

Digital Payment System Adoption among MSMEs in Kedah and Perlis: Evidence on the Moderating Role of Perceived Security

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DOI Link: <http://dx.doi.org/10.6007/IJARBSS/v16-i9/29013>

Published Date: 26 September 2026

Abstract

This study examines the determinants of digital payment adoption among micro, small, and medium enterprises (MSMEs) in Kedah and Perlis, Malaysia. Drawing on the Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM), this research investigates the effects of perceived usefulness (PU), perceived ease of use (PEOU), information quality (IQ), system quality (SYSQ), and service quality (SSQ) on digital payment adoption, with perceived security (PS) examined as a moderating variable. Data were collected from MSME respondents in Kedah and Perlis using a structured questionnaire. A total of 200 valid responses were analysed using SPSS and partial least squares structural equation modelling (PLS-SEM). The findings reveal that PEOU significantly influences digital payment adoption ($\beta = 0.272$, $p = 0.006$), while PU, IQ, SYSQ, and SSQ do not demonstrate significant direct effects. PS also has a significant positive direct effect on digital payment adoption ($\beta = 0.271$, $p = 0.037$). Furthermore, PS significantly moderates the relationships between SYSQ and digital payment adoption ($\beta = 0.456$, $p = 0.019$) and between SSQ and digital payment adoption ($\beta = -0.330$, $p = 0.034$). However, PS does not significantly moderate the relationships between PU, PEOU, and IQ and digital payment adoption. Overall, the findings highlight the importance of ease of use and perceived security in encouraging digital payment adoption among MSMEs.

Keywords: Digital payment adoption, Information Systems Success Model (ISSM), Technology Acceptance Model (TAM), MSMEs, Perceived security, Partial least squares structural equation modelling (PLS-SEM)

Introduction

Digital transformation has become an essential strategic priority for businesses worldwide, particularly among micro, small, and medium enterprises (MSMEs) seeking to enhance operational efficiency, competitiveness, and long-term sustainability. The rapid advancement of Information and Communication Technology (ICT) has transformed the way businesses communicate, conduct commercial activities, and perform financial transactions. In this

context, digital payment systems have emerged as an important component of the digital economy, providing faster, more convenient, and efficient alternatives to traditional cash-based transactions. Digital payments have increasingly gained attention as technological development, internet accessibility, and smartphone usage continue to facilitate the shift towards cashless transactions (Ghosh, 2021). As digital payment systems become increasingly integrated into business activities, their adoption has become particularly relevant to MSMEs seeking to respond to changing consumer preferences and remain competitive in an increasingly digital business environment.

Despite the growing importance of digital payment systems, their adoption among MSMEs remains varied, as businesses may face different technological, economic, and operational challenges. Although digital payment technologies offer benefits in terms of convenience and transaction efficiency, some MSMEs continue to rely on cash-based transactions due to factors such as limited digital capabilities, transaction costs, infrastructure limitations, and concerns regarding security and privacy. Previous studies have identified various factors that may influence digital payment adoption, including perceived usefulness, perceived ease of use, information quality, system quality, and service quality. Perceived usefulness and perceived ease of use reflect how businesses perceive the benefits and usability of digital payment technologies, while information quality, system quality, and service quality relate to the quality and reliability of the digital payment system and the services provided. These factors may influence whether MSMEs perceive digital payment systems as suitable for their business operations. In addition, concerns regarding transaction security, data privacy, fraud, and unauthorised access may affect businesses' confidence in using digital payment technologies (Nugroho et al., 2024). Perceived security is therefore an important consideration because digital payment transactions involve financial and business information that may be exposed to various security risks.

In Malaysia, digital payment adoption has continued to develop as the country progresses towards a more digital and cashless economy. Government initiatives, technological development, increasing internet and smartphone penetration, and the growing demand for cashless transactions have contributed to the wider use of digital payment methods among businesses and consumers. The Malaysian government has also promoted digital payment adoption through initiatives aimed at supporting digital transformation and financial inclusion. However, the increasing availability of digital payment technologies does not necessarily mean that all MSMEs have fully adopted or consistently utilised these systems. Previous studies have identified challenges such as limited digital literacy, inadequate technological infrastructure, transaction costs, cash-based business practices, and concerns about security and privacy as factors that may affect digital payment adoption among businesses. In the context of Malaysian MSMEs, cashless payment adoption has received increasing attention, particularly in relation to the factors that encourage businesses to accept and utilise digital payment solutions (Samat & Bashri, 2024). As MSMEs contribute significantly to employment, business development, and economic growth, understanding the factors that influence their adoption of digital payment systems is increasingly important for supporting business efficiency and responding to changing market demands.

Previous studies on technology adoption have widely applied the Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM) to explain technology

acceptance and system use. TAM emphasises perceived usefulness (PU) and perceived ease of use (PEOU), while ISSM highlights information quality (IQ), system quality (SYSQ), and service quality (SSQ) as important dimensions of information system success. These constructs provide a relevant foundation for examining digital payment system adoption among MSMEs because the decision to adopt digital payment technology may depend not only on the perceived benefits and ease of use but also on the quality of information, system performance, and services provided (Hair et al., 2024). Previous studies have examined these factors in different technology adoption contexts, but the findings may vary according to the characteristics of users, technologies, and business environments (Kanapathipillai et al., 2024). Therefore, examining these factors together provides a broader understanding of the determinants of digital payment system adoption among MSMEs.

In addition, previous studies have highlighted the importance of security-related perceptions in influencing digital payment adoption (Chau et al., 2024). However, perceived security may not only influence adoption directly. It may also affect the strength of the relationship between other adoption factors and digital payment system adoption. For example, a digital payment system may be perceived as useful and easy to use, but these positive perceptions may have a weaker influence on adoption when business owners have concerns about transaction security. Similarly, businesses may be more likely to respond positively to reliable systems, quality information, and good services when they have greater confidence in the security of the payment system. Therefore, perceived security may strengthen or weaken the relationships between the determinants of digital payment adoption and actual adoption behaviour.

Although previous studies have examined perceived security as an important factor in technology and digital payment adoption, the evidence regarding its moderating role remains limited and inconsistent. Some studies have found that perceived security significantly moderates the relationship between perceived usefulness and mobile payment adoption, while other studies have reported no significant moderating effect in comparable contexts (Nguyen et al., 2023). These differences suggest that the role of perceived security may vary depending on the type of technology, user characteristics, and research context. Furthermore, previous research has often examined perceived security as a direct determinant of adoption rather than examining whether it changes the strength of relationships between multiple adoption factors and digital payment system adoption. Therefore, there remains a need to further examine whether perceived security moderates the relationships between perceived usefulness, perceived ease of use, information quality, system quality, service quality, and digital payment system adoption. This provides an important research gap, particularly in the context of MSMEs where concerns about transaction security and data protection may be especially relevant.

Furthermore, existing research on digital payment adoption in Malaysia has provided valuable insights into consumers and businesses in various settings, but comparatively limited attention has been given to MSMEs in Kedah and Perlis. Differences in business characteristics, technological readiness, digital infrastructure, and access to digital resources may influence how MSMEs in these states perceive and adopt digital payment technologies. This geographical context is therefore important because findings from other regions or user groups may not fully represent the experiences of MSMEs operating in Kedah and Perlis

(Ismadi et al., 2023). Examining this context can provide additional empirical evidence on digital payment adoption among MSMEs and contribute to a more comprehensive understanding of the factors influencing adoption in the Northern Malaysian context.

Therefore, this study aims to examine the factors influencing the adoption of digital payment systems among MSMEs in Kedah and Perlis, with particular emphasis on the moderating role of perceived security. Specifically, the study integrates perceived usefulness, perceived ease of use, information quality, system quality, and service quality to examine their influence on digital payment system adoption, while perceived security is examined as a moderator of these relationships. By examining perceived security as a moderating variable, this study extends the existing understanding of digital payment adoption by examining whether security perceptions influence the strength of the relationships between the identified adoption factors and digital payment system adoption. The study also provides empirical evidence from MSMEs in Kedah and Perlis, addressing a geographical context that has received comparatively limited attention in previous research. The findings are expected to contribute to the existing literature on digital payment adoption and provide practical insights for policymakers, government agencies, digital payment providers, and MSME owners in developing strategies to encourage secure and sustainable digital payment adoption.

Literature Review

Underpinning Theory

The adoption of digital payment systems is often examined through the lens of established technology adoption theories. The most widely used frameworks include the Technology Acceptance Model (TAM) (Davis, 1989) and the Information Systems Success Model (DeLone & McLean, 2003). These theories provide a foundation for understanding how perceived usefulness, perceived ease of use, and system quality influence the adoption of digital technologies.

Independent Variables

In this study, the independent variables are conceptualized based on established technology adoption models such as the Technology Acceptance Model (TAM) and the Information Systems Success Model (ISSM), with perceived security as a moderator. These variables are believed to influence the adoption of digital technologies for operations activities. Prior literature suggests that digital transformation success among MSMEs is strongly associated with the quality and reliability of digital systems and services (Kallmuenzer et al., 2025).

Perceived Usefulness (PU)

Perceived Usefulness (PU) is defined as the degree to which an individual believes that using a particular system will enhance job performance (Davis, 1989). Within the context of digital payment systems, perceived usefulness reflects the extent to which MSMEs believe that digital payment technologies can improve operational efficiency, reduce transaction costs, enhance transaction speed, and increase customer satisfaction. Since MSMEs often operate with limited financial and operational resources, technologies perceived as beneficial may become increasingly important in supporting business sustainability and competitiveness in a rapidly evolving digital economy.

Despite the widely recognized benefits of digital payment systems, the relationship between perceived usefulness and actual adoption behaviour may not always be straightforward. Several studies suggest that users may perceive digital payment systems as useful yet hesitate to adopt them due to concerns about trust, cybersecurity, perceived risk, and transaction safety (Norbu et al., 2024). In addition, fears of online fraud, cybercrime, and data security breaches may reduce users' confidence in using digital payment systems despite recognizing their potential benefits (Lestari et al., 2024). This indicates that perceived usefulness alone may not be sufficient to ensure adoption of digital payments, particularly among MSMEs, which are more vulnerable to operational and financial risks.

H1: Perceived Usefulness (PU) has a positive and significant influence on Digital Payment Technology Adoption

Perceived Ease of Use (PEOU)

Perceived Ease of Use (PEOU) refers to the degree to which an individual believes that using a particular system would be free of effort (Davis, 1989). In the context of digital payment systems, PEOU is considered an important factor influencing users' willingness to adopt new technologies, particularly among MSMEs with limited technical knowledge and digital experience. Digital payment platforms that are easy to learn, simple to navigate, and user-friendly are more likely to encourage adoption among business owners. Previous studies have shown that PEOU positively influences the intention to adopt digital payments. For example, Ming and Jais (2022) found that PEOU significantly affects e-wallet adoption in Malaysia, while Kanapathipillai et al. (2024) emphasized that technological readiness, including ease of use, significantly contributes to digital payment adoption among MSMEs. Similarly, Mohamad et al. (2022) highlighted that systems perceived as simple and convenient are more likely to achieve successful adoption in emerging economies.

The inconsistencies in previous findings indicate that the relationship between PEOU and digital payment adoption remains inconclusive, particularly in the MSME context. Therefore, this study proposes that PEOU positively influences the adoption of digital payment systems among MSMEs in Kedah and Perlis. In line with the Technology Acceptance Model (TAM), MSMEs are more likely to adopt digital payment systems when they perceive the systems as easy to understand and operate.

H2: Perceived Ease of Use (PEOU) has a positive and significant influence on Digital Payment Technology Adoption

Information Quality (IQ)

Information Quality (IQ) pertains to the quality of information that a system provides, including aspects like accuracy, relevance, timeliness, and completeness. High-quality information is essential for SMEs to make informed decisions and maintain efficient operations. In the context of digital payment systems, IQ can influence user satisfaction and trust, thereby affecting adoption rates.

Kaur et al. (2025) highlighted that the quality of information provided by electronic payment systems is a significant factor influencing their adoption among MSMEs. Furthermore, Kanapathipillai et al. (2024) discussed the importance of technological readiness, which encompasses the quality of information systems, in driving digital payment adoption. Ming &

Jais (2022) also noted that accurate and timely information enhances users' trust in e-wallet systems.

H3: Information Quality (IQ) has a positive and significant influence on Digital Payment Technology Adoption

System Quality (SYSQ)

System Quality (SYSQ) refers to the technical performance characteristics of a digital payment system, including usability, reliability, adaptability, availability, and response time (Shanmugavel et al., 2024). Within the Information Systems Success Model (ISSM), system quality is considered an important determinant of user satisfaction and behavioural intention because users are more likely to adopt systems that are stable, efficient, and easy to operate. In the context of digital payment systems, high system quality ensures smooth transaction processes, minimal system downtime, fast response times, and secure payment experiences, which are crucial for MSMEs that rely on digital transactions for daily business operations.

Despite these positive findings, previous studies have reported inconsistencies regarding the direct influence of system quality on adoption intention. In addition, studies based on TAM and UTAUT frameworks often identified performance expectancy, trust, security, and facilitating conditions as stronger predictors of digital payment adoption compared to system quality (Linge et al., 2023). Research in developing economies also indicates that security and trust concerns may overshadow the role of system quality in influencing users' adoption decisions (Al-Shamali et al., 2025).

H4: System Service Quality (SSQ) has a positive and significant influence on Digital Payment Technology Adoption

System Service Quality (SSQ)

Service Quality (SSQ) refers to the quality of support services provided to users by digital payment service providers, including responsiveness, technical assistance, reliability, and customer support (Shanmugavel et al., 2024). Within the Information Systems Success Model (ISSM), service quality is considered an important dimension influencing user satisfaction and behavioural intention toward information systems adoption. In the context of digital payment systems, high service quality enables MSMEs to receive timely assistance, resolve transaction-related issues efficiently, and develop greater confidence in using digital payment technologies for business operations.

Likewise, Tun (2021) reported that service quality was an insignificant determinant of behavioural intention toward mobile banking adoption. These findings suggest that service quality may influence adoption indirectly through mediating variables such as satisfaction and perceived usefulness rather than exerting a direct effect on behavioural intention. Furthermore, studies based on TAM and UTAUT frameworks often identify factors such as trust, security, performance expectancy, and facilitating conditions as stronger predictors of digital payment adoption compared to service quality (Nguyen et al., 2023).

H5: System Quality (SSQ) has a positive and significant influence on Digital Payment Technology Adoption

Moderating Variable: Perceived Security (PS)

Perceived Security (PS) refers to the extent to which users believe that a digital payment system can securely protect personal information, financial data, and transaction activities from unauthorized access, fraud, or misuse. In digital payment environments, perceived security is considered a critical factor because financial transactions involve sensitive information and potential risks. Within the context of digital payment adoption among MSMEs, perceived security may strengthen or weaken the relationship between technological factors and users' intention to adopt digital payment systems.

Despite the strong theoretical support for perceived security, prior studies have reported inconsistent findings regarding its exact role in digital payment adoption models. Some researchers conceptualise perceived security as a distinct construct that independently moderates adoption behaviour (Al-Shamali et al., 2025), whereas others argue that security perceptions are embedded within broader constructs such as trust or perceived risk (Jegerson & Hussain, 2022). Studies conducted in developing economies further suggest that perceived security may become more influential in environments where concerns regarding fraud, privacy breaches, and weak digital infrastructure remain prevalent (Poudel et al., 2023).

H6a: Perceived security moderates the relationship between perceived usefulness and digital payment adoption among MSMEs.

H6b: Perceived security moderates the relationship between perceived ease of use and digital payment adoption among MSMEs.

H6c: Perceived security moderates the relationship between information quality and digital payment adoption among MSMEs.

H6d: Perceived security moderates the relationship between system quality and digital payment adoption among MSMEs.

H6e: Perceived security moderates the relationship between service quality and digital payment adoption among MSMEs.

Overall, the framework of this study is shown in Figure 1

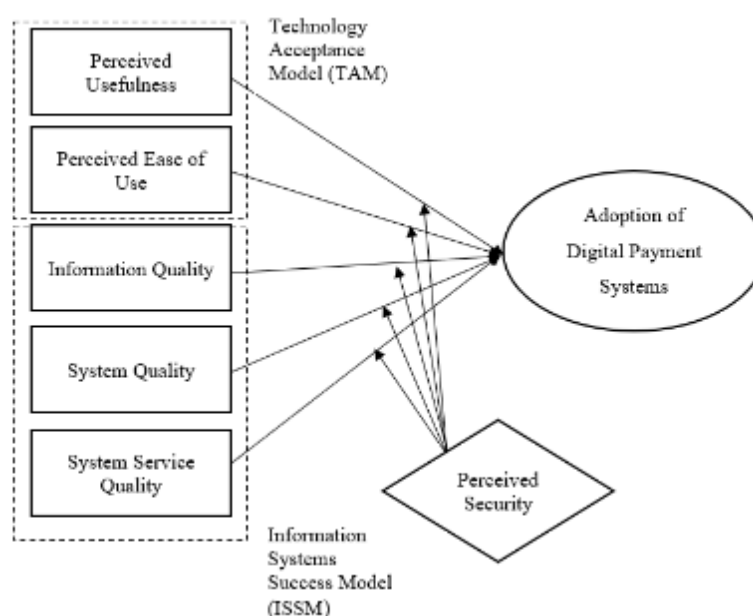


Figure 1: Research Framework of the study

Methodology

Data Collection and Population

This study employed a quantitative research approach to examine the factors influencing digital payment adoption among MSMEs. The study population consisted of MSMEs operating in the states of Kedah and Perlis, Malaysia. Data were collected using a structured questionnaire distributed primarily through online platforms, allowing respondents to complete and submit their responses electronically. A total of 200 questionnaires were completed and returned by respondents. Therefore, all 200 responses were considered valid and usable for the data analysis, resulting in an effective response rate of 100%.

Questionnaire Development

The study adopted a descriptive research design using a quantitative approach, with data collected through a structured questionnaire. To enhance the validity and reliability of the questionnaire, expert verification is conducted. This step helps ensure that the instrument effectively captures the variables of interest and reduces the risk of measurement errors (Hair et al., 2024). The development of these questionnaires necessitates careful consideration to ensure they effectively capture the data required to answer the research questions. A well-established scale can measure variables more accurately. The questionnaire in this paper was designed strictly with the principles of scale development to ensure content validity and to ensure that the questionnaire effectively captures the necessary data for robust empirical analysis.

Results and Findings

To conduct this study, the background description includes the respondents' gender, state of employment, MSME industry, business age, frequency of digital payment usage, and type of digital payment system used. Table 1 presents a comprehensive overview of the respondents' demographic and business-related information.

Table 1

Descriptive Statistics of Respondents

Constructs		Count	Column N %
Gender	Male	70	35.0%
	Female	130	65.0%
Working in state	Kedah	110	55.0%
	Perlis	90	45.0%
I am working in the MSME industry	Services	117	58.5%
	Manufacturing	34	17.0%
	Construction	30	15.0%
	Agriculture	18	9.0%
	Mining and Quarrying	1	0.5%
The age of MSME business	1-2 years	27	13.5%
	3-4 years	69	34.5%
	5-6 years	57	28.5%
	Over 7 years	47	23.5%
Frequency	Daily	118	59.0%
	Weekly	51	25.5%
	Monthly	25	12.5%
	Rarely	6	3.0%

Type	E-wallets	19	9.5%
	Online Banking	61	30.5%
	Credit/Debit card	35	17.5%
terminals			
	Mobile apps	19	9.5%
	QR code payment	66	33.0%

Normality Test

This study assessed the normality of the data distribution for each variable analysed to ensure the suitability of the dataset for subsequent statistical procedures. The data were considered to meet the normality assumption when skewness values fell within the range of -2 to $+2$ and kurtosis values within -7 to $+7$, as recommended in recent methodological guidelines (Hair et al., 2024; Tabachnick & Fidell, 2025). Descriptive statistics, including skewness and kurtosis, were generated using SPSS version 25, and the results are reported in Table 2. These results confirm that the dataset satisfies the normality criteria and is appropriate for further advanced statistical analysis.

Table 2

The Results of Normality Analysis

Variable	Mean	Standard Deviation	Skewness	S.E	Kurtosis	S.E	Normal Distribution
PU	3.7000	.79957	-1.284	.427	.061	.833	Yes
PEOU	3.6933	.81830	-1.461	.427	.796	.833	Yes
IQ	3.6800	.74018	-1.433	.427	.678	.833	Yes
SYSQ	3.6600	.78985	-1.305	.427	.147	.833	Yes
SSQ	3.7067	.72537	-1.407	.427	.623	.833	Yes
PS	3.7067	.75335	-1.550	.427	.949	.833	Yes

Reliability Test

Reliability refers to the degree to which repeated measurements of the same construct, using consistent procedures, produce stable and consistent results over time. In this study, reliability analysis was performed, and the results are presented in Table 3. These findings provide evidence regarding the consistency and dependability of the measurement scales employed in this research.

Table 3

Reliability Test Results

Construct	Items	Cronbach's Alpha value	Internal consistency status
PU	5	.840	Good reliability
PEOU	5	.874	Good reliability
IQ	5	.884	Good reliability
SYSQ	5	.856	Good reliability
SSQ	5	.846	Good reliability
PS	5	.874	Good reliability

The results of the reliability analysis indicated a high level of reliability for the constructs under examination. The PU, which consists of five items, has a Cronbach's alpha of 0.840, thereby providing evidence of its reliability. Similarly, the construct of PEOU, which comprises

five items, has a Cronbach's alpha of 0.874, indicative of good reliability. The IQ construct, comprising five items, demonstrated good internal consistency, as indicated by a Cronbach's alpha coefficient of 0.884. The SYSQ and SSQ, which also comprise five items, show Cronbach's alpha values of 0.856 and 0.846, respectively, thereby providing evidence of their reliability. The PS construct, which consists of five items, records a Cronbach's alpha of 0.874, indicating good internal consistency. Overall, all constructs demonstrated good reliability, with Cronbach's alpha values exceeding the recommended threshold of 0.70.

Validity Test

The adequacy of the sample data was assessed using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity. Bartlett's test evaluates the null hypothesis that the variables are uncorrelated in the population correlation matrix. A KMO value exceeding 0.60, together with a Bartlett's test significance level below 0.05, indicates that the data are suitable for factor analysis and that meaningful relationships exist among the variables (Hair et al., 2024).

The results of the exploratory factor analysis (EFA) suitability assessment for the constructs. The Kaiser–Meyer–Olkin (KMO) values range from 0.703 to 0.804, indicating acceptable sampling adequacy for all constructs. The total variance explained (TVE) values range from 61.459% to 69.213%, suggesting that the extracted factors explain a substantial proportion of the variance in the observed variables. Specifically, PU, PEOU, IQ, SYSQ, SSQ, and PS explain 61.459%, 68.167%, 69.213%, 64.969%, 62.443%, and 66.818% of the variance, respectively. Furthermore, Bartlett's test of sphericity is significant for all constructs ($p < 0.001$), indicating that the correlation matrices are suitable for factor analysis. The results demonstrate that all constructs meet the requirements for factor analysis, supporting the suitability of the measurement items for further analysis.

Table 4

Results of the KMO and Bartlett Test

Construct	KMO	Sampling Adequacy	TVE (%)	Bartlett Test	Factor analysis suitability
PU	.786	Acceptable	61.459	<0.001	Acceptable
PEOU	.804	Acceptable	68.167	<0.001	Acceptable
IQ	.795	Acceptable	69.213	<0.001	Acceptable
SYSQ	.779	Acceptable	64.969	<0.001	Acceptable
SSQ	.707	Acceptable	62.443	<0.001	Acceptable
PS	.703	Acceptable	66.818	<0.001	Acceptable

Convergent validity pertains to the correlation among individual measurement items when a measurement instrument assesses a concept. Adequate convergent validity is achieved when the average variance extracted (AVE) is more than 0.5 and the composite reliability (CR) is higher than 0.7 (Fornell & Larcker, 1981; Hair et al., 1998). The results are in Table 5.

Table 5

Results of Indicators Related to Convergent Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DV	0.799	0.800	0.861	0.555
IQ	0.773	0.776	0.845	0.522
PEOU	0.728	0.734	0.821	0.479
PS	0.817	0.829	0.872	0.577
PU	0.740	0.769	0.825	0.490
SSQ	0.804	0.814	0.865	0.562
SYSQ	0.782	0.787	0.852	0.536

Table 5 presents the results of the measurement model assessment, including Cronbach's alpha, composite reliability (rho_a), composite reliability (rho_c), and average variance extracted (AVE). The Cronbach's alpha values range from 0.728 to 0.817, while composite reliability (rho_a) values range from 0.734 to 0.829. Similarly, composite reliability (rho_c) values range from 0.821 to 0.872. These results indicate that all constructs demonstrate satisfactory internal consistency reliability, as the values exceed the recommended threshold of 0.70. The AVE values range from 0.479 to 0.577. DV, IQ, PS, SSQ, and SYSQ achieve AVE values above 0.50, indicating satisfactory convergent validity. However, PEOU (AVE = 0.479) and PU (AVE = 0.490) record values slightly below the recommended threshold of 0.50. Nevertheless, their composite reliability values remain above 0.70, suggesting that the constructs demonstrate acceptable reliability.

Furthermore, discriminant validity is essential to ensure that each construct is empirically distinct from others within the model. Based on the Fornell–Larcker criterion, the square root of the AVE for each construct exceeded its corresponding inter-construct correlations, suggesting that each construct shares more variance with its own indicators than with other constructs. This provides evidence of satisfactory discriminant validity at the construct level (Fornell & Larcker, 1981; Hair et al., 2024). Table 6 indicates that the discriminant validity between the constructs has been successfully tested and confirmed.

Table 6:

Discriminant Validity Test

	DV	IQ	PEOU	PS	PU	SSQ	SYSQ
DV	0.745						
IQ	0.724	0.723					
PEOU	0.749	0.728	0.692				
PS	0.697	0.717	0.661	0.760			
PU	0.622	0.640	0.646	0.564	0.700		
SSQ	0.679	0.751	0.631	0.655	0.514	0.750	
SYSQ	0.753	0.782	0.751	0.745	0.660	0.801	0.732

Specifically, the results indicate that all constructs satisfied the HTMT criterion. The HTMT values for DV, IQ, PEOU, PS, PU, SSQ, and SYSQ range from 0.514 to 0.801. The highest HTMT value was recorded between SSQ and SYSQ (0.801), followed by IQ and SYSQ (0.782), while the lowest value was observed between PU and SSQ (0.514). Although some HTMT values are relatively high, all values remain below the recommended threshold of 0.85. These findings

indicate that the constructs are empirically distinct and do not overlap excessively. Therefore, the measurement model achieved satisfactory discriminant validity, supporting the constructs' suitability for further structural model analysis.

Hypothesis Testing

Table 7

Results of Hypothesis Testing

Hypothesis	Path	β (O)	Sample Mean (M)	t-value	P- value	Decision
H1	PU $\rightarrow$ DV	0.081	0.125	0.943	0.346	Not Supported
H2	PEOU $\rightarrow$ DV	0.272	0.272	2.772	0.006	Supported
H3	IQ $\rightarrow$ DV	0.038	0.037	0.356	0.722	Not Supported
H4	SYSQ $\rightarrow$ DV	0.144	0.129	1.209	0.227	Not Supported
H5	SSQ $\rightarrow$ DV	0.079	0.101	0.765	0.445	Not Supported
H6	PS $\rightarrow$ DV	0.271	0.218	2.082	0.037	Supported
H6a	PS $\times$ PU $\rightarrow$ DV	-0.241	-0.164	1.319	0.187	Not Supported
H6b	PS $\times$ PEOU $\rightarrow$ DV	0.132	0.106	0.939	0.348	Not Supported
H6c	PS $\times$ IQ $\rightarrow$ DV	-0.162	-0.155	0.941	0.347	Not Supported
H6d	PS $\times$ SYSQ $\rightarrow$ DV	0.456	0.388	2.340	0.019	Supported
H6e	PS $\times$ SSQ $\rightarrow$ DV	-0.330	-0.298	2.116	0.034	Supported

Table 7 presents the results of the hypothesis testing using the bootstrapping procedure. The findings indicate that PEOU has a positive and significant effect on DV ($\beta = 0.272$, $t = 2.772$, $p = 0.006$), supporting H2. Similarly, PS has a positive and significant effect on DV ($\beta = 0.271$, $t = 2.082$, $p = 0.037$), supporting H6. However, PU ($\beta = 0.081$, $t = 0.943$, $p = 0.346$), IQ ($\beta = 0.038$, $t = 0.356$, $p = 0.722$), SYSQ ($\beta = 0.144$, $t = 1.209$, $p = 0.227$), and SSQ ($\beta = 0.079$, $t = 0.765$, $p = 0.445$) do not have significant effects on DV, and therefore H1, H3, H4, and H5 are not supported.

Regarding the moderating effects, PS significantly moderates the relationship between SYSQ and DV ($\beta = 0.456$, $t = 2.340$, $p = 0.019$), supporting H6d. PS also significantly moderates the relationship between SSQ and DV ($\beta = -0.330$, $t = 2.116$, $p = 0.034$), supporting H6e. However, the moderating effects of PS on the relationships between PU and DV ($\beta = -0.241$, $t = 1.319$, $p = 0.187$), PEOU and DV ($\beta = 0.132$, $t = 0.939$, $p = 0.348$), and IQ and DV ($\beta = -0.162$, $t = 0.941$, $p = 0.347$) are not significant. Therefore, H7, H8, and H9 are not supported. Overall, five hypotheses are not supported, while four hypotheses are supported.

Discussion

This study examined the determinants of digital payment adoption among micro, small, and medium enterprises (MSMEs) in Kedah and Perlis by integrating the Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM), with perceived security (PS) examined as a moderating variable. The findings indicate that perceived ease of use (PEOU) and perceived security have significant positive effects on digital payment adoption, whereas perceived usefulness (PU), information quality (IQ), system quality (SYSQ), and service quality (SSQ) do not have significant direct effects. In addition, perceived security significantly moderates the relationships between system quality and digital payment adoption, and

between service quality and digital payment adoption. These findings provide a more nuanced understanding of the factors influencing digital payment adoption among MSMEs in Kedah and Perlis.

Perceived Usefulness

The non-significant effect of perceived usefulness on digital payment adoption indicates that the perceived benefits of digital payment systems do not, on their own, significantly influence adoption decisions among MSMEs in Kedah and Perlis. Although digital payment systems may offer advantages such as transaction convenience, improved payment efficiency, and reduced reliance on cash, these benefits may not be sufficient to encourage adoption. This finding suggests that MSMEs may place greater emphasis on the practical experience of using digital payment systems, particularly their ease of operation and security, rather than on their perceived usefulness alone. From a theoretical perspective, the finding indicates that the influence of perceived usefulness may vary depending on the technological context and characteristics of the users (Tanha et al., 2024). Therefore, digital payment providers should not only communicate the benefits of digital payment systems but also ensure that these benefits are supported by simple, reliable, and secure payment experiences.

Perceived Ease of Use

The significant positive effect of perceived ease of use on digital payment adoption indicates that MSMEs are more likely to adopt digital payment systems when they perceive the systems as easy to learn, understand, and operate. This finding supports the Technology Acceptance Model, which identifies perceived ease of use as an important determinant of technology acceptance. In the context of MSMEs in Kedah and Perlis, digital payment platforms that offer simple interfaces, straightforward transaction procedures, and accessible features may encourage greater adoption. This finding also highlights the importance of digital literacy and user-friendly system design in supporting MSMEs' digital transformation (Chandra & Phadipta, 2022). Therefore, digital payment providers should prioritise the development of intuitive payment platforms and provide clear guidance to ensure that MSMEs can use digital payment systems confidently and effectively.

Information Quality

The non-significant effect of information quality on digital payment adoption suggests that the quality of information provided by digital payment systems may not be a primary determinant of adoption among MSMEs in this study. Although accurate, relevant, and understandable information is important for supporting business operations, MSMEs may place greater emphasis on the practical experience of using digital payment systems than on the information generated by these systems (Jain & Jain, 2024). This finding indicates that information quality alone may not be sufficient to influence adoption decisions. Instead, MSMEs may require a combination of useful information, ease of use, and reliable system performance before they are willing to adopt digital payment systems. From a theoretical perspective, the finding suggests that the relationship between information quality and technology adoption may vary depending on the technological context and characteristics of the users (Jegerson & Hussain, 2022). Therefore, digital payment providers should ensure that transaction information is clear, accurate, and accessible, while also improving the overall usability and functionality of their systems.

System Quality

The non-significant effect of system quality on digital payment adoption indicates that system quality alone does not significantly influence adoption among MSMEs in Kedah and Perlis. Although system quality is generally associated with reliability, accessibility, and efficient system performance, these characteristics may not be sufficient to encourage adoption when considered independently (Pushparaj et al., 2025). This finding suggests that MSMEs may evaluate digital payment systems based on a combination of factors rather than system performance alone. For example, a system may be perceived as reliable and efficient, but its adoption may still depend on whether users find it easy to operate and secure (Ma et al., 2022). Therefore, the findings suggest that system quality should be considered together with other factors, particularly perceived ease of use and perceived security, when examining digital payment adoption among MSMEs.

Service Quality

The non-significant effect of service quality on digital payment adoption suggests that the support services provided by digital payment platforms may not have a direct influence on adoption decisions among MSMEs in this study. Although service quality is important for providing technical assistance, customer support, and guidance, MSMEs may not consider these services as a primary determinant of their adoption decisions. This may indicate that service quality becomes more important when users encounter difficulties or require assistance during the use of digital payment systems (Purwantini & Anisa, 2021). Therefore, the findings suggest that service quality may play a more important role in supporting adoption when it is combined with other factors, particularly perceived security. This interpretation is further supported by the significant moderating effect of perceived security on the relationship between service quality and digital payment adoption.

Perceived Security

The significant positive effect of perceived security on digital payment adoption indicates that MSMEs are more likely to adopt digital payment systems when they perceive the systems as secure. This finding highlights the importance of security perceptions in encouraging digital payment adoption among MSMEs in Kedah and Perlis. From a theoretical perspective, the finding extends the understanding of technology acceptance by demonstrating that perceived security is not only relevant as a moderating variable but also has a direct influence on adoption behaviour. MSMEs may be more willing to adopt digital payment systems when they believe that their transactions, financial information, and business data are adequately protected (Camacho, 2022). Therefore, digital payment providers should strengthen security assurance, communicate security features clearly, and provide users with confidence that their transactions are protected.

Moderating Effect of Perceived Security on System Quality

The significant positive moderating effect of perceived security on the relationship between system quality and digital payment adoption indicates that perceived security strengthens this relationship. Although system quality does not demonstrate a significant direct effect on adoption, its interaction with perceived security is significant. This finding suggests that the influence of system quality on digital payment adoption becomes stronger when MSMEs perceive digital payment systems as more secure. In the context of MSMEs in Kedah and Perlis, reliable and efficient digital payment systems may be more likely to encourage

adoption when users also have confidence in the security of the system. Therefore, digital payment providers should focus on improving system performance while also strengthening security assurance. This may help MSMEs develop greater confidence in digital payment systems and encourage wider adoption.

Moderating Effect of Perceived Security on Service Quality

The significant negative moderating effect of perceived security on the relationship between service quality and digital payment adoption indicates that perceived security weakens this relationship. Although service quality does not demonstrate a significant direct effect on adoption, its interaction with perceived security is significant. This finding suggests that the influence of service quality on digital payment adoption becomes weaker when MSMEs perceive higher levels of security. One possible explanation is that MSMEs may place greater emphasis on security when evaluating digital payment systems, reducing the relative importance of service quality in their adoption decisions. This finding highlights the importance of examining the interaction between service quality and security perceptions rather than considering service quality as an independent determinant of adoption. Therefore, digital payment providers should ensure that service quality is supported by clear security assurance and reliable security practices to encourage MSMEs to adopt digital payment systems.

Overall, this study contributes theoretically by extending the Technology Acceptance Model and Information Systems Success Model through the inclusion of perceived security as a moderating variable in the MSME digital payment adoption context. The findings demonstrate that perceived ease of use and perceived security are significant direct predictors of digital payment adoption, while the moderating effects of perceived security on system quality and service quality highlight the importance of examining the interaction between technological characteristics and security perceptions. These findings suggest that digital payment adoption among MSMEs is influenced not only by the characteristics of digital payment systems but also by users' perceptions of security. Practically, the study suggests that digital payment providers and policymakers should focus on improving the ease of use, reliability, and security of digital payment systems. Strengthening security assurance while maintaining user-friendly system design and reliable support services may help encourage greater digital payment adoption among MSMEs in Kedah and Perlis.

Conclusion

This study applied the Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM) to examine the determinants of digital payment adoption among MSMEs in Kedah and Perlis, with perceived security (PS) as a moderating variable. The analysis revealed that the p-value for perceived usefulness (PU) was 0.346, which exceeded the significance level of 0.05, indicating that PU did not have a significant relationship with digital payment adoption and therefore did not support H1. In contrast, perceived ease of use (PEOU) demonstrated a significant positive relationship with digital payment adoption, with a p-value of 0.006, supporting H2. Similarly, information quality (IQ), system quality (SYSQ), and service quality (SSQ) did not show significant direct relationships with digital payment adoption, as their p-values were 0.722, 0.227, and 0.445, respectively, leading to the rejection of H3, H4, and H5. Perceived security had a significant positive direct effect on digital payment adoption, with a p-value of 0.037, supporting H6. Furthermore, PS did not significantly moderate the

relationships between PU, PEOU, and IQ and digital payment adoption, with p-values of 0.187, 0.348, and 0.347, respectively, resulting in the rejection of H6a, H6b, and H6c. However, PS significantly moderated the relationships between SYSQ and SSQ and digital payment adoption, with p-values of 0.019 and 0.034, respectively, supporting H6d and H6e. Overall, the findings indicate that perceived ease of use and perceived security are important determinants of digital payment adoption, while perceived security strengthens the effect of system quality but weakens the effect of service quality on digital payment adoption.

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