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The Role of System Security and Trust in Cryptocurrency Investment: Evidence from Indonesia

Jul Aidil Fadli[1], Toto Rusmanto[2], Yohannes Kurniawan[3], Yanthi Hutagaol-Martowidjojo[4]

[1]Management Department, BINUS Business School, Doctor of Research in Management, Bina Nusantara University, Jakarta, Indonesia 11480

[2]Accounting Department, School of Accounting, Bina Nusantara University, Jakarta, Indonesia 11480

[3]Information Systems Department, School of Information Systems, Bina Nusantara University, Jakarta, Indonesia 11480

[4]Finance (International Program), Accounting Department, School of Accounting, Bina Nusantara University, Jakarta, Indonesia 11480

jul.fadli@binus.ac.id; trusmanto@binus.edu; ykurniawan@binus.edu; yhutagaol@binus.edu

Abstract. This study aims to examine the role of system security and trust in driving cryptocurrency investments. An online survey was conducted with 216 active cryptocurrency investors aged 21-44 in Indonesia. The data were analysed using partial least squares structural equation modeling (PLS-SEM). The results reveal that system security has a significant positive effect on trust in cryptocurrencies. In addition, trust strongly influences investment in cryptocurrencies. However, no direct relationship was found between system security and cryptocurrency investment, indicating that trust mediates this link. These findings provide meaningful implications regarding how improving security and establishing trust can encourage cryptocurrency adoption in the Indonesian market. Specifically, enhancing transparent security protocols may nurture greater trust and confidence among investors.

Keywords: cryptocurrency, security, trust, investment

1. Introduction

Digitalisation has created new investment opportunities, including cryptocurrencies, physical assets, and currencies (Veerasingam & Teoh, 2022). Cryptocurrencies are also known as crypto assets with peer-to-peer digital value transfers that do not involve third-party organisations for transaction verification (Giudici et al., 2020). The inherent characteristics of underlying cryptocurrency models, such as transparency, immutability, auditability, and anonymity, promote their widespread adoption in the global economic market (Quamara & Singh, 2022). Furthermore, the diversification of investment opportunities in cryptocurrencies seeks new market alternatives for investors.

As digital assets, cryptocurrencies are well known for their volatility (Arli et al., 2021; Chaim & Laurini, 2018). Bitcoin, the first cryptocurrency, was introduced in 2009 at the price of USD 0.07. Since then, it has experienced a significant increase, culminating in an all-time high of USD 64,258.22 in 2019. Cryptocurrency values can be highly volatile, as evidenced by the case of LUNA, which reached an all-time high of USD 116.16 in April 2022, before plummeting to nearly USD 0 by the end of May 2022. Despite this volatility, cryptocurrencies have garnered widespread investor attention worldwide. In addition, many individuals have redirected their investment strategies to include cryptocurrencies in their portfolios (Dyhrberg, 2016).

According to data from Statista (2022), crypto asset trading in Indonesia in 2021 amounted to IDR 859.4 trillion, representing a notable increase of 1.223% from the previous year, when it was valued at IDR 64.9 trillion. Moreover, as of December 2021, the number of registered crypto-asset investors in Indonesia has reached 11,203,758, which further highlights the growing acceptance and utilisation of cryptocurrencies in the country.

The data above shows the increasing enthusiasm of cryptocurrency investors in Indonesia. Establishing trust among investors is a critical factor in promoting the acceptance and utilisation of cryptocurrencies. Both researchers and practitioners have acknowledged that without trust, entering business relationships is not a prudent course of action (Faqih, 2022; Gil-Cordero et al., 2020). Klein & Shtudiner (2016) emphasise that trust is a significant variable in risky investment behaviour. Investors not only engage in risky investments by purchasing risky instruments but also make risky investments their primary focus because they believe they comprehend the unknown. Consequently, it is intriguing to examine the impact of investors' trust as a determinant of cryptocurrency investments.

Investing in cryptocurrencies involves not only the potential for returns but also the evaluation and identification of risk factors. These digital assets are characterised by their volatility and operate without intermediaries, which makes them vulnerable to certain security risks. It is crucial to acknowledge the possibility of hacking and other security breaches, as evidenced by several high-profile incidents. For example, the theft of Ethereum and USDC stablecoin worth approximately $625 million from Ronin Network, Poly Network losing over $600 million, Binance being hit by a hack resulting in a $570 million loss, and Coincheck's $523 million loss of NEM coins. These incidents emphasise the importance of carefully considering risk factors when investing in cryptocurrencies to prevent potential losses. As cryptocurrencies are fundamentally technology-based financial products, it is essential to recognise how technological security risks are perceived when investing in these assets.

Previous research has investigated the impact of risk factors on cryptocurrency adoption. Nadeem et al. (2021) conducted a study from the perspective of China and found that security and control risks do not affect perceived usefulness, suggesting that they are not determinants of Bitcoin use. However, Walton & Johnston (2018) followed by Alaklabi & Kang (2021) discovered that security risks have an impact on the adoption of cryptocurrencies. Presthus & O'Malley (2017) also found that security concerns are a primary reason why non-users have not adopted this technology. These findings indicate that previous studies have not reached a consensus. Therefore, further research examining the influence of system security as part of technological factor on investment in cryptocurrencies would help to clarify the inconsistencies in the findings of previous studies.

It is crucial to delve deeper into the role of system security and trust in the construction of cryptocurrency investments. The findings of this study are expected to provide insights for related parties, such as investors, cryptocurrency exchanges, and regulators, to promote the widespread adoption of cryptocurrencies, especially in the Indonesian context.

2. Literature Review

2.1. Cryptocurrency

According to Nakamoto (2008), Bitcoin, the first cryptocurrency to be introduced, is a peer-to-peer electronic cash system that enables internet payments to be transmitted directly from one party to another, bypassing financial institutions. Bitcoin is also known as decentralised digital money or an internet currency, which is distributed globally without a physical form or official support but is governed digitally. According to this description, Bitcoin is primarily utilised as an alternative currency.

Since the introduction of Bitcoin in 2008, a variety of cryptocurrencies with distinct properties emerged. Cryptocurrencies are digital tokens that utilize blockchain technology and cryptographic methods (Li et al., 2023). Marella et al. (2020) define cryptocurrencies, such as Bitcoin, Ethereum, and Ripple, as innovative digital currencies backed by cryptography to secure and govern the transactions and supply of digital coins in circulation.

The term cryptocurrency refers to digital assets that based on blockchain technology. Blockchain is a public, append-only, link-list-based data structure that stores the transaction history of the entire network in the form of blocks (Conti et al., 2018). All transactions are systematically validated by each network component (Delfabbro et al., 2021). The two primary components of cryptocurrency are encryption and peer-to-peer network. The core of cryptocurrency encryption is cryptography, which guarantees the secure encoding of predetermined rules. A peer-to-peer network denotes that cryptocurrency is decentralised, with a ledger or blockchain being the essential component of such decentralisation. Blockchain is the underlying technology that enables cryptocurrency innovation and allows users to record all transactions in a shared digital ledger, ensuring the transparency and trustworthiness of all transactions.

2.2. Investment Theory in Cryptocurrency

Social Cognitive Theory (SCT) by Bandura (1989, 1992) posits that cognitive, environmental, and past behaviours interact dynamically and reciprocally to shape human behaviour. These three aspects mutually influence each other, forming the basis for behaviour and treatment interventions aimed at modifying behaviours. Environmental factors include socio-cultural, proximal, familial, and other environmental impacts that are influenced by investments. Individuals' attitudes and beliefs are primarily shaped by the culture in which they reside (Com et al., 2018). Furthermore, cryptocurrency has a significant technological component, so Liang & Xue (2009) introduced Technological Threat Avoidance Theory (TTAT) to assess the role of system security in shaping trust and investment in cryptocurrency. TTAT also examines whether cryptocurrency investors are aware of inherent technological risks.

2.3. Definition of a Variable

2.3.1 Cryptocurrency Investment

Mattke et al. (2019) highlighted that the technical nature of cryptocurrency investments endows them with distinctive traits and, as a result, limits our ability to comprehend investment in cryptocurrency. Investment can be understood as a complex behaviour influenced by rational and irrational factors that contribute to the inefficiency of security markets (Shanmugham & Ramya, 2012). Investment is defined as the process of selecting a particular alternative from a variety of options as well as an activity that involves careful evaluation of all alternatives in the hope of benefiting in the future (Ahmed et al., 2021; Jariwala, 2015; Rasheed et al., 2018). According to Rahyuda & Candradewi (2023), investing is a

procedure in which funds are invested in real or financial assets to generate future profits, considering both technical and behavioural factors.

To be considered as an investor, a person must invest money in an investment product with the intention of earning a return. Each investment has a specific set of goals that must be met, including choosing between risk and return, liquidity, growth, and protecting money from inflation. In this study, investment is defined as an investor's experience when allocating funds to cryptocurrency, taking into account their preferences for risk, the risks encountered, the expected returns, and the appropriateness of their financial goals.

2.3.2 Trust in cryptocurrency

Trust can be considered as a belief (Jalan et al., 2023). Promoting and sustaining high levels of trust in the financial services industry is considered essential due to the unique nature of many financial services and to encourage consumer involvement in the sector (Moin et al., 2015). Trust is a fundamental aspect of social interaction and is often studied in relation to economic and noneconomic transactions (Adali, 2013). From a market-oriented perspective, trust can be characterised as the expectation that other parties in a transaction will fulfil their obligations, particularly in cases where the exchange takes place over a prolonged period. In the context of cryptocurrency investment, trust is a collection of investors' beliefs about the financial and technological aspects of cryptocurrency.

2.3.3. System Security

According to Liang & Xue (2009), the TTAT explains the behaviour of technology users in response to threats that arise in the use of information technology. In behavioural science, risk is defined as an individual's assessment of ambiguity and the potential negative consequences associated with acquiring or using a product or service (Faqih, 2022). When it comes to cryptocurrency investment, security risks arise because of the association of cryptocurrencies with the technology used. The acceptance of Bitcoin as a currency is contingent on its technological significance (Shahzad et al., 2018). Moreover, decentralisation is an additional feature of the Bitcoin system, which operates independently of security trade-offs and other monitoring authorities. Scholars have defined security and control in the context of Bitcoin as the overall security arrangements of the Bitcoin system (Abramova & Böhme, 2016).

2.4. Variable Operationalisation

This study incorporated three key variables: system security, trust in cryptocurrency, and cryptocurrency investment. As these variables were latent, they were assessed using several indicators. The indicators employed in this study were derived from previous research with the following descriptions:

Table 1. Variable Operasionalisation

Variable	Indicators	References
system security	safe and secured from hacker's attack	Almajali et al., (2022); Nadeem et al. (2021)
	invest in cryptocurrency is safer	
	data security in electronic devices	
trust in cryptocurrency	cryptocurrency is reliable	Shahzad et al., (2018)
	cryptocurrency is trusted	
	confident in cryptocurrency	
	information about cryptocurrency financial system is sincere	
cryptocurrency investment	investment decisions that support investment objectives	Rahman & Gan, (2020)
	losses are normal	
	get expected return on investment decision	
	risk tolerance towards investment decisions	
	investment holding periods are spread over long span of time	

2.5. Hypotheses Development

2.5.1 System security and trust in cryptocurrency

Although the Bitcoin system is considered safe, there are threats that may tremble users' trust in Bitcoin security arrangements (Conti et al., 2018). Presthus & O'Malley (2017) found that Bitcoin security issues were one of the main reasons non-users had not adopted this technology also conveyed the same point. Trust is a hallmark of reliable interactions that can mitigate potential risks (Li et al., 2023). Thus, investors will have more confidence in cryptocurrencies if system security can be maintained. Based on this description, the following hypotheses are proposed:

H1: System security positively affects trust in cryptocurrencies.

2.5.2 System security and investment in cryptocurrency

TTAT that proposed by Liang & Xue (2009) explains the behaviour of technology users in responding to threats that manifest in the application of information technology. Although blockchain technology can technically improve the security of cryptocurrencies, some parties may still attempt to attack them and related systems, thereby increasing the security risks encountered by investors (Huang et al. 2022). The level of security connected to an online system influences cryptocurrency investment, leading to the acceptance/rejection of the system (Nadeem et al., 2021). Technological security risks are liable to encourage cryptocurrency investors to stop using them. Based on the above description, the proposed hypotheses are as follows:

H2: System security has a positive effect on cryptocurrency investment.

2.5.3 Trust in cryptocurrency and investment in cryptocurrency

Several studies have examined the influence of trust with respect to cryptocurrency on investment in financial markets. Failure to participate in the financial market is related to a lack of trust in cryptocurrency (Bricker & Li, 2017; Guiso et al., 2019). Hence, levels of trust correlate with willingness to invest (Sapienza & Zingales, 2012) and a lack of trust in the financial system results in some people failing to invest (Guiso et al., 2019). Klein & Shtudiner (2016) emphasised that trust is essential when examining risky investment behaviour. Individuals not only engage in uncertain behaviour by purchasing risky investments but also make risky investments because they believe they can predict the future (Cui & Zhang, 2021). Shahzad et al. (2018) who conducted research related to the adoption of Bitcoin in China revealed that trust concerning cryptocurrency is a key factor in the development and adoption of various information systems by creating a positive attitude among society. Based on the above description, the proposed hypotheses is as follows:

H3: Trust has a positive effect on cryptocurrency investment.

Based on the above explanation, the proposed research framework is as follows.

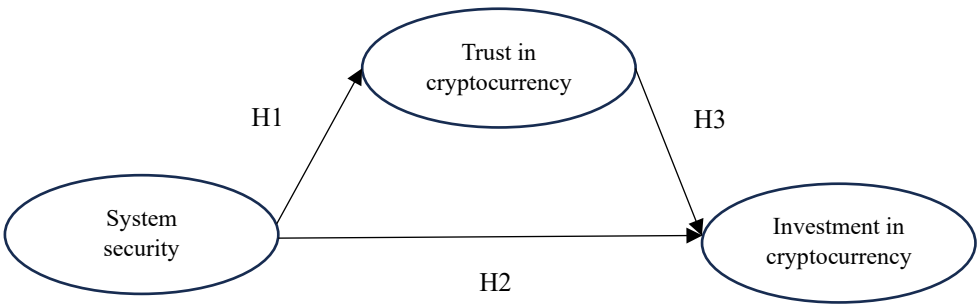

Fig.1. Research Framework

3. Research Method

3.1. Population, Sampling and Data Collection

The sampling method used in this study was purposive sampling. Purposive sampling is the sample selection method that chooses respondents to be sampled if they meet certain criteria (Cooper & Schindler, 2008). In this study, respondents were selected based on the following criteria: 1) actively investing in cryptocurrency, and 2) in the 21-44 age range. This study focuses on generation Y and generation Z. Thus, the age range of investors who can participate is 21 to 44 years. Although the youngest age in generation Z is 11 years, this study determined that the minimum age of respondents in this study was 21.

The data applied were primary data obtained using the survey method. Questionnaires containing statements that describe the variables studied will be distributed via Google Forms or QR codes. The questionnaires will be distributed on social media groups and at investor community events such as conferences, sharing sessions, or other investor association events.

Regarding sample size, according to Hair et al. (2014), the minimal sample size is ten times the number of paths. However, according to Loehlin (2004), a minimum of 200 samples is essential to reach a reliable conclusion when using structural equation modelling (SEM). Less than 200 samples may yield unreliable parameter estimations and insufficient statistical significance (Loehlin 2014). In light of this guideline, it was determined that a minimum sample size of 200 was necessary for statistical analysis in this study.

3.2. Data Analysis

SEM-PLS analysis was conducted as the main analysis for hypothesis testing to deepen the analysis related to investment in cryptocurrency by generations Y and Z. Structural equation modeling is a family of statistical models that seeks to explain the relationships among multiple variables (Hair et al., 2017). This requires construction of measurement and structural models. The measurement models included both latent variables (unobserved and unmeasured) and indicator variables (observed and measured). Structural models illustrate the hidden variables and how they are related. When both the measurement and structural models are considered simultaneously, a structural equation model is formed (Oehler et al., 2023).

PLS-SEM analysis consists of two subsection models, namely the measurement model, frequently known as the outer model, along with the structural model which is often termed as the inner model. Measurement models show how manifest or observed variables represent the latent variables to be measured, whereas structural models demonstrate the strength of estimation between latent or construct variables (Latan & Ghozali, 2015). The quality of quantitative research depends principally on the quality of research instruments. The characteristics of a good measuring instrument are determined by its level of validity and reliability (Cooper & Schindler, 2008). Thus, validity and reliability testing are essential.

4. Result and Discussion

4.1. Respondents' Profiles

Data collection through a survey was carried out by collecting 216 questionnaires from cryptocurrency investors aged 21 to 44 years. The researcher identified the profiles of the respondents from the collected questionnaires. The respondents' profiles are listed in the following table:

Table 2. Respondents' Profiles

Profile		Amount	%
Age	21-24 years old	88	40.7%
	25-28 years old	60	27.8%
	29-32 years old	33	15.3%
	33-36 years old	12	5.6%
	37-40 years old	11	5.1%
	41-44 years old	12	5.6%
gender	male	140	64.8%
	female	76	35.2%
years of experience in cryptocurrency investment	< 1 year	20	9.3%
	1-2 tyear	67	31.0%
	2-3 year	50	23.1%
	> 3 year	79	36.6%
investment horizon	short time	65	30.1%
	long time	151	69.9%

source: processed data, 2023

The table above reveals that the respondents' profiles for are diverse in terms of age, gender, and length of experience as cryptocurrency investors, as well as investment goals (long/short term). Investors aged 21-24 or Generation Z amounted to 88 people (40.7 %), while another 59.3% were those aged 25-44 years or Generation Y. Regarding gender, the respondents in this study were predominantly male, with a total of 140 people or 64.8%. Furthermore, in terms of length of experience investing in cryptocurrencies, those with more than three years of experience comprise the majority of respondents, with a total of 79 respondents (36.6 %). Additionally, the respondents in this study were dominated by investors who invested in the short term (151 respondents, 69.9 %).

4.2. Validity & Reliability

After identifying respondents' profiles, data analysis was conducted using the PLS-SEM approach. In this study, convergent validity was carried out, specifically measuring the validity of indicators as measuring variables, which can be seen from the outer loading of each variable indicator. Three variables comprising 12 statements were tested in this study. Based on suggestions from previous studies, statements with an outer loading of 0.4 – 0.7 can be maintained in developing research fields.

Table 3. Convergent Validity (Outer Loading)

	I	TC	SS
I1	0.65		
I2	0.82		
I3	0.81		
I4	0.82		
TC1		0.77	
TC2		0.84	
TC3		0.88	
TC4		0.81	
SS1			0.87
SS2			0.82
SS3			0.87

source: processed data, 2023

Furthermore, discriminant validity was also carried out by Fornell-Larcker Criterion. The test was performed by comparing the root value of the AVE with the correlation value between the latent

variables. The AVE root value must be greater than the correlation between the latent variables. According to this study, the roots of the AVE for each latent variable were greater than the correlation between latent variables, so the items in the current study could be stated to have good discriminant validity. The discriminant validity of the variables is presented in the following table:

Table 4. Discriminant Validity (Fornell-Larcker Criterion)

	I	TC	SS
I	0.78		
TC	0.45	0.82	
SS	0.29	0.65	0.85

source: processed data, 2023

In this study, several measurements were also completed to ensure the validity and reliability of the construct, including examining the Cronbach's alpha value, composite reliability, and Average Variance Extracted (AVE). From a number of tests, each variable had a Cronbach's alpha value > 0.7, composite reliability > 0.7, and AVE > 0.5. Hence, the statement items and variables in this study are deemed to have good validity and reliability. Cronbach's alpha, composite reliability, and AVE values for each variable in this research can be seen in the following table.

Table 5. Construct Validity & Reliability

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
I	0.77	0.86	0.60
TC	0.84	0.89	0.68
SS	0.81	0.89	0.73

source: processed data, 2023

4.3. Coefficient of Determination (R^2)

The coefficient of determination in the SEM analysis was employed to determine the contribution of the exogenous variables to the endogenous variables, as can be seen from the adjusted R2. According to this study, the adjusted R2 for the trust variable in cryptocurrency was 41%, while the adjusted R2 for the investment in cryptocurrency variable was 19%. This signifies that 41% of the variation in the variable trust in cryptocurrencies can be explained by system security, whereas the other 59% is explained by other variables not discussed in the present study. Moreover, 19% of the variation in investment in cryptocurrency variables can be explained by trust in cryptocurrency, while the remaining 81% is explained by variables that are not included in this research model. The coefficient of determination for the trust variable and investment in cryptocurrency is presented in the following table:

Table 6. Coefficient of Determination

R Square	R Square Adjusted
0.20	0.19
0.42	0.41

source: processed data, 2023

4.4. Hypotheses Testing

After measuring the validity and reliability, as well as reviewing the coefficient of determination, the hypothesis was tested by examining the p-value, comparing the t-statistics and t-table, and studying the coefficients to determine the magnitude of the effect.

Table 7. Hypotheses Testing (Direct Effect)

	Original Sample (O)	+/-	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
SS -> TC	0.65	+	0.65	0.06	10.43	0.00
SS -> ID	0.00	+	0.01	0.08	0.06	0.96
TC -> ID	0.44	+	0.44	0.07	5.98	0.00

source: processed data, 2023

The effect of system security on trust in cryptocurrencies was proven in this study. System security has a positive effect on trust in cryptocurrency, with a p-value of 0.00 and a coefficient of 0.65. Furthermore, the effect of system security on cryptocurrency investment was not proven in this study, with a p-value of 0.96 and a coefficient of 0.00. Finally, the effect of trust on investment in cryptocurrency is proven, with a p-value of 0.00 and a coefficient of 0.44. The result show that trust in cryptocurrency can encourage valuable experience when investing in cryptocurrency.

This study also tested the indirect effect of system security on investment in cryptocurrency through trust in cryptocurrency. The results of indirect effect testing are shown in the following table:

Table 8. Indirect Effect

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
SS -> TC-> I	0.29	0.29	0.05	5.35	0.00

source: processed data, 2023

This study reveals that system security has an indirect effect on investment in cryptocurrency through trust in cryptocurrency. This can be seen from the p-value of 0.00 and coefficient of 0.29. The results show that trust in cryptocurrency acts as a variable that bridges the security of the system to create a good experience when investing in cryptocurrency.

5. Discussion

In this study, it has been demonstrated that system security plays a crucial role in determining the level of trust in cryptocurrency. The better investor perception of system security will increase trust in cryptocurrency. This result is supported by previous evidence obtained from Murko and Vrhovec (2019), which revealed that among the factors that discourage people from using Bitcoin is a high security risk. Presthus & O'Malley (2017) who established that Bitcoin security issues are one of the principal reasons non-users had not adopted this technology also demonstrated this in their research. Consequently, investors will have more confidence in cryptocurrencies if system security can be maintained.

The results also show that system security has no significant effect on cryptocurrency investment. System security is important when investing, but competition among exchanges to provide the best security features creates a homogeneous practice in the industry. Any cryptocurrency exchange attempts to duplicate the security features provided by other cryptocurrency exchanges in its applications. Cryptocurrency exchanges offer a number of security features such as password settings, application PIN settings, and Two-Factor Authentication (2FA).

Blockchain is a technology inherent to cryptocurrency investment that possesses strong safety features and is related to the findings of this study. Cryptocurrencies have introduced a new secure financial paradigm, as evidenced by their market capitalisation. Likewise, the various security features created by cryptocurrency exchange companies make cases of fraud, scam, or phishing rare in the

context of investing in cryptocurrencies.

This study is consistent with prior study conducted by Saif et al. (2022). End users may potentially experience a sense of apprehension (i.e., security concern) in connection with the improper handling or unauthorized access to their personal and financial data, which may lead to data breaches and cybersecurity attacks. Saif et al. (2022) also pointed out this situation underscores the insufficient attention given by digital financial service users to the matter of security. The results of this study contradict the results of previous research by Nadeem et al. (2021), which states that the level of security connected with an online system has an influence on the users, which leads to acceptance or rejection of the system. Similarly, previous research by Stark et al. (2014) reveal that technological security risks are likely to drive cryptocurrency investors to cease using them.

Furthermore, the result revealed that those who trust cryptocurrency would have good experience during their investment in cryptocurrency, including achieving their investment goals, are not sensitive to price volatility in cryptocurrencies, have a certain risk tolerance when investing in cryptocurrencies, and are willing to hold cryptocurrencies for a long period. Trust in cryptocurrency is essential when examining risky investment behaviour. Cryptocurrency, being a relatively novel asset in comparison to traditional assets, necessitates a higher degree of public trust to establish credibility. Then, it is worth noting that the underlying foundation of digital assets is in blockchain technology, which possesses strong safety features. These attributes served as the primary motivations behind the inception of this technology. Blockchain is a digital ledger technology that operates in a decentralised and distributed manner, ensuring secure recording and verification of transactions over a network of computers.

These results are in line with previous literature, such as Klein & Shtudiner (2016), who asserted that trust is essential when examining risky investment behaviour. Then, individuals not only engage in uncertain behaviour by purchasing risky investments but also make risky investments in their primary investment because they believe they can predict the future (Cui & Zhang, 2021). Shahzad et al. (2018) revealed that trust is a key factor in the development and adoption of various information systems by creating a positive attitude among society. User's level of trust pertains to their perspective on the credibility of a specific technology. Trust plays a pivotal role in shaping the adoption and utilisation of cryptocurrencies.

6. Conclusion

This study provides valuable insights into the interrelationships among security, trust, and cryptocurrency investment behaviours in Indonesia. The findings confirm that establishing reliable security protocols and protection can cultivate higher degrees of trust, which subsequently drive adoption and usage. However, improved security standards alone may be insufficient to stimulate investment directly, without solid trust foundations. As cryptocurrencies continue to gain momentum across Southeast Asia, policymakers and industry leaders should focus on transparency, governance, and accountability to nurture trust among potential investors. By proactively self-regulating and demonstrating credibility, cryptocurrencies can flourish in the mainstream investment world.

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