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Analysis of The Factors Influencing the Intension to Use Cross-Border QRIS As A Payment Method

Bestari Nirmala Santi* & Dony Abdul Chalid

Department of Management, Faculty of Economics and Business, Universitas Indonesia, Salemba, Jakarta Pusat, 10440, Indonesia

Abstract

Aligned with the goal of the Indonesian Payment System 2025 to accelerate inclusive finance, develop MSMEs (Micro, Small, and Medium Enterprises), streamline transactions, and enhance economic growth, the government has implemented cross-border QRIS payment system cooperation with Thailand, Malaysia, and Singapore. Technology Acceptance Model/TAM, Unified Theory of Acceptance and Use of Technology 2/UTAUT2, user system trust theories (perceived trust and perceived security), and financial literacy are integrated to identify factors influencing the intention to use cross-border QRIS. The research method is quantitative using SEM (Structural Equation Modeling), data collected through online questionnaires distributed to cross-border QRIS users. The total number of participant respondents is 356, and the data obtained are processed using SmartPLS application. The data analysis results from this study show that the intention to use QRIS cross-border is only significantly and positively affected by perceived usefulness, habit, and then hedonic motivation.

Keywords: cross-border qris; financial literacy; payment system; perceived security; perceived trust; tam; utaut2; and usage intention.

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1. Introduction

Digital technology is currently advancing rapidly and widely accepted worldwide, particularly in the financial sector. Digital technology assists society in accessing financial products and services, with one of its innovations being Digital Fintech Payment (Daud, et al., 2022). In 2019, the global digital payment market was valued at USD 3,885.57 billion and is projected to grow to USD 8,686.68 billion by 2025. Furthermore, current trends indicate a transition towards a cashless society through digital payments (Alkhowaiter, 2020). Digital payments now extend beyond domestic transactions to include cross-border payments. Cross-border payments are a G20 Roadmap priority initiative aimed at making cross-border money transfers faster, cheaper, transparent, inclusive, and secure (Financial Stability Board, 2022).

The Indonesian government, through its monetary authority, Bank Indonesia, has issued the Blueprint for the 2025 digital payment system aiming to leverage this digitalization trend to promote inclusive financial systems (Najib and Fahma, 2020). The Quick Response Code (QR Code) standard is a server-based payment application used via mobile banking apps, known as the Indonesian Standard QR Code (QRIS). The QRIS launch is part of Indonesia's Payment System Blueprint 2025. QRIS is based on EMV Co. (the entity that sets international QR Code standards for payment systems), facilitating interconnectivity between Payment System Service Providers (PJSPs), financial instruments, and Bank Indonesia (www.bi.go.id, 2019).

Cross-border QRIS transactions are conducted using the "switching to switching" method, where Indonesian switching providers connect with counterparts in partner countries using Application Programming Interfaces (APIs) and standard messaging in the integration process. Accumulated fund transfers are settled via Local Currency Settlement (LCS) methods. In essence, settlement processes occur through bilateral transactions in respective national currencies, with settlements conducted within each country's jurisdiction. The LCS framework implementation is overseen by

* Corresponding author.
E-mail address: bestari.nirmala@gmail.com

Appointed Cross Currency Dealers banks, appointed by the authorities of both countries to facilitate LCS by opening accounts in the partner country's currency domestically (www.paydia.id, 2023).

On August 29, 2022, Indonesia implemented the cross-border QR payment linkage with Thailand (Press Release, www.bi.go.id, 2022), followed by cooperation with Malaysia on May 8, 2023 (www.bi.go.id, 2023). Bank Indonesia subsequently implemented cross-border QRIS with Singapore starting on November 17, 2023. Transaction volumes and amounts for cross-border QRIS transactions based on Bank Indonesia data is displayed in Table 1.

Table 1. Cross-border QRIS Transaction Data

Year	Month	Indonesia - Thailand		Indonesia - Malaysia		Indonesia - Singapura	
		Volume	Nominal (IDR million)	Volume	Nominal (IDR million)	Volume	Nominal (IDR million)
2022	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8	285	24				
	9	2,256	773				
	10	7,910	3,720				
	11	9,107	5,361				
	12	13,737	7,313				
TOTAL		**33,295**	**17,191**				
2023	1	15,047	8,660				
	2	12,767	6,144				
	3	14,123	6,665				
	4	15,777	5,648				
	5	20,412	7,888	5,616	1,006		
	6	20,958	8,998	12,141	2,778		
	7	22,019	8,722	17,996	5,334		
	8	19,508	8,234	20,062	7,929		
	9	21,654	8,781	32,819	11,065		
	10	19,675	8,629	39,394	12,759		
	11	19,990	8,725	55,809	13,925	2,648	745
	12	26,484	10,330	75,695	19,186	5,957	1,989
TOTAL		**228,414**	**97,424**	**259,532**	**73,983**	**8,605**	**2,734**
2024	1	24,836	10,557	84,833	23,047	7,578	2,353
	2	34,959	12,672	81,404	22,061	4,548	1,499
	3	26,440	11,439	95,296	29,048	5,529	1,504
	4	31,049	12,481	101,665	27,724	7,673	2,628
	5	30,984	12,823	130,108	39,823	6,967	2,331
TOTAL		**148,268**	**59,972**	**493,306**	**141,703**	**32,295**	**10,315**
GRAND TOTAL		**409,977**	**174,587**	**752,838**	**215,685**	**40,900**	**13,049**

Source: Bank Indonesia, Payment System Policy Department (reprocessed)

Based on the data on Table 1, it is noted that from August 2022 to May 2024, the usage volume of QRIS in Thailand amounted to 409,977 transactions with a transaction value of IDR 175 billion. For QRIS usage in Malaysia, which was implemented in May 2023, the transaction volume until May 2024 was 752,838 transactions with a transaction value of IDR 216 billion. Meanwhile, in Singapore, the volume of QRIS usage in the eight months of implementation reached 40,900 volume of transactions with a transaction value amounting to IDR 13 billion.

With the implementation of cross-border QRIS and the increasing number of Indonesians visiting Thailand, Malaysia, and Singapore, it is expected to facilitate transactions for Indonesian citizens in these three countries by reducing cash payments. Additionally, during shopping, there is no longer a need to convert Rupiah into Baht, Malaysian Ringgit, or Singapore Dollar. Simply scanning the QRIS converts the amount displayed on the QRIS at the Rupiah exchange rate (www.asean2023.id, 2023).

Several studies have been carried out to investigate the factors affecting individuals' intentions to use digital financial products, including QR Code digital payments in various countries. These studies employ various theoretical models and research methods. Major findings reveal that elements such as trust, suitability, and perceived benefits are crucial in the intention to use QR Code mobile payment systems. Other studies also highlight that perceived trust, perceived security, and perceived benefits are significant factors in the adoption of digital payment technologies in the Gulf countries. In India, factors such as performance expectations, intention to use, and complaint resolution also influence

user behavior towards mobile phone payments. Other studies show that financial literacy positively impacts financial inclusion and savings behavior in Laos (Türker, Altay, and Okumus (2021); Alkhowaiter (2020); (Patil, Pushp et al., 2020); Morgan and Long (2020); and Wu, Lee, and Tian (2021)).

With the increasing use of QRIS in Indonesia and the implementation of cross-border payment transactions between Indonesia and Thailand, Malaysia, and Singapore, in line with Indonesia's long-term goal for the SPI 2025, previous research findings on factors influencing user intentions towards financial products, including digital payments in various countries, are interesting to consider for understanding factors influencing the intention to use cross-border QRIS by Indonesian citizens for transactions in Thailand, Malaysia, and Singapore as a payment method. The uniqueness of this study is highlighted by the limitation of research on the adoption intention of cross-border QRIS, particularly given its recent implementation in 2022.

This study will combine two technology acceptance theory models i.e., the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and theories related to trust in the use of a system. Financial literacy theory will also be used as a variable from the individual factor side to investigate whether it influences the intention to use cross-border QRIS as a payment method.

The theoretical models used align with the primary goal of QRIS implementation as conveyed by Bank Indonesia, which aims to facilitate easy, fast, and secure payment transactions (www.bi.go.id, 2020). An online questionnaire will be used for data collection from QRIS users conducting transactions in Thailand, Malaysia, and Singapore. Meanwhile, Structural Equation Modeling (SEM) will be employed to test the data, and the SmartPLS application will be used to process the data.

2. Literature Review

2.1. Theory of Technology Acceptance Model

Perceived ease of use and perceived usefulness are considered crucial in TAM as they influence the belief that adopting technology will minimize effort and enhance performance. This model is used to understand how individuals accept or reject new technologies (Scherer, Siddiq, and Tondeur, (2019) and Balakrishnan and Shuib (2021)). Perceived ease of use refers to an individual's belief that using a system does not require significant effort or high complexity. In a technological context, this means users believe the technology is easy to use without requiring substantial effort (Davis (1989); Turker, Altay, and Okumus (2022); Suebtimrat and Vonguai (2021)). Perceived usefulness refers to an individual's belief that using a system will enhance their job performance or productivity. It relates to the system's ability to provide benefits to users, such as time efficiency and improved daily performance. Awareness of these benefits also influences positive attitudes towards the system and technology acceptance (Davis (1989); Setiawan et al., (2021); Suebtimrat and Vonguai (2021); Turker, Altay, and Okumus (2022)).

2.2. Theory of Extended Unified Theory of Acceptance and Use of Technology 2

According to Venkatesh et al. (2003) and (2012), UTAUT2 is a theoretical model to study how consumers accept and use technology, which includes the following variables:

a. Performance expectancy: The degree to which a person believes that utilizing the system will enhance their performance.
b. Effort expectancy: The extent to which ease of use associated with the system.
c. Social influence: How much an individual perceives that important people believe they should use the new system.
d. Facilitating conditions: The extent to which an individual believes that there is organizational and technical infrastructure in place to support system use.
e. Hedonic motivation: Satisfaction or delight derived from using technology.
f. Price value: Consumers' cognitive consideration between perceived benefits of the application and the financial costs incurred to use it.
g. Habit: Behaviors performed automatically by an individual due to learning from previous experiences.

2.3. Theory of Perceived Trust

Trust is an individual's personal belief in facing responsibilities and obligations. In financial transactions, where users face risks of uncertainty and lack of control, trust becomes crucial. Therefore, trust also functions as a key factor in influencing the adoption of new information systems (Sebastian, Antonovica, and Guede, 2023). Perceived trust is crucial in the adoption of mobile payment technologies and electronic money services, influencing security, privacy, user intent, and enhancing financial inclusion (Suebtimrat & Vonguai, 2021; Türker et al., 2021; Ha et al., 2023). Customers of mobile payment systems highly value trust for sustained usage. Trust is a primary predictor of user intention to continue using such systems. Provider competence in meeting customer needs and maintaining information confidentiality is also crucial in building trust. Trust plays a crucial role in the success of financial technologies (Singh (2020); Namahoot & Jantasri (2022); and Hanif & Lallie (2021)).

2.4. Theory of Perceived Security

Perceived security refers to confidence in the security and privacy of mobile payments. It influences users' willingness to use the application, with the expectation that providers will protect user information and transactions (Hanif & Lallie (2021); Ma et al. (2023)). Perceived security in mobile payments depends on the security features and user information privacy. User trust in service providers is determined by the level of security provided, influencing their choice to use mobile payment systems (Singh, 2020). Perceived security in mobile payments is crucial in financial transactions due to security features such as authentication and password protection, regulated by each country's security regulations. These features give users confidence in the security of mobile payment applications, ensuring the confidentiality of their payments (Pal et al., 2021).

2.5. Theory of Financial Literacy

Lusardi and Mitchell (2014) stated that financial literacy is the ability to process economic information and make decisions regarding financial planning, wealth accumulation, debt, and retirement. On the other hand, it has been suggested by Hung, Parker, and Yoong that financial literacy is understood as basic economic and financial principles, along with skills in applying other financial knowledge to effectively manage financial resources for lifelong financial well-being (Li, 2020). Financial literacy influences financial decision-making. The causality process from financial literacy can influence financial behavior (Lusardi and Mitchell, 2014).

2.6. Theory of Digital Payment System

A payment system is a set of instruments, procedures, and rules for transferring funds between participants. This includes interbank fund transfer systems and formal arrangements for clearing and settling monetary transactions (European Union, 2018). Digital payments inspire tools to make reliable and accurate decisions. Through financial literacy, fintech and gateway-based payment methods can be more modernized and strengthen the relationship between digital payments and financial performance (Daud et al., 2022). There are six characteristics to define an inclusive digital payment system, among them accessible, reliable, valuable, affordable, profitable, and interoperable (Bandura and Ramanujam, 2021).

2.7. Theory of Cross-Border Payments

Cross-border payments involve financial transactions between payers and recipients in different countries, including wholesale and retail payments including mobile payments (Bank of England, 2022). Cross-border payment services face issues such as high costs, pricing uncertainties, and transaction delays due to passing through multiple banks before reaching their destination. These constraints are caused by technology, regulations, and market structures that slow down processes and increase costs. However, digital technology has opened opportunities to improve efficiency and reduce costs in cross-border payments (He, 2021). The Cross-Border Mobile Payment (CBMP) platform acts as a central point in the cross-border payment ecosystem, integrating different payment methods and facilitating transactions between buyers and sellers across borders. Value created by CBMP ecosystem participants is spread across various global markets, optimizing payment processes and expanding international reach (Wu et al., 2023).

3. Research Method and Materials

This research employs quantitative research using a survey research design. The study combines two technology acceptance models, TAM with perceived ease of use and perceived usefulness variables, and the UTAUT2 model with all its variables: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit. The researchers also incorporate trust and security theories related to the use of a system as additional variables. Additionally, financial literacy theory is used as a variable representing individual factors influencing to make a payment using cross-border QRIS in Thailand, Malaysia, and Singapore. Figure 1 depicts the research model.

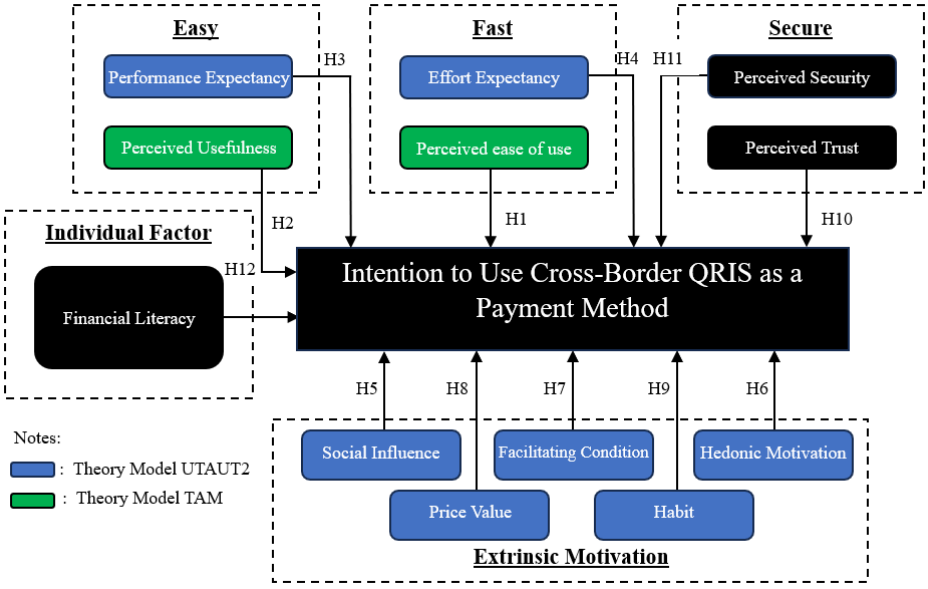

Figure 1. Research Model
Source: Adapted by the researchers

3.1. Hypothesis

Hypothesis Based on the research model in Figure 1, the research hypothesis are:

H1 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its perceived ease of use

Perceived ease of use refers to the belief that using a system will be effortless. Previous research supports this concept as a crucial factor in predicting technology adoption. Studies indicate that perceived ease of use influences user attitudes towards new technologies, such as Bio-QR for tracking edible bird's nest (Ausawanetmanee et al., 2023). In Vietnam, this factor also influences consumer intention to use mobile money by simplifying the payment process (Ha, Sensoy, and Phung, 2023). Research in Indonesia also shows that perceived ease of use is a significant determinant in fintech adoption (Setiawan et al., 2021).

H2 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its Perceived usefulness

Perceived usefulness refers to the belief that using a system will enhance individual performance. Previous research supports that this perception is crucial in influencing technology acceptance. Alkhowaiter (2020) found that perceived usefulness is critical for digital payment adoption in Gulf countries. In Vietnam, perceived usefulness influences users' intention to use mobile money (Ha, Sensoy, and Phung, 2023), while in Hungary, it affects Generation X's behavior in using mobile payment services during the pandemic (Daragmeh, Lentner, and Sagi, 2021). Other studies also indicate that perceived usefulness is a key factor in user intention to use QR codes in Turkey and fintech adoption in Indonesia (Turker, Altay, and Okumus, 2022; Setiawan et al., 2021).

H3 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its Performance expectancy.

Performance expectancy refers to the belief that using technology will enhance user performance in specific activities. Research confirms that performance expectancy significantly influences user intention and behavior towards technology. Other studies show that performance expectancy has a positive and significant impact on technology adoption in various contexts, such as electronic money usage in developing countries (Pobee, Jibril, and Owusu-Oware, 2023), mobile payments in India (Patil et al., 2020), mobile banking applications in South Africa by millennials (Thusi and Maduku, 2020), digital wallets in Vietnam (Phan, Ho, and Le-Hoang, 2020), innovative banking channels in Saudi Arabia (Baabdullah et al., 2019), cross-border mobile payments in South Korea (Wu, Lee, and Tian, 2021), cashless payments in Thailand (Namahoot and Jantasri, 2022), and M-payment in Oman (Al-Saedi et al., 2020). Performance expectancy is also identified as a key factor predicting user intention to use mobile payment solutions (Singh, 2020).

H4 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its effort expectancy.

Effort expectancy refers to how easy users perceive the use of a system to be. This concept includes perceptions of usability and complexity. Venkatesh et al. (2003) in their reserach shows that effort expectancy significantly influences technology acceptance and usage behavior. Other studies confirm that effort expectancy significantly affects user intention to use technology, such as cross-border mobile payments in South Korea (Wu, Lee, and Tian, 2021), adoption of electronic money and mobile money in developing countries (Senyo and Osabutey, 2020; Pobee, Jibril, and Owusu-Oware, 2023), and adoption of mobile payments and digital payments (Ong, Yusri, and Ibrahim, 2023; Al-Saedi et al., 2020). In the context of mobile payments in India, effort expectancy plays a crucial role in shaping positive attitudes and consumer intention towards mobile payment applications (Patil et al., 2020). Effort expectancy also helps reduce perceived risks and build trust in the adoption of non-cash mobile payment solutions in Thailand (Namahoot and Jantasri, 2022).

H5 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its social influence.

Social influence, according to Venkatesh et al. (2003), refers to the extent to which individuals feel that important others believe they should use a new system. This concept includes subjective norms, social factors, and self-image. Studies show that social influence significantly affects technology adoption, such as digital banking usage in Gulf countries (Alkhowaiter, 2020) and the Bizum payment platform in Spain (Sebastian et al., 2023). In Malaysia, social influence also influences the intention to use digital payment solutions among rural residents (Ong, Yusri, and Ibrahim, 2023), while in Indonesia, social influence positively correlates with the intention to use QR Code Payment (Glory, 2021), mobile payments in India as well (Patil et al., 2020).

H6 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its facilitating conditions.

Facilitating conditions refer to individuals' beliefs about the availability of organizational and technical infrastructures that support system use. Studies show that this factor positively and significantly influences the intention to use technology, such as electronic money innovation (Pobee, Jibril, and Owusu-Oware, 2023). In Vietnam, facilitating conditions directly influence e-wallet usage, suggesting application integration with mobile operators as a potential factor (Phan, Ho, and Le-Hoang, 2020). In South Africa, millennials consider the availability of support and informational support in using mobile banking applications (Thusi and Maduku, 2020). Studies in Saudi Arabia show that facilitating conditions are important for customer satisfaction and loyalty to mobile banking (Baabdullah, 2019). In South Korea, facilitating conditions influence Chinese tourists' intentions to use cross-border mobile payments (Wu, Lee, and Tian, 2021). In India, facilitating conditions are a key factor influencing the intention to use mobile payments (Patil et al., 2020).

H7 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its hedonic motivation.

Hedonic motivation is the pleasure or enjoyment derived from using technology. Research indicates that this factor significantly influences the acceptance and use of technology, especially from the consumer perspective (Venkatesh et al., 2012). Other studies have found that perceptions of usefulness, enjoyment, and status benefits from M-Banking apps are significantly related to the intention to adopt such technology (Kamdjoug et al., 2021). In Saudi Arabia, hedonic

motivation has also been shown to have a significant relationship with mobile banking usage behavior, contributing to customer satisfaction and loyalty (Baabdullah, 2019).

H8 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its price value.

Price value refers to consumers' cognitive consideration between the benefits gained from an app and the monetary costs incurred. Studies show that if the benefits of using technology are perceived to outweigh the monetary costs, then price value becomes positive and influences the intention to use technology (Venkatesh et al., 2012). In Saudi Arabia, key factors like price value significantly impact mobile banking usage behavior (Baabdullah, 2019). In Indonesia, price value is positively and significantly associated with the intention to adopt QR Code Payments (Glory, 2021). Similarly, price value significantly influences the intention to use cross-border mobile payments by Chinese tourists in South Korea, highlighting the importance of cost considerations in cross-border mobile payment services (Wu, Lee, & Tian, 2021).

H9 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its habit.

Habit refers to automatic behaviors influenced by previous experiences. In the UTAUT2 theory, habit has a direct effect on technology use and an indirect effect through user intention. Habit also plays a crucial role in predicting sustained technology use, especially among demographic groups such as older, experienced men (Venkatesh et al., 2012). In Cameroon, habit is a significant factor in explaining user intentions to adopt the "SARA" M-Banking app (Kamdjoug et al., 2021). In other developing countries, habit is also an important factor influencing millennial intentions to use mobile banking apps (Thusi & Maduku, 2022). In Saudi Arabia, habit plays a significant role in mobile banking usage behavior, where customers who form habits of using the service tend to be more satisfied and loyal (Baabdullah, 2019). In Spain, habit also proved strong in the adoption of P2P Bizum payments, especially after significant changes in payment habits due to the COVID-19 pandemic. Over 60% of Spain's population switched from cash transactions to digital payments like Bizum, with habits developing alongside regular usage (Sebastian et al., 2023). In Indonesia, habit is also positively and significantly related to user behavior intentions to adopt QR Code payments (Glory, 2021).

H10 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its perceived trust.

Trust is a crucial belief in financial transactions that reduces risk and uncertainty. In the context of adopting new payment information, trust plays a crucial role in success and acceptance. Perceived trust, or the trust felt, is important in evaluating the adoption of mobile payments, influencing expectations of the honesty of service providers. Trust also affects user desire and determines trust in payment. In e-commerce and the adoption of electronic money services in developing countries, trust affects user intentions and behaviors, helping to overcome cybersecurity risks ((Sebastian, Antonovica, & Guede, 2023), (Suebtimrat & Vonguai, 2021), (Türker, Altay, & Okumus, 2021), (Ha, Şensoy, & Phung, 2023)). Trust also influences user intentions in various contexts, including the adoption of QR payment in Thailand, cross-border payment usage in South Korea by Chinese residents, digital payment adoption in Gulf states, mobile money usage in Vietnam, M-payment adoption in Oman, post-adoption behaviors of mobile payment users, and mobile banking app usage among African millennials ((Suebtimrat & Vonguai, 2021), (Wu, Lee, & Tian, 2021), (Alkhowaiter, 2020), (Ha, Sensoy, & Phung, 2023), (Al-Saedi et al., 2020), (Singh, 2020), (Thusi & Maduku, 2020)).

H11 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its perceived security.

Perceived security is users' belief in the security of mobile payments and the service provider's ability to protect user information. This trust affects users' willingness to use mobile banking apps and is a key factor in digital payments. Trust in cybersecurity is also important, with the expectation that banks will protect user data and transactions from security risks. Strong security features enhance user trust in services, motivating app usage. Security regulations in each country also influence perceived security by setting standards such as authentication and password protection. Perceived security is also a key factor in the adoption of digital payments and banking in various countries, demonstrating its importance in influencing user intentions ((Hanif & Lallie, 2021), (Ma et al., 2023), (Singh, 2020), (Pal et al., 2021), (Alkhowaiter, 2020)).

H12 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its financial literacy.

Financial literacy influences individuals' intentions and behaviors related to technology and financial products. Studies show that ownership of crypto in Japan is associated with higher financial literacy, while older people with low incomes and those not using financial management apps have lower financial literacy in Vietnam. In the Middle East and North Africa (MENA), households with higher financial literacy tend to be more active in saving and borrowing formally. Financial literacy also helps reduce financial risks among the poor in Uganda by understanding financial products and increasing demand for formal and informal products. Lack of understanding of financial literacy can lead to irrational financial decisions and potentially decrease market efficiency and social economic welfare ((Fujiki, 2019), (Nguyen et al., 2022), (Lyons & Kass-Hanna, 2021), (Bongomin, Munene, & Yourougou, 2021), (Li, 2020), (Morgan & Long, 2020)).

3.2. Population and Sample

The population of this study consists of cross-border QRIS users who have conducted transactions in Thailand, Malaysia, and/or Singapore, with a sample size of 356.

3.3. Data Collection Method

The researcher will collect primary data by distributing an online questionnaire to respondents who have used cross-border QRIS in Thailand, Malaysia, and/or Singapore. Secondary data will be sourced from previous studies in literature, books, journals, data sets, and credible news articles to aid in identifying issues or findings obtained in primary data processing. The research questionnaire will be distributed online using the services of a third-party questionnaire distribution company, PT Populix Informasi Teknologi.

3.4. Definition and Operational Variables

Dependent variables (Y) or latent endogenous variables in the SEM model, also known as dependent variables, are variables that researchers consider to be influenced by other variables in a study. Conversely, independent variables (X) or latent exogenous variables in the SEM model, or independent variables, are variables that researchers consider influencing dependent variables (dependent) in a study (Hair, et al, 2021). In this study, the endogenous variable is the intention to use cross-border QRIS and the exogenous variables are perceived ease of use, perceived usefulness, performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, perceived trust, perceived security, and financial literacy. The operational variables used as a reference to formulate questions in the research questionnaire can be seen in Appendix 1.

3.5. Questionnaire Design

The questionnaire structure consists of two parts: respondent profiles and core questions. The target respondents for this study are respondents who have used cross-border QRIS in Thailand, Malaysia, and/or Singapore. To ensure respondents can answer the core questionnaire questions, respondents must be at least 19 (nineteen) years old, where the age of 19 years according to the Ministry of Health falls into the adult category (www.ayosehat.kemkes.go.id). Therefore, the questionnaire design will use two screening questions: whether respondents have ever conducted transactions using cross-border QRIS and are aged 19 years or older. If the answer is no to either of these questions, the survey cannot proceed.

3.6. Measurement Scale

A 4 (four) point Likert scale is used in this study to prevent respondents from answering neutrally.

Table 2. Likert Scale Measurement

Description	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Source: Balakrishnan, V and Nor Shuib, L.N.M (2024) (reprocessed by the author)

3.7. Questionnaire Testing (Pilot Testing)

Validity testing involves correlating the scores of each indicator item with the total construct score, with a significance level of 0.05 using the following criteria (Janna, 2021): a) H0 is accepted if the calculated r-value is greater than the

table r-value (the measuring instrument used is considered valid). b) H0 is rejected if the calculated r-value is less than or equal to the table r-value (the measuring instrument used is considered invalid).

The method that the researcher will use to test data reliability is Cronbach's Alpha. When the Cronbach Alpha for each questionnaire item exceeds 0.60, those indicators and variables are considered reliable. Conversely, if it is less than 0.60, they are considered unreliable (Sugiyono, 2019).

3.8. Data Analysis of Questionnaire Results

The quantitative method used to test and develop the conceptual model among variables is the Structural Equation Model (SEM). Data processing is conducted using the SmartPLS 4.1.0.2 software to obtain research results that can address the problems and conclude hypothesis. PLS-SEM is a suitable analysis method for this study, as per Hair et al. (2019) in Hanif and Lallie (2021), for the following reasons:

a. Several hypotheses based on literature studies are tested in this research.
b. The model in this study is considered complex as it involves several independent variables, each with multiple measurement indicators.
c. This study also adopts and expands existing frameworks, namely TAM, UTAUT2, perceived trust, perceived security, and financial literacy, to deepen the understanding of the studied situation.

Moreover, the recent implementation of cross-border QRIS might present data availability challenges, but the analysis can still be conducted accurately even with a small sample size.

According to Hair et al. (2021), the criteria for validity and reliability testing in PLS-SEM from the four steps above are summarized as follows:

a. Reflective indicator loadings: A value greater than 0.708 indicates acceptable indicator reliability and the construct explains more than 50% of the indicator variance. If an indicator obtains a lower value between 0.40 and 0.708, consideration may be given to removing the indicator only if its removal enhances internal consistency reliability or convergent validity.
b. Internal Consistency Reliability: Higher reliability levels are considered "acceptable for exploratory research" between 0.60 to 0.70, and "satisfactory to good" between 0.70 to 0.90. Values above 0.90 indicate redundant indicators, while values above 0.95 indicate undesirable response patterns. Cronbach's alpha, though conservative, serves as an acceptable lower estimate of internal consistency reliability, while rho_a reliability falls between Cronbach's alpha and rho_c values.
c. Convergent Validity: The metric used to measure convergent validity is the Average Variance Extracted (AVE). AVE is calculated by averaging the squared correlations of the indicators for each construct. An accepted minimum AVE is 0.50, meaning the construct can explain at least 50% of the variance in its indicators.
d. Discriminant Validity: The heterotrait–monotrait ratio (HTMT) is used to assess discriminant validity. HTMT calculates the average correlation between indicators across different constructs compared to within the same construct. Inter-construct correlations should be as low as possible, while intra-construct correlations should be as high as possible. High HTMT values indicate discriminant validity issues. The recommended thresholds are 0.90 for highly similar constructs and 0.85 for more distinct constructs.

In hypothesis testing using PLS-SEM, the formative measurement model is assessed for indicator collinearity, and the structural model is evaluated using the coefficient of determination (R^2), cross-validated redundancy measures (Q^2), statistical significance, and path coefficient relevance. Indicator collinearity is assessed using the Variance Inflation Factor (VIF), where values above 5 indicate collinearity issues. The relevance of each indicator is also evaluated, with weights close to 0 indicating weak relationships, while weights close to +1 or -1 indicate strong relationships (Hair et al., 2019).

The next step is to check the R^2 values of the endogenous constructs. R^2 measures the variance explained in each endogenous construct. R^2 values range from 0 to 1, with higher values indicating greater explanatory power. As a guideline, R^2 values of 0.75 are considered substantial, 0.50 are considered moderate, and 0.25 are considered weak. Another way to assess the predictive accuracy of the PLS path model is by calculating the Q^2 value. For a particular endogenous construct, Q^2 values need to exceed zero to demonstrate the predictive accuracy of the structural model. Typically, Q^2 values greater than 0, 0.25, and 0.50 indicate small, medium, and large levels of predictive relevance in the PLS path model, respectively.

4. Results and Discussion

4.1. Pre-Research Test

The purpose of conducting this pre-research test is to ensure that the indicators used by the researchers are valid and reliable, so that data can be distributed more widely to respondents in larger numbers. During this pre-research test, there were 25 respondents who reported having conducted transactions using cross-border QRIS in Thailand, Malaysia, and/or Singapore and were above 19 years old, out of a total of 36 respondents who answered the pre-research questionnaire. Based on the responses from the respondents' using indicators measured on a Likert scale, validity and reliability tests were then conducted on each indicator used in this study using Microsoft Excel. The test results indicated that all indicators of the variables used in the study produced a calculated r value greater than the critical r value. Thus, it can be inferred that all indicators across all variables demonstrate sufficient validity. Meanwhile, the pre-research reliability test was conducted on the indicators predicted to influence latent variables. The result showed that each independent variable has a Cronbach's Alpha value greater than 0.6. Based on this, the researcher concludes that all indicators used in this test are reliable.

4.2. Respondent Profile

The total number of respondents analyzed was 356, the majority of whom were female, namely 258 respondents or 72.47%, with the remainder being male, totaling 98 respondents or 27.53%. In terms of age, the respondents were predominantly young (under 30 years old), with the highest number in the 18-24 age group, totaling 151 respondents (42.42%), classified as Generation Z. Regarding their highest education level, respondents with a Bachelor's degree (S1) ranked first in having used cross-border QRIS applications, totaling 169 respondents (47.47%), followed by respondents with a high school education, totaling 146 respondents (41.01%).

Looking at their occupations, respondents using cross-border QRIS included private sector employees, totaling 172 respondents (48.31%), self-employed individuals, totaling 103 respondents (28.93%), and students, totaling 43 respondents (12.08%). The largest domicile was in West Java, with 78 respondents (21.91%), followed by East Java with 68 respondents (19.10%), DKI Jakarta with 58 respondents (16.29%), and Central Java with 48 respondents (13.48%). Additionally, the questionnaire was filled out by respondents whose monthly income ranged from Rp5,000,001 to Rp15,000,000, totaling 166 respondents (46.62%), and less than Rp5,000,000, totaling 159 respondents (44.66%). This aligns with respondent profile data where the majority of those using cross-border QRIS applications are young.

4.3. Validity and Reliability Testing Results (Outer Models)

Based on outer loadings analysis, two indicators had values below 0.708, namely PEU2 and FL2 with values of 0.602 and 0.699, respectively, indicating that these two indicators are not reliable for explaining the perceived ease of use and financial literacy variables. Meanwhile, other indicators showed values above 0.708, thus they are considered reliable for explaining their respective construct variables. Based on the analysis, removing these two indicators would not affect the internal consistency reliability or convergent validity, as the remaining indicators already exceeded the threshold. Therefore, the researcher retained these two indicators for hypothesis testing.

4.4. Internal Consistency Reliability

The results of internal consistency reliability testing showed the Table 3.

Based on Table 3, the values of Cronbach's Alpha, rho_a, and rho_c all fall within the interval between 0.6 and below 0.95, indicating that all indicators and variables in this study can be considered reliable because Cronbach's Alpha values are less than rho_a and rho_c values.

4.5. Convergent Validity

All analyzed variables showed AVE values greater than 0.50, as seen in Table 4. Therefore, it can be concluded that the construct variables mentioned above can explain at least 50% of their indicator variances.

4.6. Discriminant Validity

Based on data analysis, it was found that the discriminant validity between perceived ease of use and effort expectancy variables was 0.904, which is above the recommended threshold, indicating that there are indicators that are very similar in both construct variables. To address this, PEU4 and EE3 indicators were then removed, as shown in Table 5.

Table 3. Internal Consistency Reliability Results

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)
Perceived Ease of Use	0.824	0.837	0.878
Perceived Usefulness	0.787	0.790	0.862
Performance Expectancy	0.844	0.845	0.895
Effort Expectancy	0.869	0.874	0.910
Social Influence	0.847	0.855	0.907
Facilitating Conditions	0.795	0.796	0.867
Hedonic Motivation	0.765	0.767	0.865
Price Value	0.889	0.890	0.931
Habit	0.882	0.883	0.919
Perceived Trust	0.856	0.858	0.902
Perceived Security	0.826	0.831	0.883
Financial Literacy	0.769	0.803	0.845
Intention to Use	0.881	0.882	0.913

Table 4. Convergent Validity Results

Variable	Average variance extracted (AVE)
Perceived Ease of Use	0.592
Perceived Usefulness	0.609
Performance Expectancy	0.681
Effort Expectancy	0.718
Social Influence	0.766
Facilitating Conditions	0.620
Hedonic Motivation	0.682
Price Value	0.818
Habit	0.739
Perceived Trust	0.698
Perceived Security	0.654
Financial Literacy	0.577
Intention to Use	0.677

Table 5. Excluded Indicators

Variable	Indicator	Question
Perceived Ease of Use (PEU)	PEU4	It is easy for me to learn how to get information using cross-border QRIS.
Effort Expectancy (EE)	EE3	I find cross-border QRIS easy to use

After removing these two indicators, the variance discriminant value is now below 0.90, indicating that all construct variable indicators used to test hypothesis are valid, as shown in Table 6.

4.7. Hypothesis Testing Results (Inner Models)

Based on the Assessing Formative Measurement Models test, the VIF values were below 5, indicating no collinearity issues. The R2 test results (assessing structural model) showed that 70.6% of the variation in the dependent variable can be explained by the independent variables in the model, which falls into the moderate category, while 29.4% is due to other factors not included in the model. Additionally, the Q2 values generated from the research data processing indicated positive Q^2_predict values (above 0), demonstrating that the PLS model has good predictive ability for all indicators from IU1 to IU5. The PLS model used in this analysis shows sufficiently strong predictive ability for the measured indicators, with positive Q^2_predict values falling below 0.50, categorizing them as moderate.

Table 6. Discriminant Validity Results

Variable	EE	FC	FL	HM	HT	IU	PE	PEU	PS	PT	PU	PV	SI
EE													
FC	0.883												
FL	0.473	0.647											
HM	0.843	0.843	0.573										
HT	0.727	0.873	0.590	0.753									
IU	0.774	0.838	0.612	0.828	0.869								
PE	0.749	0.807	0.601	0.838	0.822	0.787							
PEU	0.876	0.851	0.566	0.738	0.772	0.757	0.754						
PS	0.504	0.700	0.754	0.578	0.738	0.644	0.613	0.630					
PT	0.776	0.787	0.531	0.798	0.792	0.785	0.695	0.758	0.658				
PU	0.827	0.822	0.576	0.870	0.699	0.810	0.886	0.800	0.574	0.794			
PV	0.683	0.857	0.523	0.726	0.864	0.762	0.696	0.682	0.668	0.773	0.727		
SI	0.666	0.869	0.597	0.733	0.867	0.759	0.772	0.719	0.664	0.690	0.720	0.741	

4.8. Hypothesis Testing

The hypothesis testing analysis will prove whether the hypothesis are accepted with parameters having p-values ≤ 0.05 (positively influencing) and whether they are statistically significant. Significant parameters are indicated by t-statistic > 1.96 (Ghozali, 2016). The following are the results of hypothesis testing in Table 7.

Table 7. Hypothesis Testing Results

Hypothesis	Variable	T statistics (|O/STDEV|)	P values	Conclusion
H1	Perceived Ease of Use -> Intension to Use	0.180	0.857	Hypothesis Rejected
H2	**Perceived Usefulness -> Intension to Use**	**2.431**	**0.015**	**Hypothesis Accepted**
H3	Performance Expectancy -> Intension to Use	0.171	0.864	Hypothesis Rejected
H4	Effort Expectancy -> Intension to Use	1.332	0.183	Hypothesis Rejected
H5	Social Influence -> Intension to Use	0.238	0.812	Hypothesis Rejected
H6	Facilitating Conditions -> Intension to Use	0.623	0.534	Hypothesis Rejected
H7	**Hedonic Motivasion -> Intension to Use**	**2.122**	**0.034**	**Hypothesis Accepted**
H8	Price Value -> Intension to Use	0.161	0.872	Hypothesis Rejected
H9	**Habit -> Intension to Use**	**4.820**	**0.000**	**Hypothesis Accepted**
H10	Perceived Trust -> Intension to Use	1.231	0.218	Hypothesis Rejected
H11	Perceived Security -> Intension to Use	0.092	0.927	Hypothesis Rejected
H12	Financial Literacy -> Intension to Use	1.729	0.084	Hypothesis Rejected
H13	Financial Inclusion -> Intension to Use	0.425	0.671	Hypothesis Rejected

Based on the above results, it can be concluded that out of twelve hypothesis formulated as research questions, only the variables perceived usefulness, hedonic motivation, and habit influence the intention to use cross-border QRIS. The p-values of these three variables were less than 0.05, indicating positive and significant influence because their t-statistic values exceeded 1.96.

Based on the data analysis presented in Table 7, the results of hypothesis testing in this study are as follows:

a. H1 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its Perceived ease of use.

It can be assumed that Indonesian society is already accustomed to using QRIS when shopping at Indonesian merchants. This is also supported by the increasing use of QRIS in Indonesia, which has grown by 86%, with approximately 28.76 million users recorded by 2022 (www.katadata.com, 2023). Therefore, many users are already familiar with using cross-border QRIS in Thailand, Malaysia, and/or Singapore because the process is similar to using QRIS at merchants in Indonesia. Furthermore, easy access to the internet and smartphones enables people to easily learn how to use cross-border QRIS, making perceived ease of use no longer a significant factor influencing usage intention.

b. H2 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its perceived usefulness.

The positive and significant impact found in this study aligns with payment system theories, where a good payment system is essential for financial stability and economic prosperity, facilitating efficient exchange of goods and services between consumers and businesses (Hanegraaf et al., 2020). Moreover, Summers (1993) states that a payment system should meet the needs of individuals and businesses, with efficient fund transfers being crucial infrastructure. This theory also aligns with the characteristics of inclusive digital payment systems, where services should be low-cost or free for everyone and profitable, engaging both public and private sectors, enabling service providers to build sustainable business models.

Therefore, the perceived usefulness of cross-border QRIS positively and significantly affects usage intention because it is predicted to be more useful, beneficial, and cost-effective compared to other payment methods, thus enhancing ease and efficiency in the payment system. Usage intention for cross-border QRIS will increase if transaction costs are low and beneficial, as users do not need to exchange cash when making payments abroad.

c. H3 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its performance expectancy.

Unlike perceived usefulness, which emphasizes direct usability, benefits, and efficiency of a technology, performance expectancy emphasizes long-term expectations and productivity improvements in using cross-border QRIS, but it is not a significant factor influencing usage intention. This may be because societal expectations regarding payment systems require systems to be perceived as useful, beneficial, and efficient immediately, not in the long term.

d. H4 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its effort expectancy.

In this study, based on the survey respondent profile, 73.32% are respondents aged 30 and below, categorized as young. Therefore, the difficulty of using cross-border QRIS is no longer a factor influencing usage intention for Indonesian users transacting in Thailand, Malaysia, and/or Singapore. Young users can quickly learn and become proficient in using cross-border QRIS because its usage is similar to QRIS used for shopping in Indonesia. Thus, effort expectancy is not a significant determining factor in usage intention for cross-border QRIS for transactions in Thailand, Malaysia, and/or Singapore.

e. H5 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its social influence.

In this study, social influence also does not have a positive and significant effect, predicted because users of cross-border QRIS already have a good experience with the technology. As mentioned earlier, the use of cross-border QRIS is similar to QRIS used at local merchants, so users are accustomed to and have a good experience using cross-border QRIS. If initial experiences are unsatisfactory, social influence from others who may have tried and been dissatisfied will also affect new user intentions. Therefore, it can be predicted that users' experience using QRIS at local merchants is quite good, so social influence does not have a positive and significant effect on usage intention for cross-border QRIS.

f. H6 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its facilitating conditions.

Based on the research results, facilitating conditions do not have a positive and significant effect on usage intention. When associated with digital payment system theory and cross-border payments, it can be inferred that the infrastructure required by cross-border QRIS users is only internet and mobile phones, which almost all people can access and have facilities for. Moreover, it is predicted that internet supply is already adequate and easily accessible in Thailand, Malaysia, and/or Singapore (such as electricity supply, internet, and mobile phones). This can be seen from data on internet speed in Southeast Asia in 2021, where Thailand, Malaysia, and/or Singapore rank in the top three

(www.katadata.co.id, 2021). Therefore, facilitating conditions when people use cross-border QRIS in these three countries are no longer positive and significant factors influencing usage intention.

g. H7 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its hedonic motivation.

In his book, Venkatesh et al. (2003) explain that consumers tend to seek novelty and perceive the novelty of a particular technology. As users begin to use technology, they tend to be more interested in new features and may use the technology because of its novelty. However, as experience grows, interest in novelty decreases, and users focus more on improving efficiency or effectiveness in using technology. Additionally, research shows that age and gender influence consumer innovation levels. Therefore, the influence of experience on hedonic motivation in technology use will vary depending on user age and gender. Based on this theory, it can be concluded that respondents, the majority of whom are young (over 70% under 30 years old), use cross-border QRIS due to the novelty of its implementation, creating a high curiosity to try it out, thus generating pleasure and joy.

h. H8 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its price value.

Price value is the cognitive consideration of consumers between the perceived benefits of an application and the monetary cost incurred to use it. Price value becomes positive when the perceived benefits of using technology are considered higher than the monetary cost, and the price value influences intention positively (Venkatesh et al., 2003). Therefore, It can be inferred that the intention to use cross-border QRIS is not positively and significantly influenced by price value because users may not know about the benefits of using cross-border QRIS, such as whether currency conversion using QRIS is cheaper than payment with credit cards, debit cards, exchanging money at money changers, or other payment applications.

i. H9 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its habit.

The positive and significant impact of habit on the use of cross-border QRIS by Indonesian society shopping in Thailand, Malaysia, and/or Singapore in this study may be due to the use of smartphones, which is unavoidable. Almost all Indonesian people have smartphones, and payment features provided by banks can be executed through their smartphones. In 2023, it is known that there are 354 million active phones in Indonesia, making Indonesia the fourth largest user of phones in the world (www.tekno.kompas.com).

As mentioned earlier, before the implementation of cross-border QRIS, Indonesian society was familiar with QRIS payments at merchants in the country, where the users of QRIS in Indonesia has increased significantly, thereby affecting the intention to utilize cross-border QRIS as a payment method in Thailand, Malaysia, and/or Singapore.

With the COVID-19 pandemic in 2020, people started to reduce physical contact, thus forming a habit of using digital payments, including cross-border QRIS as a payment method abroad.

j. H10 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by perceived trust.

The results of this study show that perceived trust does not have a positive and significant effect on the intention to use cross-border QRIS. It can be concluded that users may already trust that cross-border QRIS is reliable and meets user expectations, so it is not a significant factor influencing usage intention. This is consistent with research by Suebtimrat and Vonguai (2021), who found that perceived trust does not have a significant impact on behavioral intentions toward QR code payment systems through three major mobile banking applications in Bangkok, Thailand. This finding is consistent with previous research in the context of mobile payments, which explains that the strongest factor influencing behavioral intentions is suitability, attitude, readiness for adoption, and personal innovation.

k. H11 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its perceived security.

As shown in the results of this study, perceived security does not have a positive and significant effect on the intention to use cross-border QRIS. It can be concluded that users may already feel secure with the cross-border QRIS application because it has security standards, such as passwords (PINs) when conducting transactions, merchant names displayed to ensure no fund transfer errors, instant payment proof for transactions made with cross-border QRIS, and real-time currency conversion value to Indonesian Rupiah.

l. H12 = The intention to use cross-border QRIS as a payment method is positively and significantly influenced by its financial literacy.

This study shows that the intention to use cross-border QRIS does not have a positive and significant effect on financial literacy. Therefore, the decision to use cross-border QRIS is not influenced by whether someone has high or low financial literacy. This result may be because cross-border QRIS offers substitute payment products that are also popular and provide benefits for transactions abroad, such as mobile banking, debit/credit cards, electronic banking, and cash. It is not influenced by the financial literacy of the user. Additionally, some people may be more comfortable using traditional methods such as cash payments, regardless of their understanding of the benefits of QRIS and the level of financial literacy.

5. Conclusion

The positive and significant factors influencing the intention to use cross-border QRIS in the TAM and UTAUT2 model theory are perceived usefulness, hedonic motivation, and habit. However, other variables including perceived trust, perceived security, and financial literacy do not positively and significantly affect the intention to use cross-border QRIS.

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