preliminary adoption of cryptocurrency (Sukumaran et al., 2022; Marikyan et al., 2022; Aw & Chuah, 2023)). The subsequent layer (level 3) encompasses facilitating conditions as enabling variables. The existence of these factors, delineated as facilitating conditions at level 3, will provide support for Bitcoin investment, thereby augmenting the adoption of Bitcoin as modulated by the factors at level 2. The components classified as performance expectancy, personal innovativeness, perceived trust, perceived value, and attitude are positioned at the summit of the model (level 1), indicating their relatively diminished impetus, necessitating institutional attention on these components following the implementation of the elements positioned below their level. Figure 2, illustrates that the factors of Gender, Financial Knowledge, and Policy Support are assigned to level 4. These components are vital in achieving facilitating conditions, thereby enhancing User-Friendliness and social influence (levels 3 and 2), which subsequently fosters the factors at Level 1, culminating in the adoption of Bitcoin.

Figure 1 – Digraph representing the relationship among factors of Bitcoin investment



Notes: G-Gender; FK-Financial Knowledge; PE-Performance Expectancy; UF-User-Friendliness; SI-Social Influence; PI-Personal Innovativeness; FC-Facilitating Conditions;PT-Perceived Trust; PV-Perceived Value; PS-Policy Support;ATT-Attitude

Figure 2 – ISM Model



#### 4.5. MICMAC analysis

Given by Godet (1986), the concept of MICMAC which stands for “matrix of cross-impact multiplication applied to classification”. The goal of MICMAC is to determine the driving and dependence power of the indicated factors. Further, the identified variables are classified into four quadrants (Figures 3, 4).

**Quadrant 1 – Autonomous factor (Nil)** These factors have low driving as well as low dependence power as shown in the first quadrant (Figure 3). The aforementioned factors exhibit a certain degree of disconnection from the system, as they possess only a limited number of links, which may not be particularly robust. The factors within this grouping lack any form of relationship amongst themselves. They neither exert an influence on other factors nor are they influenced by them. This research does not identify any singular factor that falls within this cluster.

**Quadrant 2 – Dependent factor (PI)** These factors have low driving power and high dependence power as shown in the second quadrant (Figure 3). Personal innovativeness falls into this cluster with the highest dependence power. Personal innovativeness can be seen as influenced by all other factors and therefore retained at the top of the hierarchy. Personal innovativeness is dependent on other factors when considering the adoption of Bitcoin as an investment instrument. Furthermore, personal innovativeness acts as primary

predictor of intention and usage towards Bitcoin, which is consistent with a study conducted (Jegerson et al., 2023; Kumari et al., 2023). Further, personal innovativeness can be induced by introducing certain policies, rewards and strengthening knowledge to initiate them to be part of this technology (Deci & Ryan, 1985; Schön, 1997). This will enhance its driving power.

**Quadrant 3 – Linkage Factor (PE, UF, SI, PT, PV, ATT)** These factors have high driving as well as high dependence power as shown in the third quadrant (Figure 3). The existence of these factors demonstrates the degree of interdependence among the factors. In addition to influencing other variables, these variables also influence themselves. Factors such as Performance expectancy, User-Friendliness, Social influence, perceived trust, perceived value, and attitude fall into this quadrant as linkage factors. These factors form a link with every other factor.

**Quadrant 4 – Driving/Independent factors (G, FK, PS, FC)** These factors have high driving power and low dependence power which makes them the most important factors. Factors such as Gender, Financial Knowledge, facilitating conditions and Policy Support fall into this quadrant (Figure 3). These factors have a strong influence on other factors. The findings from the previous studies have confirmed the influence of demographic variables such as Gender and Financial Knowledge (Arias-Oliva et al., 2019; Del & Lopez, 2023; Koroma et al., 2022).

Figure 3 – Diagram for driving and dependence power of enablers of investment in Bitcoin

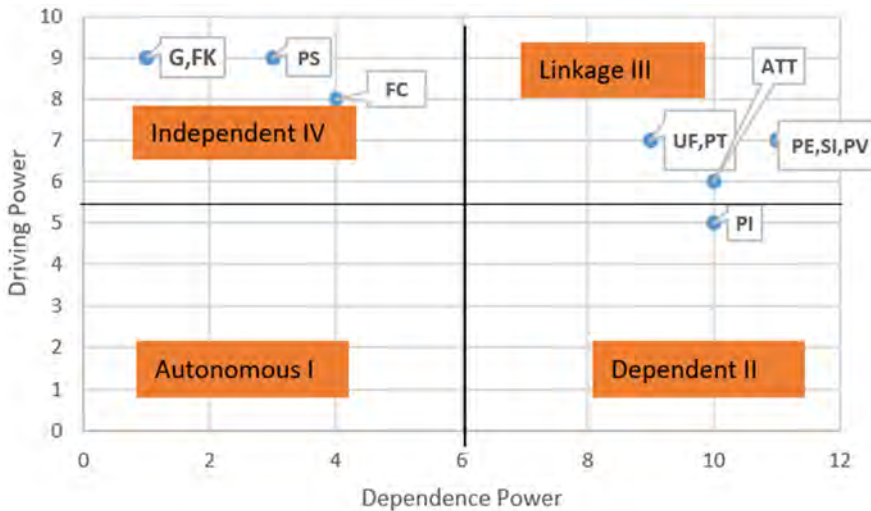
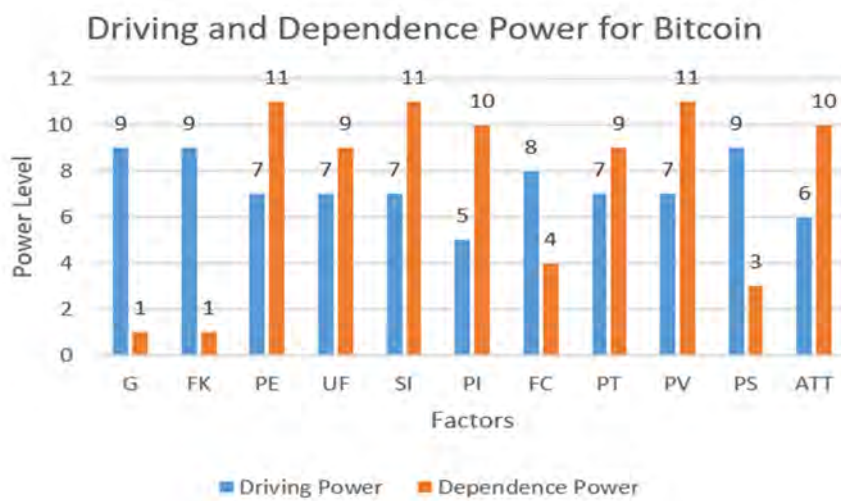


Figure 4 – Driving and Dependence Power for Bitcoin



## 5. Discussion and conclusion

Blockchain based on distributed ledger technology has many applications and one of the major applications that emerged with Bitcoin in 2009 is cryptocurrency. Cryptocurrency can be utilized for investment as well as payment. In the existing studies, it has been discovered that cryptocurrency as an investment tool is more suitable due to its volatile nature which assists in the development of wealth and portfolio diversity. Since the inception of Bitcoin in 2009, it has provided extraordinarily significant returns to its investors. Cryptocurrencies, like Bitcoin, is widely considered as a major avenue for investment, helping to the creation of wealth. Consequently, this study tries to detect the reasons that influence the acceptance of Bitcoin purely as an investment vehicle, while also studying the interconnection among these elements. To achieve this, an ISM-based methodology was established, drawing upon the knowledge of professionals who are also crypto investors from the fields of finance, academia, and blockchain technology. By doing so, contextual links among the identified elements that investors examine while adopting Bitcoin were explained. The ISM hierarchy model provides a visualization of the relationships between these components. The heterogeneity observed in the responses of experts was systematically addressed through a series of iterative discussions, during which deviations were scrutinized and a consensus was pursued by means of majority opinion.

The resolution of conflicting responses was achieved by applying weighted assessments contingent upon the level of expertise of each participant, thereby ensuring that the ISM/MICMAC model encapsulated a comprehensive and representative perspective.

Through the combined application of ISM and MICMAC analyses, valuable insights are generated regarding the relative significance of the identified factors that affect the adoption of Bitcoin as an investment vehicle.

Upon examining the driving forces and dependence on power, the analysis underscores that Gender, Financial Knowledge, Policy support, and Facilitating conditions are the fundamental factors that empower investment in Bitcoin with the utmost driving force. The fact that gender serves as a primary enabler of investment in Bitcoin underscores the importance of addressing gender-related concerns when contemplating investment. The discrepancy between women and men in terms of financial matters highlights the necessity of developing gender-specific financial interventions. These findings align with (Sukumaran et al., 2022; Sukumaran & Bee, 2022), which indicate that gender exerts a significant influence on Bitcoin adoption. This calls for future scholars to investigate the role of women in the cryptocurrency realm.

Another crucial determinant is the Financial Knowledge. Blockchain represents a nascent technology, necessitating a comprehensive knowledge of the cryptocurrency market and its associated terminology for effective investment. As Financial knowledge rise, subjective financial acumen improves, thereby indicating a more accurate assessment of the cryptocurrency market. The Financial Knowledge thus serves as a major driving force, corroborating the findings of (Abraham et al., 2019; Aw & Chuah, 2023; Bhimani et al., 2022). Policy Support and facilitating conditions also emerged as the driving factors in the context of Bitcoin investment. The regulations towards cryptocurrency are unclear. Regulatory support, effective laws, and policies are required by the consumers, this can foster the higher adoption of cryptocurrency, as found in a study conducted by (Regulation et al., 2023).

As depicted in Figure 2, within the ISM hierarchy model, there exist five elements positioned at the apex. Among these variables, personal innovativeness (PI) depends upon other criteria when investing in Bitcoin. Further, personal innovativeness can be induced by introducing certain policies to initiate them to be part of this technology. This will enhance its driving power. Future scholars are advised to conduct sensitivity analysis using this model.

Six characteristics are classified as linking factors, namely Performance expectancy, User-Friendliness, Social influence, perceived trust, perceived value, and attitude. These specific factors indicate significant driving force and substantial reliance power. They display an underlying relationship with

every aspect, rendering them fundamentally unstable. In addition to influencing other aspects, these factors also impact themselves. Consequently, investors must continually focus their attention on these issues while investing in cryptocurrencies. These findings align with Del & Lopez, (2023); Diéguez et al., (2023); Gupta et al., (2020); Sobhanifard & Sadatfarizani, (2019), which confirm the persistent role of these factors in the adoption of cryptocurrency as an investment instrument.

Further, the valuation of Bitcoin exhibits a pronounced susceptibility to market sentiment, predominantly influenced by news developments and social media discourse (Corbet et al., 2020). Favorable news reports can catalyze price increases, whereas adverse news may incite sell-offs (Coulter, 2022). The regulatory landscape governing Bitcoin demonstrates considerable variation among different nations. For instance, in jurisdictions where Bitcoin is officially acknowledged and regulated, investors may experience heightened confidence, potentially resulting in increased capital influx (Makoza, 2022). Conversely, in territories characterized by stringent or ambiguous regulations, the perceived risk escalates, thereby dissuading investment. Enhancing public understanding of the technological underpinnings of Bitcoin can elucidate the investment process and promote wider engagement. Moreover, economic indicators such as inflation rates, currency stability, and overall economic growth can significantly impact Bitcoin investments (Corbet et al., 2020). Investors may perceive Bitcoin as a safeguard against inflationary pressures or economic volatility, which can subsequently affect demand and, in turn, pricing dynamics.

The interaction among these variables can profoundly influence investment results. For instance, an advantageous regulatory framework coupled with optimistic market sentiment may result in a bullish trend, whereas adverse sentiment in the context of regulatory ambiguity could trigger significant downturns. Investors who grasp the dynamics of these interactions can enhance their ability to forecast market fluctuations and modify their strategies in response (Pham & Thi Nguyet, 2023). The impact of sentiments combined with the above factors can be a future direction in this field.

For the investors who seek risk, the investment in Bitcoin could be an alternative. The investment in Bitcoin promises higher returns compared to other investment instruments. For risk-averse investors, an investment in Bitcoin doesn't fit since this investment has the highest risk. This research has practical implications for the investors who require high returns. At the same time, investors also have to understand the risk along investment on Bitcoin. The cryptocurrency develops rapidly in this crypto world era. The role and regulation on cryptocurrency are needed to secure investors and economic growth.

## 5.1. Theoretical implications

In terms of theoretical implications, this research fills the identified research gap in the development of a comprehensive framework for the adoption of Bitcoin in the context of investment. By leveraging established theories like Innovation diffusion theory, UTAUT2, TAM, prospect theory, and consumption value theory, this research identifies a multitude of variables influencing adoption behavior. This multifaceted approach departs from a singular theoretical perspective, offering a deeper understanding of the interplay between factors specific to cryptocurrency as an investment tool. Furthermore, the combined application of Interpretive structure modelling (ISM) and MICMAC underlines methodological innovation, paving the way for further research on blockchain-based cryptocurrency within the investment landscape.

## 5.2. Practical implications

In terms of practical implications, this research offers valuable insights for various stakeholders in the cryptocurrency market. Firstly, the novelty of this research lies in elucidating the interrelationship among the factors influencing cryptocurrency adoption by examining the investment perspective, particularly in a study that can assist investors and institutions in developing more effective investment strategies. The identification of key components at four levels within the ISM hierarchy, further validated by MICMAC analysis, provides a roadmap for navigating this volatile landscape. Financial educators and policymakers can leverage this framework to develop targeted strategies that consider the interplay of these critical factors. Similarly, Web developers and crypto exchanges can utilize this knowledge to design user-centric applications and software tailored to address specific investor needs within the identified quadrants. Ultimately, investors themselves can use this framework to build informed investment strategies in a market characterized by high volatility.

## 5.3. General limitations

While this study provides valuable insights, it's important to consider some limitations. Firstly, the analysis focused on a set of eleven factors, potentially overlooking other relevant influences on Bitcoin adoption. Age being more skewed towards the younger generation has not been considered in

this study, thereby it needs to be explored from the perspective of mid-age group above 40 specifically. Other influential factors that invest in Bitcoin differently from other asset classes need to be explored such as trust in blockchain technology, the role of speculation, perception of limited supply of Bitcoin and global accessibility. Secondly, the identified relationships might be subject to research bias. The selection of experts and further interpretation of qualitative data in variable selection and relationship establishment can be subjective, impacting the final model. Thirdly, the study extracted the data from Web of Science and Scopus only, impacting the generalizability of the findings. Finally, while ISM and MICMAC techniques offer valuable insights, they lack the statistical output of some quantitative methods.

#### *5.4. Specific limitations*

The heterogeneity observed in the responses of experts was systematically addressed through a series of iterative discussions, during which deviations were scrutinized and a consensus was pursued through majority opinion. The resolution of conflicting responses was achieved by applying weighted assessments contingent upon the level of expertise of each participant, thereby ensuring that the ISM/MICMAC model encapsulated a comprehensive and representative perspective. Potential biases inherent in expert responses and the susceptibility of results to the decisions made during coding, underscore critical domains where additional research may enhance and corroborate the findings elucidated.

Although the results obtained are resilient, it is recognized that different coding frameworks may yield divergent interpretations of the dataset. Change in the proportion of factors could provide robust results. Sensitivity analysis could predict better results as the adoption of Bitcoin is sensitive to the new, media and policies. Personal innovativeness can be induced by introducing certain policies to initiate them to be part of this technology. This will enhance its driving power. Future scholars are advised to conduct sensitivity analysis and longitudinal study using this model.

#### *5.5. Future research scope*

This study opens opportunities for future research. First, exploring a wider range of variables influencing cryptocurrency adoption can enhance

the model's comprehensiveness. Trust in blockchain technology, role of speculation, perception of limited supply of Bitcoin and global accessibility can be explored. To overcome this barrier, future scholars can survey more experts from different backgrounds. Further, the role of news, media and policies concerning the identified factors can be explored keeping this study as a reference. Additionally, segmenting surveys by factors like generation, gender, region, and industry specialization could provide deeper insights into specific user groups. Furthermore, applying Structural Equation Modelling (SEM) could statistically validate the relationships identified in this study strengthening the model's foundation.

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**Ethical Approval:** Consent was taken from the experts. The manuscript should not be submitted to more than one journal for simultaneous consideration.

**Availability of data and material:** The datasets used and analyzed during the current study will be available from the corresponding author at reasonable request.

**Conflict of interest:** The authors declare that they have no competing interests.

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## Supplementary material

Figure 1 – Questionnaire sample

### Questionnaire

#### Guidelines for respondents

For each variable pair, the respondent should select the level of influence they believe exists based on the V, A, X, O scale. |

#### Explanation of symbols: -

1. V: if 'I' leads to 'J', but not vice versa (Strong influence).
2. A: if 'I' doesn't lead to 'J' but 'J' leads to 'I' (Reverse influence),
3. X: if both 'I' and 'J' are responsible for each other (Mutual influence).
4. O: if no relation exists between 'I' and 'J'.

Variables Gender (G) denotes Variable (I) Other variables (J)	1: I influence J (Strong influence)	2: J influences I (Reverse influence)	3: Both influence each other (Mutual influence)	4: No influence
Gender (G) ↔ Financial Knowledge (FK)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Performance Expectancy (PE)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ User-Friendliness (UF)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Social Influence (SI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Personal Innovativeness (PI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Facilitating Conditions (FC)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Perceived Trust (PT)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Perceived value (PV)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Policy support (PS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender (G) ↔ Attitude (ATT)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: The above format is continued for each variable