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# Analyzing Influence Factors of Consumers Switching Intentions from Cash Payments to Quick Response Code Indonesian Standard (QRIS) Digital Payments

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**Abstract:** The COVID-19 pandemic has precipitated several challenges, prompting the Indonesian government to enact rules aimed at minimizing direct contact to mitigate the spread of COVID-19, which has also affected transactional activities. Transactions conducted using a digital wallet represent a technological advancement that facilitates a cashless society lifestyle. Bank Indonesia established the Quick Response Code Indonesian Standard (QRIS) as a QR Code standard for digital payments using Electronic Money-Based (EU) servers, electronic wallets, or Mobile Banking. This study aims to identify the elements that affect consumer willingness to convert from cash payments to the QRIS during the COVID-19 epidemic. This study collected data through an online survey, distributing a 17-item questionnaire to QRIS users, yielding 568 valid responses. This research used a modified version of the Push-Pull-Mooring theory and an adaptation of the Unified Theory of Acceptance and Use of Technology (UTAUT2) model, concentrating on consumers' intentions to transition from cash payments to QRIS utilization. This study employed the Hybrid SEM-ANN methodology with the SmartPLS and IBM SPSS Statistics 27 applications for data analysis. This investigation had 11 hypotheses, of which 4 were accepted. The findings indicated that alternative attractiveness, trust, critical mass, and traditional payment habits significantly influenced the intention to transition from cash payments to QRIS payments during the COVID-19 pandemic.

**Keywords:** hybrid SEM-ANN; switching intention; push-pull-mooring; QRIS; UTAUT2



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## 1. Introduction

The world, including Indonesia, has been confronting the COVID-19 pandemic, which is caused by the coronavirus SARS-CoV-2. The COVID-19 pandemic has engendered numerous issues encompassing economic, social, political, and labor dimensions ([Gajimu.com, 2020](#)). Despite a decrease in reported COVID-19 cases, the World Health Organization (WHO) warns that the epidemic persists. The WHO also emphasizes the importance of maintaining knowledge of the risks ([Wulandari, 2022](#)). The pandemic has compelled the Indonesian government to implement rules mandating house confinement and minimizing direct contact to mitigate COVID-19 transmission, hence affecting transactional activities.

Digital payment transactions align with the government's initiative to optimize payment methods while minimizing direct physical contact.

Despite these advancements, Indonesia still faces barriers to full digital payment adoption, particularly regarding consumer switching behavior from cash to the QRIS. While previous studies have explored digital payment adoption broadly, research on the specific drivers and inhibitors of QRIS adoption remains limited. Understanding these factors is crucial for policymakers, financial institutions, and businesses to design more effective strategies that encourage widespread adoption and enhance financial inclusion. This study is particularly relevant as Indonesia seeks to accelerate its digital economy growth in line with national policies such as Indonesia's Payment System Blueprint 2025.

Evidence indicates that cash, whether in paper or coin form, can harbor numerous viruses and bacteria on its surface ([Azharudin, 2021](#)). In 2014, Bank Indonesia initiated the National Non-Cash Movement (GNNT), marking Indonesia's inaugural stride towards achieving a cashless society. Subsequently, on 17 August 2019, Bank Indonesia introduced the Quick Response Code Indonesian Standard (QRIS) as a standardized QR Code for digital payments via server-based Electronic Money (EU) applications, electronic wallets, or Mobile Banking ([Antara, 2022](#)). The QRIS has expanded its user base, demonstrating the phenomena of switching intention. Switching intention refers to the likelihood or certainty that consumers would transition from their present service provider to a new one ([Bansal et al., 2005](#)). The Push-Pull-Mooring (PPM) framework can be utilized to analyze switching behavior and integrate the switching process. The Push-Pull-Mooring (PPM) framework is a paradigm based on consumer migration research ([Moon, 1995](#)). Prior studies exclusively employed PLS-SEM to evaluate the structural model; however, PLS-SEM merely offers a conventional linear model, and reliance on a linear model alone is inadequate ([Yang et al., 2022](#)).

To address this issue, subsequent research included an Artificial Neural Network (ANN) analysis to enhance the interpretation of nonlinear correlations beyond PLS-SEM. The key predictors that were determined in PLS-SEM function as input neurons for the ANN model ([Yang et al., 2022](#)). This research contributes to the literature by examining consumer switching intentions using a Hybrid SEM-ANN methodology, combining Push-Pull-Mooring (PPM) theory and the Unified Theory of Acceptance and Use of Technology (UTAUT2). This study employs PLS-SEM to validate hypotheses and the ANN to analyze nonlinear relationships, providing a more comprehensive understanding of digital payment adoption behavior.

The rest of this article is arranged as follows: Section 2 presents the literature review, discussing QRIS adoption, digital payment trends, and theoretical frameworks. The methodology, detailing the research design, sampling approach, and data analysis methods, are described in Section 3. Section 4 outlines the results and discussion, interpreting key findings from the SEM-ANN analysis. Finally, Section 5 provide conclusions and implications, summarizing key insights and offering recommendations for policymakers and industry stakeholders.

## 2. Literature Review

The Quick Response Code Indonesian Standard (QRIS) was introduced by Bank Indonesia in 2019 as a standardized QR Code payment system to promote digital transactions. The QRIS aims to simplify and unify various digital payment methods, making transactions more seamless across different financial platforms ([Antara, 2022](#)). The COVID-19 pandemic further accelerated digital payment adoption due to the need for contactless transactions ([Aji et al., 2020](#)). Studies indicate that QRIS adoption has grown significantly due to conve-

nience, security, and regulatory support, making it a crucial factor in Indonesia's transition toward a cashless society (Purwandari et al., 2022).

Consumer switching behavior refers to the decision-making process where individuals transition from one service to another. The Push-Pull-Mooring (PPM) framework, originally developed for migration studies (Moon, 1995), has been widely applied in digital services, including mobile payments (Fan et al., 2021). Push factors represent dissatisfaction with current payment methods, such as concerns over hygiene, transaction speed, or the inconvenience of handling cash (Yu & Chen, 2022). Pull factors attract users toward new services, such as the ease of use, perceived benefits, and social influence (Loh et al., 2021). Mooring factors act as barriers to switching, including trust issues, security concerns, and perceived switching costs (Wu et al., 2022).

The Unified Theory of Acceptance and Use of Technology (UTAUT2) is another widely used framework to study digital payment adoption (Venkatesh et al., 2012). Key determinants such as performance expectancy, effort expectancy, and critical mass (social influence) have been found to significantly impact the user adoption of financial technology (Pham et al., 2022). However, while PPM and UTAUT2 are both useful for studying digital payment adoption, few studies have integrated them to comprehensively analyze QRIS adoption.

Most previous studies use PLS-SEM, which only models linear relationships (Yang et al., 2022). The Hybrid SEM-ANN approach, which integrates structural equation modeling (SEM) with Artificial Neural Networks (ANNs), allows for the identification of nonlinear effects and complex decision-making processes (Hidayat-ur-Rehman et al., 2021). Prior research has examined e-wallet adoption in general, but fewer studies have focused specifically on what drives users to switch from cash to the QRIS (Loh et al., 2021). While security concerns have been discussed in general digital payment adoption studies, their role in QRIS switching behavior remains underexplored (Purwandari et al., 2022). While studies have established that the pandemic accelerated digital payment adoption, there is limited analysis on whether this effect is temporary or long-term (Aji et al., 2020). By addressing these gaps, this study integrates the PPM framework, UTAUT2 model, and Hybrid SEM-ANN approach to provide a comprehensive analysis of factors influencing consumer switching behavior from cash to the QRIS.

Qing Yang et al. contend that health awareness can influence an individual's sense of health and safety values (Yang et al., 2022). Betty Purwandari et al. advocate for the correlation between health awareness and switching intents, positing that consumer health consciousness motivates switching behavior (Purwandari et al., 2022). The COVID-19 pandemic necessitates that consumers understand methods to preserve their health and avert disease outbreaks. Adhering to health protocols is essential for COVID-19 prevention, one of which involves utilizing QRIS payments to minimize physical contact during transactions. Compared to cash payments, the QRIS significantly reduces the transmission of COVID-19, as the virus can be transmitted via banknotes and coins. Enhanced health awareness prompts consumers to adopt precautions that contribute to their well-being, indicating that health awareness is a significant motivator for switching intentions. Therefore, the proposed hypothesis for the Health Awareness variable is proposed as follows:

**H1.** *Health awareness significantly enhances the intention to shift from cash payments to QRIS utilization.*

COVID-19 has negatively impacted not only individuals but also commercial, economic, financial, primary, secondary, and tertiary sectors (Aji et al., 2020). Betty Purwandari et al. endorse the correlation between the perceived effects of COVID-19 and switching intention. They assert that electronic payment is among the most efficacious measures to

mitigate the risk of COVID-19 transmission, since the perceived risk is influenced by the apprehension of virus contraction and the existence of health hazards (Purwandari et al., 2022). A growing body of research has established that fear is positively connected with customer behavior and can facilitate and expedite adoption. Technologies or approaches, such as mobile payments, alleviate these concerns (Yu & Chen, 2022). Hendy Mustiko Aji et al. contend that COVID-19 affects business and consumer behavior; physical distancing and self-quarantine measures compel individuals to remain indoors, prompting consumers to seek contactless alternatives and to eschew purchasing groceries at supermarkets or minimarkets, thereby resulting in a rise in online food delivery in Indonesia. Numerous retailers and transit providers are promoting the use of digital wallets or e-wallets for customer payments. A growing number of individuals are developing an awareness of the hazards associated with cash usage (Aji et al., 2020). Consumer apprehensions regarding the transmission of the COVID-19 virus during transactions, particularly in the absence of health protocols and the potential for contagion via cash, may influence their inclination to adopt QRIS services. The utilization of the QRIS minimizes direct contact, thereby safeguarding health against the COVID-19 threat. Consequently, the perceived risk of COVID-19 is a significant determinant of consumer switching intention. This study aims to assess consumers' perceptions of the risk posed by COVID-19, particularly regarding its potential impact on their health when engaging in monetary transactions. Therefore, the proposed hypothesis for the perceived risk variable is proposed as follows:

**H2.** *The perceived risk of COVID-19 markedly increases the intention to transition from cash payments to QRIS utilization.*

Research conducted by Liu Fan et al. identified dissatisfaction with system quality and service quality as contributing factors. Systems characterized by inadequate usability and responsiveness lead to user dissatisfaction and anxiety (Fan et al., 2021). Shin-Yi Yu and Der Chao Chen contend that content consumers are inclined to persist in utilizing a product or service, while discontented consumers may contemplate transitioning to other options. Dissatisfaction with current products and services positively influences consumers' inclination to switch (Yu & Chen, 2022). Cash transactions do not afford consumers additional time for completing transactions, prompting some users to transition to QRIS payments. This method eliminates the need for sellers to locate appropriate change, avoids direct physical contact with banknotes or coins, and allows consumers to expedite transactions by merely scanning the QR Code of the QRIS service with their smartphones. This indicates that performance expectations are a significant factor influencing switching intentions. Therefore, the proposed hypothesis for the dissatisfaction variable is proposed as follows:

**H3.** *Dissatisfaction markedly elevates the propensity to shift from cash transactions to QRIS utilization.*

The performance expectation variable is derived from the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model, as it serves as an indicator of the reliability of QRIS payments by enhancing user productivity, conserving time, and expediting user transactions in this study. An Ha Thi Pham et al. contend that performance expectations significantly influence the customer acceptance of online banking services, as these services enable users to manage their accounts remotely at their convenience and at a reduced cost (Pham et al., 2022). Betty Purwandari and colleagues contend that performance expectations relate to the efficacy and rapidity of transactions while utilizing e-payments in contrast to cash-on-delivery (COD) payments. This suggests that non-cash payments

can improve user productivity, conserve time, and accelerate transactions (Pham et al., 2022). Performance expectation evaluates the reliability of the QRIS as a non-cash payment mechanism, since it improves user productivity, conserves time, and expedites transactions. This signifies that performance expectation is a crucial element of the pull factor influencing the desire to switch. Therefore, the proposed hypothesis for the performance expectation variable is proposed as follows:

**H4.** *Performance expectations markedly increase the propensity to transition from cash payments to QRIS utilization.*

The effort expectation variable is derived from the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model. Effort expectations indicate the requisite effort for transactions via the QRIS compared to cash payments; the less the effort, the stronger the impetus for users to transition. An Ha Thi Pham et al. contend that, within the realm of financial technology, effort expectations in a service pertain to variables such as the ease of use, complexity, simplicity, and comprehensibility. The convenience offered will motivate consumers to utilize it; evidence suggests that customers see new technology as user-friendly, hence considerably enhancing the adoption of Mobile Banking services (Pham et al., 2022). Purwandari et al. (2022) contend that effort expectations assess the reliability of e-payments, as non-cash methods, based on their convenience, ease of learning, and the low work and time necessary for users to attain proficiency. Utilizing the QRIS for payment is straightforward to master and requires minimal effort for comprehension. With minimal guidance on utilizing the QRIS, users can swiftly attain expertise in its application. Payment via the QRIS service is only conducted by scanning the QR Code provided through a smartphone, significantly facilitating and expediting transaction processes, hence enhancing company expectations for consumers during transactions. Business expectations are utilized to assess whether users feel at ease and confident in performing transactions, hence indicating their willingness to transition from cash payments to QRIS. This demonstrates that business expectations constitute a pull element influencing switching intentions. Therefore, the proposed hypothesis for the effort expectation variable is proposed as follows:

**H5.** *The expectation of effort considerably increases the intention to shift from cash payments to QRIS utilization.*

The critical mass variable represents a concept of social impact within the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework. Critical mass refers to the phenomenon where users of the QRIS payment application are swayed by the actions of others (Purwandari et al., 2022). An Ha Thi Pham et al. contend that social influence gauges the degree to which a person is swayed by significant others in the adoption of specific technologies, and it is a contributing factor that positively affects customer intention to utilize online banking (Pham et al., 2022). Liu Fan et al. contend that critical mass signifies the degree to which an individual perceives that a behavior is prevalent among others, highlighting that an individual is likely to emulate behaviors exhibited by significant others. Critical mass has typically been utilized to evaluate the impact of media adoption, including blogs, email, Twitter, and Facebook; if a significant proportion of a user's friends utilize m-payments, the user is likely to wish to avoid being part of a minority (Fan et al., 2021). The ease of making payments through the QRIS, along with the numerous advantages offered by service providers, such as promotions or cashback, can stimulate interest in its use. Consequently, recommendations from acquaintances, family, or others may encourage individuals to explore this convenient and beneficial option. Critical mass



is utilized to assess the impact of significant individuals on consumers' probable transition from cash payments to the QRIS during the COVID-19 period, indicating that critical mass constitutes a pull factor in the desire to transfer. Therefore, the proposed hypothesis for the critical mass variable is proposed as follows:

**H6.** *Critical mass has a significant positive impact on the intention to switch from cash payments to QRIS usage.*

Xiu-Ming Loh et al. contend that alternative attraction pertains to the allure of mobile payments as a substitute for cash. Consumers who view m-payments as preferable to cash are more inclined to adopt m-payments. The appeal of m-payments is evident in features such as convenience and speed (Loh et al., 2021). Shih-Yi Yu and Der Chao Chen contend that alternative attractiveness pertains to the allure of mobile payments as a substitute for cash. Consumers regard mobile payments as superior, hence enhancing the probability of transitioning to m-payments (Yu & Chen, 2022). QRIS payments provide diverse service alternatives, intuitive functionalities, several promotions, and cashback incentives, all of which entice users to utilize the QRIS for transactions. The QRIS service facilitates a streamlined transaction process encompassing both pre-purchase and post-purchase phases, delivering a secure, rapid, and convenient method for transactions. The advantages offered by the QRIS enhance happiness and enjoyment, rendering it a more attractive alternative to cash payments, hence motivating consumers to alter their payment habits. Consumers who regard QRIS payments as superior to cash payments are more inclined to transition to the QRIS. Consequently, alternative appeal is regarded as a motivating factor in the intention to switch. Therefore, the proposed hypothesis for the alternative attraction variable is proposed as follows:

**H7.** *The appeal of alternatives markedly increases the propensity to transition from cash payments to QRIS utilization.*

Betty Purwandari et al. contend that trust is crucial in influencing individual technology adoption, particularly with e-payment systems that need personal data. The conviction that transactions are secure motivates individuals to utilize the technology. Multiple prior research studies have highlighted that this component is essential in shaping the intention to adopt new technology (Purwandari et al., 2022). Research conducted by Xiu-Ming Loh et al. indicates that trust serves as a perceived guarantee for m-payment users, affirming the reliability and fulfillment of service promises. Users must have confidence in m-payment adoption, as it entails transactions between unfamiliar parties and encompasses numerous uncertainties and hazards (Loh et al., 2021). Transporting substantial sums of cash during travel can be cumbersome; however, utilizing the QRIS streamlines the procedure, enabling users to keep and manage funds without the concern of misplacement in pockets or wallets. The use of QRIS cultivates confidence and delivers dependable services, guaranteeing the security of all transactions executed through the QRIS. Trust is employed to assess whether users regard the technology as reliable, prioritizes their interests, and fulfills the promised services. Users must possess a degree of trust in QRIS services to utilize them, as transactions conducted via the QRIS require engagement with unfamiliar organizations and encompass different uncertainties and hazards linked to the shift from cash payments to the QRIS (Loh et al., 2021). Consequently, trust is seen as a pivotal component influencing consumers' propensity to transition from cash payments to the QRIS. Therefore, the proposed hypothesis for the trust variable is proposed as follows:

**H8.** *Trust has a strong positive influence on the intention to switch from cash payments to using the QRIS.*

Xiu-Ming Loh et al. assert that perceived security and privacy indicate the extent of individuals' apprehension regarding the aspects of mobile payment associated with personal data and financial transactions. These characteristics aim to safeguard the privacy and security of transactions; yet, unauthorized access and transaction errors continue to pose a risk (Loh et al., 2021). Betty Purwandari et al. contend that security and privacy pertain to users' perceptions of online transactions, encompassing hazards associated with unauthorized information theft, viruses, and dangerous software, along with apprehensions regarding the illicit use of personal information. Concerns over security and privacy may diminish the incentive to transition, stemming from uncertainties about the capability, integrity, and supremacy of the payment service (Purwandari et al., 2022). Transactions executed over the QRIS are certainly safeguarded by service providers, alleviating users' concerns regarding security when utilizing the QRIS. The QRIS offers features and services aimed at safeguarding user privacy. Nevertheless, several consumers remain skeptical and apprehensive over the security of their data and accounts during the shift to the QRIS, prompting them to persist in choosing cash transactions to mitigate potential dangers. Perceived security and privacy are used to examine how apprehensions about privacy and security may diminish the inclination to transition from cash payments to QRIS. Consequently, perceived security and privacy are seen as anchoring factors affecting the intention to switch. Therefore, the proposed hypothesis for the perceived security and privacy variable is proposed as follows:

**H9.** *Perceived security and privacy significantly influence the intention to transition from cash payments to the QRIS.*

Xiu-Ming Loh et al. assert that switching costs are characterized by the expenditures borne by users while shifting from cash transactions to electronic payments. Users may consider switching, but perceived switching costs can dissuade them if they believe that these costs surpass the advantages (Loh et al., 2021). Liu Fan et al. assert that customers may endure current products or services when switching costs are considered substantial. Switching fees may impede users' willingness to change providers, notwithstanding their regret and dissatisfaction with the existing service. For example, an individual dissatisfied with the quality of an internet payment system may prefer to persist with cash transactions instead of transitioning to QR Code-based payments, as the changeover could incur additional expenses such as wireless internet fees or potential dangers (Fan et al., 2021). Betty Purwandari et al. conducted a study examining switching costs, identifying characteristics that hinder consumers from transitioning from cash-on-delivery (COD) to electronic payment systems. A contributing aspect is the necessity for consumers to establish an e-payment account, which entails labor and expenses. Additional research indicates that switching costs may arise from the time and cognitive effort required to acquire proficiency in a new technological service, as well as potential concealed expenses.

Transitioning from cash payments to the QRIS necessitates time and effort to comprehend the services and functionalities of the QRIS. Utilizing QRIS services necessitates users to establish an account for transaction completion, and they must possess internet connectivity to utilize the service. Numerous individuals consider the transition from cash payments to the QRIS to be cumbersome, mostly due to the associated costs. Switching costs significantly impact customer transactions with the QRIS. The perceived switching costs dictate that, when these costs increase for users, the barrier to transitioning from cash payments to the QRIS becomes more significant. Consequently, switching costs are

regarded as a deterrent that influences consumers' willingness to transition from cash payments to the QRIS. Therefore, the proposed hypothesis for the switching cost variable is proposed as follows:

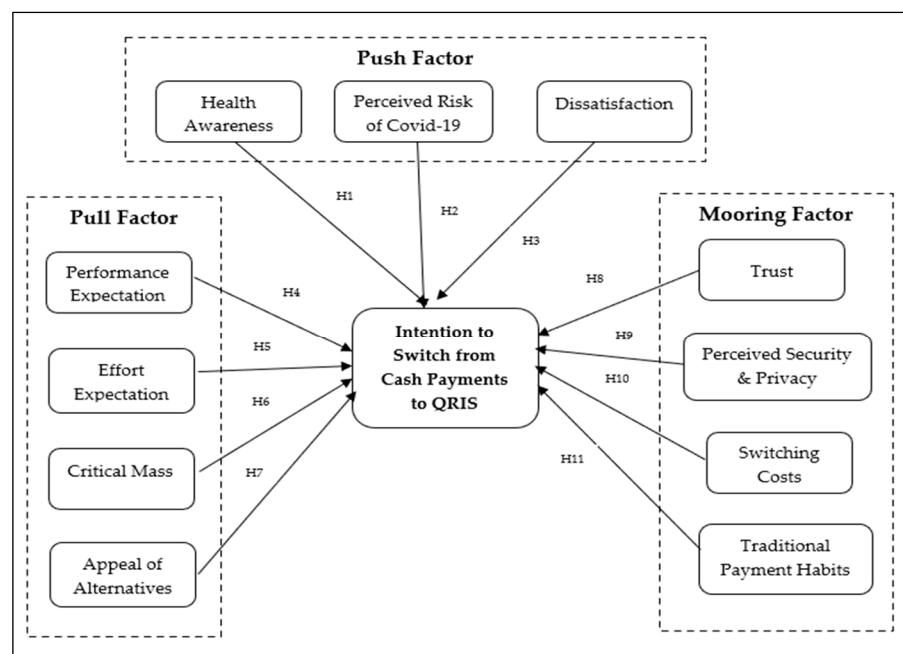
**H10.** *Switching costs have a significant negative impact on the intention to switch from cash payments to the QRIS.*

Habits are generally characterized as situational behavioral patterns that have evolved into automatic responses to certain circumstances, typically executed unconsciously, to attain a particular purpose or end (Loh et al., 2021). Bingyan Wu et al. contend that habits are the outcomes of users' previous behaviors or experiences. Research indicates that habits are a crucial element in diverse domains, including mobile payments, navigation applications, and restaurant applications (Wu et al., 2022). Xiu-Ming Loh et al. conducted a study revealing that customers generally refrain from transitioning to mobile payments for transactions due to their familiarity with cash payments. Users typically adhere to established replies and persist in their current behavioral patterns to reduce the cognitive expenses linked to decision-making processes. Consumers seeking to evade the anxiety associated with change find it simpler to persist in habitual behaviors (Loh et al., 2021).

Numerous behaviors are challenging to alter, and the reliance on cash payments is one such behavior that individuals may persist in unwittingly, irrespective of the advantages or services offered by the QRIS. Certain individuals may perceive QRIS utilization as inconvenient before experiencing it and will persist in using cash for transactions. Consequently, conventional payment practices are regarded as a stabilizing element affecting the inclination to change. Therefore, the proposed hypothesis for the habits variable is proposed as follows:

**H11.** *Traditional payment habits have a significant negative impact on the intention to switch from cash payments to the QRIS.*

Based on those hypotheses, we developed the research model as shown in Figure 1 below.



**Figure 1.** Research model.



### 3. Research Methodology

#### 3.1. Research Approach and Design

This study employs a quantitative research approach to analyze the factors influencing consumer switching intentions from cash payments to QRIS digital payments. This research integrated the Push-Pull-Mooring (PPM) framework and the Unified Theory of Acceptance and Use of Technology (UTAUT2) to develop a conceptual model. A Hybrid SEM-ANN approach was utilized to combine the strengths of Partial Least Squares-Structural Equation Modeling (PLS-SEM) and Artificial Neural Networks (ANNs) for both hypothesis testing and predictive analysis. The PLS-SEM method was selected to examine the linear relationships among the independent variables and switching intention, while ANN was applied to capture complex and nonlinear patterns that may exist in consumer decision making. This dual-stage approach provides deeper insights beyond traditional regression-based methods.

PLS-SEM is suitable for theory testing and exploring relationships between constructs in complex models. It accommodates latent variables and measurement errors, making it ideal for analyzing user behavior models. ANN complements SEM by identifying nonlinear relationships and assessing the relative importance of predictors in consumer decision making. This addresses the limitations of traditional linear models used in past digital payment studies. By integrating PLS-SEM for hypothesis testing and ANN for predictive modeling, this study provides a comprehensive evaluation of consumer switching behavior in QRIS adoption.

Despite the advantage of this method, there are also disadvantage of ANN that must be pointed out. First, ANN functions as a “black box”, meaning that it does not provide direct causal explanations like SEM ([Hidayat-ur-Rehman et al., 2021](#)). As for computational complexity, ANN requires significant processing power, and improper model tuning can lead to overfitting or underfitting ([Loh et al., 2021](#)). Lastly, for optimal training, ANN models require large datasets, making sample size selection crucial for reliable results ([Hidayat-ur-Rehman et al., 2022](#)).

#### 3.2. Sampling Method

The data were gathered by a purposeful sample strategy via the distribution of online surveys. The subject of this research comprises all QRIS payment consumers in Indonesia. This study examines the aim to transition from cash to QRIS payments. Applications that facilitate QRIS usage include DANA, OVO, ShopeePay, GoPay, LinkAja, and Mobile Banking services (BCA, BRI, BNI, Danamon, Livin’ by Mandiri). Refer to Hair et al., who suggest that PLS-SEM requires a minimum sample size of 10 times the number of the most complex predictor variables in the model ([Hair et al., 2022](#)). Given that our model includes 11 predictor variables, the required minimum sample size is 110 respondents. With 568 valid responses, this study significantly exceeds the minimum requirement, ensuring statistical power and reliability of the results. Furthermore, in ANN analysis, larger datasets improve model training and predictive accuracy ([Hidayat-ur-Rehman et al., 2021](#)). The chosen sample size is sufficient to train and test the ANN model without overfitting, ensuring generalizability of findings.

#### 3.3. Data Collection

The survey was administered in two stages. The survey was initially administered to 30 participants, and the outcomes were evaluated for validity, reliability, and readability. During the second phase, the enhanced questionnaire was disseminated via social media platforms including Instagram, WhatsApp, Telegram, and Twitter utilizing Google Forms. The variables in the questionnaire were assessed on a 4-point Likert scale ranging from

strongly agree to strongly disagree. A total of 604 responses were received, of which 568 were deemed valid after data cleaning. The survey was conducted over a one-month period.

Demographic data indicate that female respondents exceed male respondents, comprising 514 women and 54 men. The highest number of respondents, 435, falls within the age range of 18–22 years, while the majority of respondents, totaling 376, possess an educational background of elementary, junior high, or high school equivalency. The most prevalent group of respondents, numbering 336, had a monthly salary of less than Rp 1,000,000. The majority of respondents reside in the Java Area (excluding Jabodetabek), totaling 268 individuals, while the predominant group of respondents utilizes the Mobile Banking application (BCA, BRI, BNI, Danamon, Livin' By Mandiri), amounting to 295 individuals.

### 3.4. Research Instrument

The questionnaire comprised sections on respondent demographics and assertions pertaining to each variable. The demographic component collected data on name, gender, age, occupation, residence, highest level of education, monthly income bracket, QRIS application utilized, and mobile phone number. The statement section comprised 51 statements pertaining to the following variables: health awareness, perceived COVID-19 risk, dissatisfaction, performance expectation, effort expectation, alternative attractiveness, critical mass, trust, perceived security and privacy, switching costs, traditional payment habits, and switching intention.

## 4. Result and Discussion

### 4.1. Validity and Reliability

The assessment of the validity and reliability of each indicator involves three steps: the convergent validity test, the discriminant validity test, and the composite reliability test (Aburumman et al., 2023). The convergent validity test assesses the validity of the relationships between indicators and constructs or latent variables. Convergent validity assessments can be determined using outer loadings exceeding 0.70, indicating that the variable accounts for 50% of the indicator's variation, hence validating the indicator (Meiryani, 2021; Hair et al., 2022). The convergent validity assessment has two primary evaluations: Factor Loading and Average Variance Extracted (AVE). The Average Variance Extracted (AVE) resulting from the convergent validity test (Aburumman et al., 2023) stipulates that the AVE value for each latent variable must exceed 0.5 to demonstrate an adequate level of convergent validity, signifying that the latent variable accounts for more than half of its indicator variance (Sarstedt et al., 2020).

The discriminant validity test seeks to confirm that the variable exhibits the most robust relationship with its indicators in comparison to others (Aburumman et al., 2023). Discriminant validity is assessed through two metrics: the Fornell–Larcker Criterion and Cross Loadings. To establish discriminant validity via Cross Loadings, the loading of an indicator on its corresponding latent variable must exceed its loading on other variables (Hair et al., 2014). Another approach to ascertain discriminant validity is the Fornell–Larcker Criterion, which involves comparing the square root of the Average Variance Extracted (AVE) for each variable to its correlations with other variables, ensuring that the former exceeds the latter. The model demonstrates strong discriminant validity when the squared value of the Average Variance Extracted (AVE) for each exogenous construct surpasses the correlations with other constructs.

To assess the reliability of the measurement model, Cronbach's alpha (CA) and composite reliability (CR) were used. In general, a Cronbach's alpha value of 0.7 or higher is considered acceptable for internal consistency (Hair et al., 2022). In this study, most constructs

exceeded the 0.7 threshold for Cronbach's alpha, confirming internal consistency. However, a few constructs had Cronbach's alpha values slightly below 0.7, specifically dissatisfaction (0.629) and performance expectancy (0.649). Despite these lower values, the constructs remain acceptable for exploratory research (Thorndike, 1995; Ursachi et al., 2015).

The conclusive outcomes of the validity and reliability assessment of this study indicate that nine indicators were deemed invalid: KTP1 and KTP3 (dissatisfaction), EK4 (performance expectations), CM4 (critical mass), BB1, BB2, and BB3 (switching costs), and KPT3 and KPT4 (traditional payment habits). The outer loading indicator value fell below 0.70, resulting in the removal of those indicators. Subsequent to the removal of the indicators, all variables successfully met the validity and reliability criteria. The conclusive outcomes of outer loading are presented in Table 1, while the dependability metrics are documented in Table 2.

**Table 1.** Final result of outer loadings.

Variable	Indicator	Outer Loading Value
Health Awareness	KK1	0.851
	KK2	0.871
	KK3	0.888
	KK4	0.701
Perceived COVID-19 Risk	RC1	0.837
	RC2	0.822
	RC3	0.798
	RC4	0.752
Dissatisfaction	KTP2	0.865
	KTP4	0.843
Performance Expectation	EK1	0.748
	EK2	0.771
	EK3	0.776
Effort Expectation	EU1	0.862
	EU2	0.868
	EU3	0.867
	EU4	0.770
Critical Mass	CM1	0.836
	CM2	0.844
	CM3	0.815
Alternative Attractiveness	DTA1	0.776
	DTA2	0.835
	DTA3	0.865
	DTA4	0.806
Trust	KP1	0.784
	KP2	0.849
	KP3	0.854
	KP4	0.823
	KP5	0.782
Perceived Security and Privacy	KAP1	0.740
	KAP2	0.812
	KAP3	0.868
	KAP4	0.858
	KAP5	0.806

**Table 1.** *Cont.*

Variable	Indicator	Outer Loading Value
Switching Costs	BB4	0.926
	BB5	0.911
Traditional Payment Habits	KPT1	0.873
	KPT2	0.927
Switching Intention	NB1	0.852
	NB2	0.889
	NB3	0.921
	NB4	0.873

**Table 2.** Reliability measurement results.

Variable	Composite Reliability	Cronbach's Alpha
Health Awareness	0.899	0.848
Perceived COVID-19 Risk	0.879	0.817
Dissatisfaction	0.843	0.629
Performance Expectancy	0.809	0.649
Effort Expectancy	0.907	0.863
Critical Mass	0.910	0.852
Alternative Attractiveness	0.892	0.838
Trust	0.910	0.877
Perceived Security and Privacy	0.910	0.876
Switching Costs	0.915	0.815
Traditional Payment Habits	0.895	0.771
Switching Intention	0.935	0.907

#### 4.2. Structural Model and Hypothesis Testing

The inner model or structural model seeks to evaluate the model's predictive capacity and the interrelationships among variables (Aburumman et al., 2023). The primary evaluation criteria for the structural model are the magnitude and level of R-square, as well as the importance of the path coefficient; for the R-square level, the principal goal variable must be elevated (Hair et al., 2022). The R-squared scale categorizes values as follows:  $\geq 0.67$  indicates strong, 0.66–0.33 signifies medium, and 0.32–0.19 denotes weak. Upon estimating the model and ensuring that it satisfies the outer model criteria, the subsequent step is to evaluate the inner model. The R-squared value for the variables in this research model is 0.477. The variable switching intention (NB) can be elucidated solely by the variables health awareness (KK), perceived COVID-19 risk (RC), dissatisfaction (KTP), performance expectations (EK), effort expectations (EU), critical mass (CM), alternative attractiveness (DTA), trust (KP), perceived security and privacy (KAP), switching costs (BB), and traditional payment habits (KPT), which collectively account for only 47.7% of its variance.

Switching intention (NB) falls into the moderate inner model group. Hypothesis testing relies on the bootstrapping procedure, focusing on the Original Sample value, *t*-statistic, and *p*-value. The determination of whether the hypothesis is accepted or rejected is based on the *t*-Statistics value (Ali Akbar et al., 2022). In this study, a *t*-statistics value exceeding 1.96 (at a 5% significant level) signifies acceptance of the hypothesis, whereas a value below 1.96 results in rejection of the hypothesis. The *p*-value indicates the acceptance of the study hypothesis; it is accepted if the *p*-value is below 0.05 (Sari et al., 2023). This study included 11 factors and involved 568 respondents. The error rate in this study is 5% or 0.050. The outcomes of the hypothesis are presented in Table 3 as follows.

**Table 3.** Hypothesis result.

Hypothesis	Original Sample	<i>t</i> -Statistics ( O/STDEV )	<i>p</i> -Value	Description
KK → NB	−0.010	0.224	0.823	Rejected
RC → NB	0.069	1.733	0.084	Rejected
KTP → NB	0.070	1.720	0.086	Rejected
EK → NB	0.076	1.464	0.144	Rejected
EU → NB	0.045	1.194	0.233	Rejected
CM → NB	0.102	2.098	0.036	Accepted
DTA → NB	0.384	6.655	0.000	Accepted
KP → NB	0.122	2.296	0.022	Accepted
KAP → NB	0.024	0.447	0.655	Rejected
BB → NB	0.043	1.223	0.222	Rejected
KPT → NB	−0.119	3.383	0.001	Accepted

#### 4.3. Importance-Performance Map Analysis (IPMA) Testing

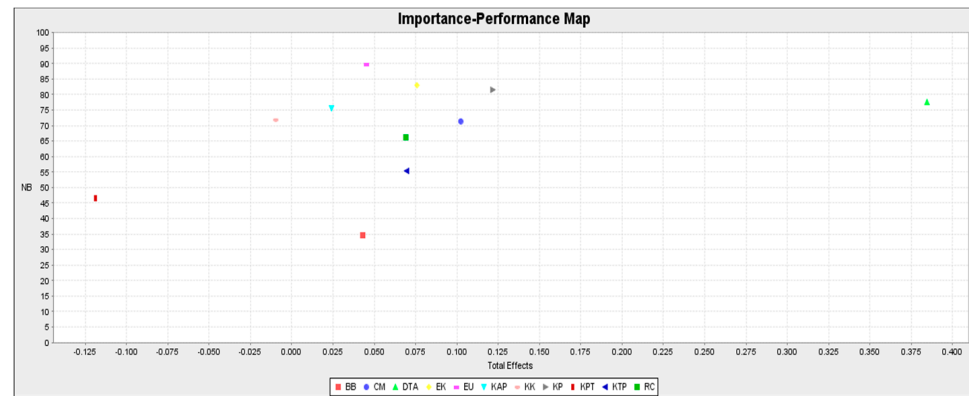
The Importance–Performance Map Analysis (IPMA) evaluates the factors affecting switching intention (NB) by PLS-SEM. The IPMA enhances comprehension of the PLS-SEM methodology, serving as an alternate path coefficient evaluator (Importance Measurement). It also encompasses latent components and associated performance metrics ([Almarzouqi et al., 2022](#)). BB, CM, DTA, EK, EU, KAP, KK, KP, KPT, KTP, and RC constitute the 11 parameters evaluated for significance and efficacy. The IPMA results are presented in Table 4 as follows.

**Table 4.** Importance–Performance Map Analysis Results.

Variable	Importance	Performance
BB	0.043	33,609
CM	0.103	71,404
DTA	0.384	77,592
EK	0.076	83,109
EU	0.045	89,786
KAP	0.024	75,653
KK	−0.010	71,859
KP	0.122	81,431
KPT	−0.119	46,584
KTP	0.070	55,274
RC	0.069	66,086

The IPMA results are illustrated in a graph, featuring a horizontal axis representing the important value (Total Effects) of the influential elements on a scale from 0 to 1 and the vertical axis indicating performance on a range from 0 to 100 ([Sternad Zabukovšek et al., 2022](#)). This study’s results indicate that DTA possesses the highest important value, succeeded by KP, CM, EK, KTP, RC, EU, BB, KAP, KK, and KPT. Conversely, the variable exhibiting the best performance is EU, followed by EK, KP, DTA, KAP, KK, CM, RC, KTP, KPT, and BB. Figure 2 below illustrates a graph of the IPMA results.

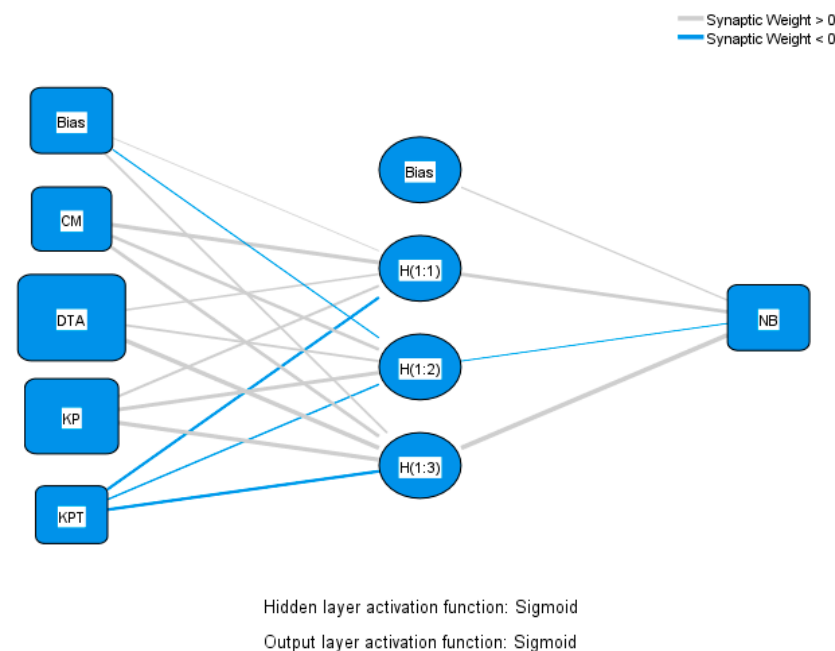




**Figure 2.** Importance–Performance Map Analysis Results.

#### 4.4. Artificial Neural Network (ANN) Testing

The testing of Artificial Neural Networks (ANNs) seeks to validate the results of PLS-SEM and assess the relative significance of the significant factors identified by SEM (Hidayat-ur-Rehman et al., 2022). SEM analysis confirms all proposed associations, while ANN analysis corroborates the SEM findings (Elnagar et al., 2021). Only significant variables identified by PLS-SEM testing are subsequently included in ANN testing (Hidayat-ur-Rehman et al., 2022). This study used ANN analysis with the variables CM, DTA, KP, and KPT. This work employs the ten-fold cross-validation approach (80:20 ratio) with one hidden layer for ANN testing and training of the gathered data to mitigate overfitting (Elnagar et al., 2021; Alhumaid et al., 2021), utilizing the IBM SPSS Statistics 27 application. The prediction accuracy of the ANN approach is assessed using the Root Mean Square Error (RMSE) value throughout both the testing and training phases of each evaluation SEM (Hidayat-ur-Rehman et al., 2022). Figure 3 illustrates the ANN model, while Table 5 presents the RMSE values for both ANN training and testing.



**Figure 3.** ANN models.

**Table 5.** RMSE values for training and testing ANN.

Neural Network	N1	Training SSE	RMSE	N2	Testing SSE	RMSE	Total Sample N1 + N2
1	460	4.897	0.103	108	0.880	0.090	568
2	463	4.699	0.101	105	0.863	0.091	568
3	459	7.906	0.131	109	2.350	0.147	568
4	437	4.623	0.103	131	1.056	0.090	568
5	442	4.535	0.101	126	1.071	0.092	568
6	443	4.629	0.102	125	0.962	0.088	568
7	451	4.489	0.100	117	1.061	0.095	568
8	439	7.396	0.130	129	2.555	0.141	568
9	450	4.346	0.098	118	1.206	0.101	568
10	443	4.316	0.099	125	1.278	0.101	568
Mean		5.184	0.107		1.328	0.104	
Standard Dev.		1.249	0.013		0.577	0.022	

The mean RMSE for training data is 0.107, while, for testing data, it is 0.104, suggesting that the proposed research model demonstrates superior performance with the use of the ANN, as the RMSE value between variables is minimal (Elareshi et al., 2022). The standard deviation for the training data is 0.013, and, for the testing data, it is 0.022.

The sensitivity analysis phase involves computing the normalized importance as a percentage by dividing the relative value of each input by the optimal relative importance (Lee et al., 2015). The normalized importance is determined by dividing the relative value of the input neuron with the highest relative importance in the ANN model and is given as a percentage (Amos et al., 2021). Assessing the predictive capacity of input neurons necessitates sensitivity analysis, which uses the resultant relative relevance sensitivity analysis to prioritize exogenous constructs (Hidayat-ur-Rehman et al., 2022). The sensitivity values presented in Table 6 are as follows.

**Table 6.** Sensitivity value results.

Neural Network	CM	DTA	KP	KPT
1	0.184	0.402	0.293	0.122
2	0.123	0.576	0.183	0.118
3	0.201	0.496	0.152	0.151
4	0.178	0.451	0.278	0.093
5	0.119	0.485	0.279	0.116
6	0.115	0.560	0.170	0.116
7	0.062	0.585	0.234	0.118
8	0.101	0.530	0.239	0.129
9	0.146	0.539	0.192	0.123
10	0.183	0.510	0.18	0.127
Average Importance	0.141	0.513	0.220	0.121
Normalized Importance	29.2%	100%	44.1%	23.9%

#### 4.5. Discussion of SEM-ANN Results

This study explores the factors that influence users' intentions to transition from cash. This study examines the determinants affecting customers' inclinations to shift from cash payments to the QRIS amid the COVID-19 outbreak. The results indicate that the elements of the push factor do not significantly influence the desire to transition from cash payments to the QRIS at this moment. The dissatisfaction component in the push aspect does not significantly influence switching intentions. This indicates that customer discontent with

cash payments does not compel them to adopt the QRIS for transactions, suggesting that users may transition to the QRIS for reasons unrelated to displeasure with cash payments. These results contrast with [Purwandari et al. \(2022\)](#), who found that COVID-19 concerns significantly accelerated digital payment adoption in Indonesia. [Aji et al. \(2020\)](#) also reported that health-related motivations played a role in mobile payment uptake during the pandemic. The discrepancy in findings may be attributed to the easing of COVID-19 restrictions, reducing the urgency for contactless transactions.

In the pull dimension, the variables of performance expectation and effort expectation do not significantly influence the intention to transition from cash rewards to the QRIS during the COVID-19 pandemic. These results contradict findings by [Venkatesh et al. \(2012\)](#) and [Purwandari et al. \(2022\)](#), where the ease of use and perceived efficiency played a crucial role. This indicates that the apparent advantages and convenience of utilizing the QRIS do not compel customers to forsake cash payments in favor of the QRIS for transactions. The pull feature of this study, representing the alternative attraction and critical mass factor, significantly influences the intention to transition from cash payments to the QRIS during the COVID-19 pandemic, supporting previous research conducted by [Loh et al. \(2021\)](#) and [Yu and Chen \(2022\)](#). This suggests that users regard QRIS services as preferable to cash payments because of QRIS's attractiveness, which encompasses a diverse array of service alternatives, intuitive functionalities, and many promotions and cashback incentives offered by the QRIS. These appealing attributes incentivize users to select the QRIS for transactions.

The trust element in the mooring aspect significantly influences the inclination to transition from cash payments to the QRIS during the COVID-19 epidemic aligning with [Loh et al. \(2021\)](#) and [\(Hidayat-ur-Rehman et al., 2021\)](#), which emphasize that trust in financial technology enhances adoption rates. This indicates that trust serves as a safeguard for users, instilling a sense of security in utilizing the QRIS as a transactional instrument. The perceived security and privacy aspects do not significantly influence the desire to transition from cash payments to QRIS usage during the COVID-19 pandemic, indicating that users' feelings of security and privacy do not affect their intention to refrain from utilizing QRIS services diverging from studies conducted by [Wu et al. \(2022\)](#) and [Purwandari et al. \(2022\)](#), which identified security concerns as a major barrier. Enhancing security and safeguarding privacy for QRIS service users can bolster user trust, hence reducing the likelihood of reverting to cash transactions. The switching cost element does not significantly influence the intention to transition from cash payments to the QRIS during the COVID-19 pandemic. This suggests that customers disregard the associated switching costs, indicating that such charges do not affect their desire to refrain from utilizing QRIS services.

This study evaluates SEM-based IPMA and ANN-based sensitivity analysis, revealing that the Attractiveness of Alternatives (DTA) holds the highest importance value as the primary factor influencing an individual's intention to switch to the QRIS for transactions during COVID-19, followed by trust (KP) and critical mass (CM). The significance of independent variables was derived from SEM-ANN analysis. The findings regarding the significance of the SEM-ANN independent variables presented in Table 7 are as follows:

**Table 7.** SEM-ANN independent variable importance results.

Variable	IPMA	Sensitivity Analysis
DTA	0.384	0.513
KP	0.122	0.220
CM	0.103	0.141

## 5. Conclusions and Future Research

This study provides insights into consumer switching intentions from cash payments to QRIS digital payments by integrating the Push-Pull-Mooring (PPM) framework and the Unified Theory of Acceptance and Use of Technology (UTAUT2). By employing a Hybrid SEM-ANN methodology, this study captures both linear relationships (PLS-SEM) and nonlinear patterns (ANN), offering a more comprehensive analysis of consumer behavior. The findings indicate that alternative attractiveness and social influence (critical mass) significantly drive QRIS adoption, while trust plays a key role in overcoming consumer reluctance. However, health awareness, perceived risk, and dissatisfaction with cash payments do not significantly influence switching behavior, suggesting that public health concerns alone may not be sufficient to encourage digital payment adoption. Additionally, traditional payment habits remain a major barrier, highlighting the need for behavioral interventions to promote cashless transactions.

The Hybrid SEM-ANN methodology used in this study can be adapted to examine digital payment adoption in other emerging economies, such as India, Vietnam, and Brazil, where cash usage remains prevalent but digital payment infrastructure is expanding. The approach can also be extended to analyze adoption patterns of cryptocurrencies, blockchain-based payments, or central bank digital currencies (CBDCs), where trust and regulatory factors play a crucial role. Beyond payments, this framework can be applied to healthcare (e.g., telemedicine adoption), education (e.g., e-learning platforms), or smart cities (e.g., digital identity systems), where user transition from traditional to digital solutions follows similar behavioral patterns.

Despite its contributions, this study has several limitations that should be addressed in future research, such as the following: (1) a more diverse sample should be used beside Indonesian QRIS users including rural populations and non-users to capture broader perspectives on digital payment adoption; (2) the use of regulatory policies should be considered, merchant adoption rates, or economic conditions, which may influence QRIS adoption to provide a more holistic view; and (3) other explainable AI (XAI) techniques should be used to improve the interpretability of ANN-based findings.

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