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Adoption of e-wallets: trust and perceived risk in Generation Z in Colombia

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Abstract

Purpose – This study aims to explore the development of trust in relation to security and privacy concerns, as well as the influence of perceived risk on the intention to use e-wallets. The research focused on the Colombian context because of its characterization as an underdeveloped financial system that has experienced considerable security and privacy violations in recent years. Additionally, this geographical area is relatively under-researched, and the target demographic for this investigation was Generation Z, given their pivotal role in driving the adoption of e-wallets.

Design/methodology/approach – Based on measurement scales that had already been tested in the academic literature on mobile payment systems, a questionnaire was developed and distributed electronically. A total of 424 responses were obtained from young Colombians. Structural equation modeling (SEM), specifically the PLS-SEM method, was used to process the data to study the explanatory and predictive power of the proposed model.

Findings – The findings revealed that security and privacy have a positive and significant effect on perceived trust, and that this at the same time has a positive and significant effect on attitude, perceived usefulness, perceived ease and intention to use, as well as a significant but negative effect on perceived risk. On the other hand, perceived risk showed an inverse, but not significant, relationship with intention to use.

Originality/value – This research explored the adoption of e-wallets by young people in Colombia, which has been widely claimed in the academic literature. In a turbulent context with a high distrust of financial institutions, as well as a change in digital money consumption patterns, it is critical to understand the factors that contribute to the adoption of mobile payment services. The findings, in addition to contributing to the academic debate, have important implications for e-wallet providers, as they offer information that allows designing strategies to attract and keep current and potential users. At the same time, the recommendations by the authors allow the design of tools, especially related to security and privacy, to improve their trust and build loyalty, thus contributing to the consolidation and development of the mobile payment system.

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Paper type Research paper

Adopción de monederos electrónicos: confianza y riesgo percibido en la Generación Z en Colombia

Resumen

Objetivo – Este estudio explora el desarrollo de la confianza en relación con las preocupaciones sobre seguridad y privacidad, así como la influencia del riesgo percibido en la intención de utilizar monederos electrónicos. La investigación se centró en el contexto colombiano debido a su caracterización como un sistema financiero subdesarrollado que ha experimentado violaciones considerables de seguridad y privacidad en los últimos años. Además, esta área geográfica está relativamente poco investigada, y el público objetivo de esta investigación fue la Generación Z, dado su papel clave en la adopción de monederos electrónicos.

Diseño/metodología/enfoque – Basado en escalas de medición ya probadas en la literatura académica sobre sistemas de pago móvil, se desarrolló y distribuyó electrónicamente un cuestionario. Se obtuvieron un total de 424 respuestas de jóvenes colombianos. Se utilizó el modelado de ecuaciones estructurales, específicamente el método PLS-SEM, para procesar los datos y estudiar el poder explicativo y predictivo del modelo propuesto.

Resultados – Nuestros hallazgos revelaron que la seguridad y la privacidad tienen un efecto positivo y significativo en la confianza percibida, y que esto, a su vez, tiene un efecto positivo y significativo en la actitud, la utilidad percibida, la facilidad percibida y la intención de uso, así como un efecto significativo pero negativo en el riesgo percibido. Por otro lado, el riesgo percibido mostró una relación inversa, pero no significativa, con la intención de uso.

Originalidad/valor – Esta investigación exploró la adopción de monederos electrónicos por parte de los jóvenes en Colombia, un tema ampliamente mencionado en la literatura académica. En un contexto turbulento con alta desconfianza hacia las instituciones financieras, así como un cambio en los patrones de consumo de dinero digital, es crucial comprender los factores que contribuyen a la adopción de servicios de pago móvil. Nuestros hallazgos, además de contribuir al debate académico, tienen importantes implicaciones para los proveedores de monederos electrónicos, ya que ofrecen información que permite diseñar estrategias para atraer y retener a usuarios actuales y potenciales. Al mismo tiempo, nuestras recomendaciones permiten diseñar herramientas, especialmente relacionadas con la seguridad y la privacidad, para mejorar la confianza y fomentar la lealtad, contribuyendo así a la consolidación y desarrollo del sistema de pago móvil.

Palabras clave confianza percibida, Riesgo percibido, Privacidad percibida, Seguridad percibida, TAM ampliado, Monederos electrónicos

Tipo de artículo Trabajo de investigación

电子钱包的采纳：哥伦比亚Z世代的信任与感知风险

摘要

目的 – 本研究探讨了与安全性和隐私问题相关的信任发展，以及感知风险对使用电子钱包意图的影响。研究集中在哥伦比亚的背景下，因为该国的金融系统被认为是欠发达的，近年来经历了相当大的安全性和隐私侵犯问题。此外，这一地理区域的研究相对较少，本研究的目标人群为Z世代，考虑到他们在推动电子钱包采纳中的关键作用。

设计/方法 – 基于已经在移动支付系统学术文献中测试过的测量尺度，开发并电子分发了一份问卷。共获得了424份哥伦比亚年轻人的回应。使用结构方程建模中的PLS-SEM方法处理数据，以研究所提出模型的解释力和预测力。

发现 – 研究发现，安全性和隐私对感知信任有显著正向影响，同时，感知信任对态度、感知有用性、感知易用性和使用意图也有显著正向影响，并对感知风险有显著负向影响。另一方面，感知风险与使用意图之间呈现出反向但不显著的关系。

原创性/价值 – 本研究探讨了哥伦比亚年轻人对电子钱包的采纳，这在学术文献中已有广泛讨论。在一个对金融机构高度不信任的动荡背景下，以及数字货币消费模式的变化中，理解促使移动支付服务采纳的因素至关重要。我们的研究结果不仅有助于学术讨论，还对电子钱包提供商具有重要意义，因为这些结果提供了信息，有助于设计吸引和留住当前及潜在用户的策略。同时，我们的建议有助于设

计特别与安全性和隐私相关的工具，以提高用户信任并建立忠诚度，从而促进移动支付系统的巩固和发展。

关键词 感知信任, 感知风险, 感知隐私, 感知安全, 扩展技术接受模型（TAM）, 电子钱包
文章类型 研究型论文

1. Introduction

Fintechs have grown exponentially in the past decade, leading to a transformation of digital payment systems (Sutticherchart and Rakthin, 2023), which are defined as a financial service that is carried out through mobile devices and that allows transactions, cross-selling of products or even advisory services, while allowing users to know their history and performance (Gerlach and Lutz, 2021). One of the most widely used mobile payment systems today are e-wallets, which are electronic cards that allow users to make transactions through smartphones, characterized by their ease of use, convenience and by not offering location and time restrictions (Qasim and Abu-Shanab, 2016).

Currently, e-wallets have become an interesting service from an academic point of view for two main reasons: because after COVID-19 people prefer digital solutions (Al-Qudah *et al.*, 2022), and because financial technologies are booming, especially e-wallets, which are being driven by generation Z, which is the current target audience of financial service providers (Abu-Daqar *et al.*, 2020). Along these lines, generation Z, referring to the segment of consumers born between 1995 and 2010, is a very large group of consumers who use or will use e-wallets in the coming years, as they frequently interact with their mobile phones to stay connected and make online purchases, being the generation that carries out a greater volume of financial transactions (Dalimunte *et al.*, 2019).

However, the use of e-wallets by generation Z is subject to overcoming a series of barriers. On the one hand, recent security problems, with more than 15 million people recently losing their digital identity (McAfee, 2023), with the mobile phone being the most frequent cause of identity theft (Finanso, 2022). On the other hand, security issues, as recent studies have pointed out that e-wallets are vulnerable to trivial attack vectors (Kaur *et al.*, 2018). Along these lines, the academic literature has found evidence that privacy and security are two of the aspects most valued by users of mobile payment services, and the absence of them can lead to the rejection of the technology (Hu *et al.*, 2023). In parallel, privacy and privacy are fundamental antecedents of trust in mobile payment systems (Gouthier *et al.*, 2022), this being the greatest concern of providers for the acceptance of their financial technology (Lian and Li, 2021). In addition to security, privacy and trust, Karsen *et al.* (2019) argue that perceived risk is also a determinant for consumers' acceptance of mobile payment services.

Consequently, the need to evaluate the effect of these factors on the use of e-wallet adoption by generation Z is identified, especially in Colombia, which is characterized by underdeveloped financial infrastructures and populations with a high distrust of financial institutions (Kalaignanam *et al.*, 2021; Schildknecht, 2020). In this way, our research aim is to study how perceived security and privacy shape feelings of trust, as well as the effect of perceived risk, on the adoption of e-wallets by generation Z in Colombia. To meet this aim, we pose the following research questions:

RQ1. What effect do perceptions of security and privacy have on building trust for Gen Z's adoption of e-wallets in Colombia?

RQ2. How does building trust contribute to improving the levels of adoption of e-wallets among young Colombians?

RQ3. How does the adoption of e-wallets by generation Z in Colombia affect the perceived risk?

2. Literature review

2.1 Operationalization of mobile payment systems and study context

The lack of research is leading to low adoption of mobile payment services in certain regions of the world, especially emerging economies, as is the case in Latin America and Colombia (Bailey *et al.*, 2022; Kumar *et al.*, 2019). In this geographical context, it is worth highlighting some particularities that affect consumer behavior in Colombia: (a) it is an emerging economic context characterized by distrust and uncertainty (Dion and Mazzalovo, 2016); (b) the financial and economic infrastructure is somewhat underdeveloped (Kalaignanam *et al.*, 2021); (c) cash is the most used payment system, among other issues, because of distrust of financial institutions (Schildknecht, 2020). Additionally, the Latin American mobile market is the fourth largest in the world, with a unique subscriber penetration of 65%, and Colombia is the fourth most important economy in Latin America (Roa *et al.*, 2017).

In Colombia, after COVID-19, there has been a sharp increase in digital money. Thus, between 2019 and 2021, users of mobile payment services have tripled (26.57 million in 2021), with e-wallets being the preferred mobile payment service, experiencing a growth in the number of users of 99%, 122% of financial transactions and 195% of their volume (Portfalio, 2022). In 2023, 80% of Colombians used e-wallets. However, cybersecurity data is worrying, as Colombian mobile service providers received 1.362 million cyberattacks (Bloomberg, 2022), several hundred customers were victims of the theft of their be-wallets (El Tiempo, 2023), and the number of consumer complaints about identity theft increased from 41,000 to 60,000 between 2021 and 2022. generating great concern among e-wallet users about fraud, hacking and the introduction of malware on their mobile devices (Infobae, 2023).

As a result, Colombia has recently seen a change in consumer preferences regarding the use of e-wallets, while serious problems of security, privacy, trust and risk of providers toward consumers have been identified. At the same time, the characteristics of the Colombian population, the penetration of mobile payment services and the prices of mobile products and services make it a representative sample of most Latin American markets (Alfonso *et al.*, 2020). This, together with the fact that there are no studies that have analyzed consumer behavior in the adoption of mobile payment systems in Colombia, despite the fact that it has already been claimed (Olavarrieta and Diaz, 2021), make this research novel, relevant and current, with the potential to contribute to the development of mobile payment systems in the country.

2.2 Theoretical framework and conceptual model

Multiple theories have explained the adoption of mobile payment services. The first was the theory of reasoned action, proposed by Fishbein and Ajzen (1977), and which was quickly evolved by Ajzen (1991) into the theory of planned behavior. Both are based on the fact that the action of individuals is based on behavior, with attitude and subjective norms being the most relevant predictor variables. At the same time, Davis (1989) proposed the technology acceptance model (TAM) model, according to which the intention of use is fundamentally determined by the perceived ease of use as well as by the perceived utility. Subsequently, Venkatesh and Davis (2000) proposed TAM2 or extended TAM, incorporating variables that referred to the social conditions that affect the adoption of technology. Venkatesh *et al.* (2003) proposed the unified theory of acceptance and use of technology (UTAUT), which synthesized several previous theories of technology acceptance and incorporated new constructs such as social influence, age, experience, performance expectations, or facilitating conditions. More recently, Venkatesh *et al.* (2012) presented an updated version (UTAUT 2), which added variables such as hedonic motivation, price value and habit.

This research is based on the extended TAM model, as it is a parsimonious model that allows the incorporation of new variables to study direct and indirect effects without compromising its robustness (Venkatesh and Davis, 2000). The original model was expanded, incorporating variables such as privacy, security, trust, attitude and perceived risk. The attitude is justified by the fact that authors such as Wiese and Humbani (2020) call for evaluating how generation Z shapes their attitudes in the adoption of mobile payment systems. Security, privacy and trust are motivated by the importance that the academic literature has given to these variables in the adoption of mobile payment services, which is more relevant in a context such as Colombia, characterized by an underdeveloped financial system and distrust of institutions (Schildknecht, 2020). Finally, the incorporation of perceived risk is justified in the growth of the mobile payment services market in Colombia, which makes it a key variable for attracting and retaining consumers in a highly competitive market (Portfalio, 2022).

2.2.1 Intention to use and attitude. Intent to use refers to the inclination of users to use a given technology (Fishbein and Ajzen, 1977), and in the proposed model, utility, ease of use, attitude and confidence act as predictors. In this study, attitude is defined as the degree to which users have good or bad perceptions of their behavior in the face of an event (Ajzen, 1991), being a particularly relevant variable in the evaluation of technology adoption according to the TAM model (Davis, 1989). Khan *et al.* (2023) have recently found evidence of a positive influence of consumer attitudes toward the adoption of mobile payment systems. Consequently, the following research hypothesis is established:

H1. Attitude has a positive and significant effect on the intention to use e-wallets.

2.2.2 Perceived usefulness and perceived ease of use. Perceived utility was defined by Davis (1989) as the consideration by individuals that the use of technology can be useful to improve their performance, playing a crucial role in the decision to adopt a technology. Academics have shown that perceived utility positively influences consumer attitudes toward mobile payment systems (Liébana-Cabanillas *et al.*, 2017) and the intention to use them (Sarmah *et al.*, 2021). For this reason, we propose the following research hypotheses:

H2a. Perceived utility has a positive and significant effect on attitudes toward e-wallets.

H2b. Perceived utility has a positive and significant effect on the intention to use e-wallets.

Davis (1989) defined perceived ease of use as users' belief that mobile payments can be used effortlessly, being considered the most important precedent in evaluating the adoption of mobile payment systems. Academics have shown the positive effect of perceived ease of use on attitudes toward the use of mobile payment systems (Barry and Jan, 2018), perceived utility (Kalinić *et al.*, 2020) and the intention of use (Shaw and Sergueeva, 2019). For this reason, we propose the following research hypotheses:

H3a. Perceived ease of use has a positive and significant effect on the perceived usefulness of e-wallets.

H3b. Perceived ease of use has a positive and significant effect on attitudes toward e-wallets.

H3c. Perceived ease of use has a positive and significant effect on the intention to use e-wallets.

2.2.3 Perceived risk. Perceived risk is defined as consumers' conception of the possibility of unfavorable outcomes when using mobile payment systems (Gupta and Dhingra, 2022), which generates uncertainty that increases resistance to adopting new services (Chen *et al.*, 2022), being a very relevant variable in predicting the intention to use mobile payment systems (Ögel and Ögel, 2021). Risk perception decreases the intention to adopt the mobile payment system (Al-Saedi *et al.*, 2020). Therefore, we establish the following research hypothesis:

H4. Perceived risk has a negative and significant effect on the intention to use e-wallets

2.2.4 Perceived trust. Perceived trust is defined as the predisposition of users to assume a certain risk when they have little information or previous experience (Oliveira *et al.*, 2014), being a crucial variable in the adoption of mobile payment systems, to the point that the absence of trust can lead to the rejection of financial technology (Zmud *et al.*, 2016). In mobile payment services, trust shows an inverse relationship with perceived risk (Chin *et al.*, 2022), as well as a positive relationship with attitude (Zhang *et al.*, 2019), ease of use and perceived utility (Alshurideh *et al.*, 2021) and the intention to use mobile payment systems (Gan and Lau, 2024). Thus, we propose the following research hypothesis:

H5. Trust has a negative and significant effect on perceived risk toward e-wallets.

H6. Perceived trust has a positive and significant effect on the attitude toward e-wallets.

H7. Perceived trust has a positive and significant effect on the ease of use of e-wallets.

H8. Perceived trust has a positive and significant effect on the perceived usefulness of e-wallets.

H9. Perceived trust has a positive and significant effect on the intention to use e-wallets.

2.2.5 Perceived privacy. Perceived privacy refers to the perceived risk of users having their personal information lost or misused, as well as the possibility of incorrect transactions and the authenticity of the provider, i.e., their personal information being compromised (Gupta and Dhingra, 2022). Schomakers *et al.* (2019) showed that the absence of privacy has a negative effect on building trust in mobile payment systems. So, we put forward the following research hypothesis:

H10. Perceived privacy about e-wallets has a positive and significant impact on perceived trust.

2.2.6 Perceived safety. Security is defined as the ability of a given system to protect users' information from a suspicious item during transactions (Zhang *et al.*, 2019), i.e., users' assessment of authentication, confidentiality, non-repudiation and integrity when conducting transactions (Türker *et al.*, 2022). This is a key element in building trust in institutional structures, just as the absence of security leads to the rejection of financial technology (Shao *et al.*, 2019). Gouthier *et al.* (2022) have shown that the absence of security negatively affects users' trust in mobile payment systems. Therefore, we propose the following research hypothesis:

H11. Perceived security about e-wallets has a positive and significant impact on perceived trust.

2.2.7 Proposed theoretical model. Based on the academic literature, as well as on the formulation of the research hypotheses, Figure 1 presents the proposed theoretical model.

3. Methodology

3.1 Data and sample

To obtain the data, a personal survey was developed using the LimeSurvey software and distributed electronically (via email, WhatsApp, LinkedIn, Facebook, X or Telegram) to participants during September and October 2023. The target audience of our research was generation Z in Colombia, with age being the only requirement used to answer the questionnaire. Given the difficulty of reaching the entire population, non-probability sampling was applied for convenience, using a "contact snowball" technique, according to which the researchers asked other colleagues to distribute in social media groups in which they knew about the participation of young people.

The process of preparing the questionnaire followed a procedure that involved up to six experts in marketing, finance and mobile payment systems. First, the authors independently conducted a literature review to propose measurement scales. After a first discussion on the suitability of the scales, a draft was drawn up, which was shared with other colleagues, who were asked for their opinions and comments. They carried out a review as well as formulated recommendations, mainly focused on their suitability, given that some scales have presented better results than others in the previous academic literature. These recommendations were considered, and the final version of the questionnaire was constructed.

To ensure that our target audience could answer all the questions asked, the authors produced a 1:34-min video explaining what e-wallets are and their main functionalities, and then asked to answer the questionnaire. A total of 424 valid responses were obtained. Table 1 presents the general characteristics of the sample.

3.2 Measurement scales

The measurement scales were based on previous research in the field of mobile payment systems, although some minor adjustments were made, such as replacing the terms of the payment systems

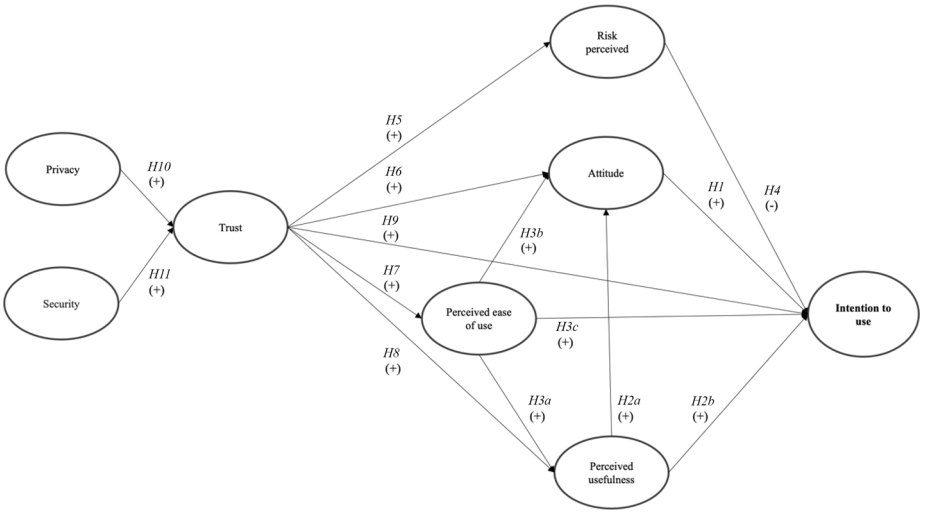

Figure 1. Proposed theoretical model

Table 1. General characteristics of the sample (n = 424)

Variable	Cases (%)
Gender	
Men	219 (51.65%)
Woman	205 (48.35%)
Education	
Student	387 (91.27%)
University degree	29 (6.84%)
Postgraduate	8 (1.89%)
Previous experience in the use of e-wallets	
Yes	341 (80.42%)
No	43 (19.58%)

that had been studied with the term e-wallets, as well as some adjustments. derived from the translation from English to Spanish. Eight constructs and a total of 28 items were considered, which were rated on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). Perceived privacy consisted of three items (Alshurideh *et al.*, 2021), such as perceived safety (Kumar *et al.*, 2018) and perceived risk (Im *et al.*, 2008), while perceived confidence was composed of 4 items (Alshurideh *et al.*, 2021). The endogenous variables were attitude, which was composed of 4 items (De Luna *et al.*, 2019), such as perceived ease of use and perceived utility (Kalinić *et al.*, 2020), while the intention to use was composed of three items (Irimia-Diéguez *et al.*, 2023).

3.3 Data analysis

The data obtained were analyzed using structural equation models (SEM), specifically PLS-SEM, which is a casual-predictive approach that allows measuring the explanatory and predictive power of the models (Hair *et al.*, 2021). SEM models are well suited when it comes to evaluating theoretical concepts that are represented through latent variables, as well as when the data comes from observable measures or variables and indicators (Williams *et al.*, 2009). The SEM methodology carries out an integrated analysis at two levels:

(1) on the one hand, at an external or measurement level, where the relationships between latent variables or constructs and their indicators are evaluated; and

(2) at the internal or structural level, in which the evaluation and analysis of the relationships between the different constructs or compounds that make up the model is studied (Gefen *et al.*, 2000).

Consistent PLS was used to explain causal relationships between defined constructs (Dijkstra and Henseler, 2015) through SmartPLS 4 (Ringle *et al.*, 2022), which is considered software capable of addressing inconsistency. Bootstrapping procedures were applied with 5000 samples to obtain the importance of weights, loads and trajectory coefficients (Benítez *et al.*, 2020).

4. Results

4.1 Analysis of the quality of the measurement scales

In the analysis of the measurement model, the loads of the indicators and their significance, Cronbach's alpha, composite reliability, extracted variance and multicollinearity through the variance inflation factor (VIF) were analyzed. Tables 2 and 3 show the results obtained.

The burdens are statistically significant ($p < 0.01$) and exceed the minimum threshold of 0.7 (Chin, 2010). Cronbach's alpha and composite reliability met the requirements established by Martínez (2014) (>0.7). The convergent validity (AVE) of each construct exceeded the minimum values of 0.5, while the multicollinearity analysis, which was evaluated through the VIF, revealed values below 5, so there is no multicollinearity (Diamantopoulos and Siguaw, 2006). Consequently, the measurement scales have adequate convergent validity.

Three analyses were performed in the discriminant validity analysis. The first, that of Fornell and Larcker (1981), for whom the composite variance of the constructs must exceed the threshold of 0.5. The second criterion was that of cross-loads, which according to Chin (1998), the charge of each indicator must be greater than that of all its cross-loads. Finally,

Table 2. External measurement results

Measurement items	Factor loadings
Perceived privacy (PP). Adapted from Alshurideh *et al.* (2021); $\alpha = 0.897$; CR = 0.902; AVE = 0.756	
I believe the information (personal and behavioral) being collected about me is not being used for purposes other (PP001)	0.750***
I do feel totally safe by providing personal privacy information through an e-wallet (PP002)	0.928***
I feel comfortable with the information being collected about me by the e-wallets (PP003)	0.918***
Perceived security (PS). Adaptated from Kumar *et al.* (2018); $\alpha = 0.893$; CR = 0.893; AVE = 0.736	
e-Wallet is a secure method of payments (PS001)	0.827***
Use of e-wallets is safe and secure (PS002)	0.843***
e-Wallet payments maintain privacy (PS003)	0.901***
Perceived trust (PT). Adapted from Alshurideh *et al.* (2021); $\alpha = 0.929$; CR = 0.929; AVE = 0.766	
e-Wallets are trustworthy (PT001)	0.966***
I feel that the e-wallets protect my privacy (PT002)	0.796***
The ability to access my personal information to ensure that it is accurate and complete makes me feel that e-wallet is trustworthy (PT003)	0.858***
I trust e-wallets to be reliable (PT004)	0.872***
Attitude (ATT). Adapted from De Luna *et al.* (2019); $\alpha = 0.941$; CR = 0.942; AVE = 0.801	
The use of e-wallets is a good idea (ATT001)	0.913***
The use of e-wallets is convenient (ATT002)	0.900***
The use of e-wallets is beneficial (ATT003)	0.903***
The use of e-wallets is interesting (ATT004)	0.863***
Perceived ease of use (PEOU). Adapted from Kalinić *et al.* (2020); $\alpha = 0.922$; CR = 0.924; AVE = 0.748	
I think learning to use e-wallets is easy (PEOU001)	0.852***
I think finding what I want via e-wallets is easy (PEOU002)	0.836***
I think becoming skillful at using e-wallets is easy (PEOU003)	0.840***
I think using e-wallets is easy (PEOU004)	0.928***
Perceived usefulness (PU). Adapted from Kalinić *et al.* (2020); $\alpha = 0.935$; CR = 0.935; AVE = 0.784	
e-Wallets are useful mode of payment (PU001)	0.897***
Using e-wallets make the handling of payments easier (PU002)	0.847***
e-Wallets allow quick use of mobile applications (PU003)	0.859***
In general, e-wallets could be useful for me (PU004)	0.936***
Perceived risk (PR). Adapted from Im *et al.* (2008); $\alpha = 0.809$; CR = 0.813; AVE = 0.616	
It is probable that e-wallets would frustrate me because of its poor performance (PR001)	0.689***
It is probable that e-wallets would not be worth its cost (PR002)	0.814***
Comparing with other technologies, using e-wallets has more uncertainties (PR003)	0.801***
Intention to use (ItU). Adapted from Irimia-Diéguez *et al.* (2023); $\alpha = 0.946$; CR = 0.946; AVE = 0.854	
Given the opportunity, I will use e-wallets (ItU001)	0.924***
I am likely to use e-wallets in the near future (ItU002)	0.911***
I am open to using e-wallets in the near future (ItU003)	0.937***

Note: ***$p < 0.01$

Table 3. Valuation of multicollinearity (internal VIF)

	VIF
Attitude → intention to use	4.773
Perceived ease of use → attitude	2.302
Perceived ease of use → intention to use	2.314
Perceived ease of use → perceived usefulness	1.389
Perceived privacy → perceived trust	2.962
Perceived risk → intention to use	3.232
Perceived security → perceived trust	2.962
Perceived usefulness → attitude	2.200
Perceived usefulness → intention to use	4.971
Perceived trust → attitude	1.442
Perceived trust → intention to use	3.490
Perceived trust → perceived ease of use	1.000
Perceived trust → perceived risk	1.000
Perceived trust → perceived usefulness	1.389

the third criterion analyzed was the heterotrait–monotrait criterion, according to which all values must be less than 0.9 (Henseler *et al.*, 2015). Tables 4–6 present the results obtained for all the above criteria, showing that all the values meet the required criteria, thus confirming the discriminant validity of the measurement scales.

4.2 Structural (internal) model evaluation and hypothesis testing

In the analysis of the structural model, first, the goodness of fit of the model was analyzed, which was positive (SRMR = 0.066). Second, the explanatory power and effect size were assessed. Explanatory power was measured from R^2, which assesses the explained variance of endogenous constructs from exogenous constructs (Hair *et al.*, 2021), while effect size was assessed from f^2, which measures how the exogenous construct contributes to explaining the endogenous construct in terms of R^2 (Cohen, 2013). R^2 values of 0.25, 0.5 and 0.7 show weak, moderate or substantial explanatory power, respectively (Hair *et al.*, 2021), while f^2 values of 0.02, 0.15 and 0.35 should be interpreted as small, medium and large, respectively (Cohen, 2013). Table 7 presents the results.

Table 4. Discriminant validity according to Fornell and Larker

	ATT	ItU	PEOU	PP	PR	PS	PU
ATT							
ItU	0.747						
PEOU	0.662	0.571					
PP	0.502	0.508	0.426				
PR	0.560	0.552	0.501	0.810			
PS	0.760	0.678	0.606	0.817	0.744		
PU	0.867	0.645	0.726	0.398	0.464	0.636	
PT	0.590	0.636	0.527	0.859	0.729	0.850	0.492

Notes: PP = perceived privacy; PS = perceived security; PT = perceived trust; ATT = attitude; PEOU = perceived ease of use; PU = perceived usefulness; PR = perceived risk; ItU = intention to use

Table 5. Discriminant validity according to the cross-loading criterion

	ATT	ItU	PEOU	PP	PR	PS	PU	PT
ATT001	0.913	0.663	0.613	0.472	0.493	0.681	0.812	0.541
ATT002	0.900	0.659	0.601	0.484	0.530	0.689	0.786	0.560
ATT003	0.903	0.682	0.601	0.449	0.504	0.664	0.778	0.532
ATT004	0.863	0.670	0.558	0.389	0.470	0.675	0.728	0.498
ITU001	0.681	0.924	0.532	0.466	0.525	0.628	0.586	0.607
ITU002	0.685	0.911	0.517	0.475	0.502	0.635	0.600	0.574
ITU003	0.704	0.937	0.533	0.474	0.504	0.613	0.605	0.593
PEOU001	0.552	0.505	0.852	0.367	0.457	0.508	0.602	0.468
PEOU002	0.552	0.473	0.836	0.395	0.426	0.510	0.590	0.472
PEOU003	0.566	0.476	0.840	0.359	0.413	0.519	0.616	0.430
PEOU004	0.620	0.519	0.928	0.353	0.420	0.549	0.699	0.461
PP001	0.363	0.320	0.284	0.750	0.668	0.641	0.285	0.675
PP002	0.463	0.479	0.401	0.928	0.703	0.735	0.368	0.835
PP003	0.474	0.515	0.412	0.918	0.711	0.743	0.375	0.826
PR001	0.382	0.347	0.389	0.594	0.689	0.531	0.309	0.592
PR003	0.465	0.482	0.378	0.601	0.814	0.584	0.390	0.650
PR004	0.438	0.438	0.381	0.647	0.801	0.597	0.364	0.664
PS001	0.707	0.590	0.579	0.657	0.586	0.827	0.598	0.711
PS002	0.675	0.618	0.547	0.665	0.642	0.843	0.558	0.725
PS003	0.572	0.537	0.435	0.769	0.679	0.901	0.481	0.775
PT001	0.649	0.642	0.536	0.770	0.742	0.816	0.541	0.966
PT002	0.422	0.454	0.419	0.790	0.711	0.705	0.351	0.796
PT003	0.474	0.540	0.431	0.815	0.757	0.728	0.394	0.858
PT004	0.521	0.590	0.458	0.784	0.685	0.758	0.435	0.872
PU001	0.787	0.573	0.658	0.340	0.363	0.552	0.897	0.402
PU002	0.736	0.523	0.642	0.339	0.417	0.533	0.847	0.415
PU003	0.738	0.556	0.619	0.382	0.439	0.581	0.859	0.473
PU004	0.808	0.632	0.654	0.345	0.421	0.578	0.936	0.469

Notes: PP = perceived privacy; PS = perceived security; PT = perceived trust; ATT = attitude; PEOU = perceived ease of use; PU = perceived usefulness; PR = perceived risk; ItU = intention to use

Table 6. Discriminant validity via heterotrait–monotrait

	ATT	ItU	PEOU	PP	PR	PS	PU	PT
ATT	0.895							
ItU	0.747	0.924						
PEOU	0.663	0.571	0.865					
PP	0.502	0.510	0.425	0.869				
PR	0.558	0.552	0.495	0.796	0.770			
PS	0.756	0.676	0.604	0.814	0.742	0.858		
PU	0.867	0.646	0.727	0.397	0.462	0.633	0.885	
PT	0.595	0.640	0.529	0.859	0.726	0.850	0.496	0.875

Notes: PP = perceived privacy; PS = perceived security; PT = perceived trust; ATT = attitude; PEOU = perceived ease of use; PU = perceived usefulness; PR = perceived risk; ItU = intention to use

The results show that the variables privacy and attitude have substantial explanatory power; perceived risk, intention to use and perceived usefulness show moderate explanatory power; and ease of use shows weak explanatory power. Disaggregating the explanatory power, attitude is the one that explains a higher percentage of the variance in the intention to use (41.68%), while it is the perceived utility that explains the attitude to a greater extent (66.24%). On the other hand, trust also contributed greatly to explain the variance of intention to use (20.67%), attitude (13.15%) and perceived risk (68.23%). On the other hand, privacy contributes to explain trust to a greater extent (53.04%), compared to security (32.68%). Finally, in terms of effect size, attitude was the only variable with a significant effect on intention to use, as well as a large and mediated effect on attitude of perceived usefulness and confidence, respectively. Trust also showed a large and significant effect size on ease of use and perceived risk, while only privacy showed a significant effect on trust.

Finally, Table 8 presents the trajectory coefficients associated with the relationship of each of the constructs, as well as the *p*-values, the *t*-statistics and the evaluation of the hypotheses.

The findings reveal that privacy and security have a positive and significant effect on perceived trust, just as perceived trust has a positive and significant effect on attitude, perceived ease of use, perceived usefulness and intent to use, as well as a negative and significant relationship with perceived risk. On the other hand, of the basic relationships of the extended TAM model, it could only prove a positive and significant relationship between attitude and intention to use, perceived usefulness and attitude, as well as ease of use and

Table 7. Explanatory power and effect size

	β	Corr.	EV	R^2	f^2 (sig.) – Effect
ItU				0.620	
PR	−0.050	0.552	−2.76%		0.002 (0.852) – Small and not significant
ATT	0.558	0.747	41.68%		0.172 (0.023) – Medium and significant
PEOU	0.077	0.571	4.40%		0.007 (0.657) – No effect
PU	−0.031	0.646	−2.00%		0.001 (0.953) – No effect
PT	0.323	0.640	20.67%		0.079 (0.117) – Small and not significant
ATT				0.788	
PU	0.764	0.867	66.24%		1.254 (0.001) – Small and significant
PEOU	−0.009	0.663	−0.60%		0.000 (0.986) – No effect
PT	0.221	0.595	13.15%		0.160 (0.011) – Medium and significant
PU				0.545	
PEOU	0.644	0.727	46.82%		0.658 (0.000) – Small and significant
PT	0.156	0.496	7.74%		0.038 (0.243) – Medium and not significant
PEOU				0.280	
PT	0.529	0.529	27.98%		0.389 (0.000) – Small and significant
PR				0.682	
PT	0.826	0.826	68.23%		2.145 (0.001) – Small and significant
PT				0.857	
PP	0.590	0.899	53.04%		0.826 (0.000) – Small and significant
PS	0.380	0.860	32.68%		0.341 (0.090) – Small and not significant

Notes: PP = perceived privacy; PS = perceived security; PT = perceived trust; ATT = attitude; PEOU = perceived ease of use; PU = perceived usefulness; PR = perceived risk; ItU = intention to use; β = coefficient path; R^2 = determinant coefficient; Corr = correlation; EV = explained variance; f^2 = effect size

Table 8. Hypothesis testing

Hypothesis	β	*t*-Statistics	*p*-value	Results
H1: Attitude → Intention to use	0.558	5.387	0.000	Supported
H2a: Perceived usefulness → Attitude	0.764	14.687	0.000	Supported
H2b: Perceived usefulness → Intention to use	−0.031	0.304	0.761	Not supported
H3a: Perceived ease of use → Perceived usefulness	0.644	10.982	0.000	Supported
H3b: Perceived ease of use → Attitude	−0.009	0.164	0.870	Not supported
H3c: Perceived ease of use → Intention to use	0.077	1.079	0.281	Not supported
H4: Perceived risk → Intention to use	−0.050	0.570	0.569	Not supported
H5: Perceived trust → Perceived risk	−0.826	23.709	0.000	Supported
H6: Perceived trust → Attitude	0.221	5.118	0.000	Supported
H7: Perceived trust → Perceived ease of use	0.529	10.974	0.000	Supported
H8: Perceived trust → Perceived usefulness	0.156	2.456	0.014	Supported
H9: Perceived trust → Intention to use	0.323	3.154	0.002	Supported
H10: Perceived privacy → Perceived trust	0.590	8.404	0.000	Supported
H11: Perceived security → Perceived trust	0.380	4.943	0.000	Supported

perceived usefulness. The rest of the basic relations were empirically rejected (*H2b*, *H3b* and *H3c*). Finally, the risk showed no effect on the intention to use, so *H4* was rejected.

5. Discussions and conclusions

This study explains the impact of privacy, security, trust and perceived risk on the adoption of e-wallets among generation Z in Colombia. The findings are both innovative and pertinent, thereby possessing the potential to enhance academic discourse while simultaneously providing valuable insights for e-wallet providers aiming to attract and retain users.

In accordance with the research inquiries, security and privacy exhibited a positive and significant correlation with perceived trust (*RQ1*), indicating that young e-wallet users are apprehensive regarding how service providers safeguard their personal information and use it appropriately (Gupta and Dhingra, 2022; Gouthier *et al.*, 2022). Conversely, the establishment of trust in e-wallets is deemed essential for their adoption within volatile markets pertaining to financial technology (Gan and Lau, 2024; Lian and Li, 2021), as it significantly influences all endogenous variables analyzed (*RQ2*): attitude (Zhang *et al.*, 2019), ease of use and usefulness (Alshurideh *et al.*, 2021), as well as intention to use (Nguyen *et al.*, 2022); moreover, it was found to have a negative and significant impact on perceived risk (Chin *et al.*, 2022). Ultimately, our results indicated that perceived risk did not exert a significant influence on intention to use (RQ3), which stands in contrast to earlier studies (Chen *et al.*, 2022; Ögel and Ögel, 2021). This discrepancy may be elucidated by: (a) elevated levels of trust mitigating risk perceptions (Chin *et al.*, 2022) or (b) the sample's high educational attainment potentially leading to greater tolerance levels (Liébana-Cabanillas *et al.*, 2020).

Table 9 summarizes the research conclusions and implications.

5.1 Theoretical implications

This research theoretically elucidates the adoption of e-wallets among generation Z in Latin America through the lens of the expanded TAM. This model is notable for its capacity to integrate additional variables without sacrificing its robustness, as noted by Venkatesh and Davis (2000). The original framework has been augmented with factors

Table 9. Conclusions and theoretical and managerial implications

Conclusions	Theorical and managerial implications
Perceptions of security and privacy contribute to the generation of trust in e-wallets	In contexts of uncertainty, perceptions of security and privacy improve the intention to use electronic wallets. E-wallet providers must ensure fair exchange and transparency in the use of information. Effective measures are data encryption, two-factor authentication or the interaction of the wallet with the NFC system of the mobile device, so that it is activated and deactivated when opening and closing the wallet
Trust contributes to the improvement of attitude, perceived usefulness, perceived ease of use and intention to use e-wallets	
Perceived risk does not influence the intention to use e-wallets	The construction of trust through strong security and privacy systems in e-wallets contributes to the absence of risk on the part of users when intending to use them

such as privacy, security, trust and perceived risk, reflecting the unique characteristics of the context under research.

This research is one of the first to explain the adoption of e-wallets in Latin America and the first in the Colombian context (Bailey *et al.*, 2022; Wiese and Humbani, 2020). This study found that, especially for the youngest, efforts to develop security and privacy systems are essential to improve the trust of users, who are regular digital users and are familiar with the most developed protection systems. Furthermore, this is particularly relevant as it seems to show that security and privacy are often the most worrying risks; the effect of trust on perceived risk caused an absence of the effect of the latter on the intention to use. In parallel, the findings showed that improved trust improves users' attitude toward e-wallets, as well as that they will find them more useful and easier to use, thus leading to a greater willingness to use the mobile payment system. Thus, this research shows that, in underdeveloped and growing markets, the development of trust by providers takes on a special dimension for the adoption of e-wallets (Shao *et al.*, 2019).

5.2 Management implications

Our findings have the potential to offer valuable insights to e-wallet providers to improve user trust and, thus, intent to use. Given the rapid pace of technological innovations, it is critical to ensure that robust security measures are in place to protect users' information. In this regard, first, providers must ensure strict compliance with security and privacy protocols, as well as establish transparent and effective communication about the use of their personal data. In this way, providers must build a strong reputation for privacy and security, thereby building a strong and transparent relationship with their customers. Second, it is essential to provide training to staff to keep their knowledge up to date, as well as to carry out periodic updates and checks of security and privacy systems to identify failures and the causes that caused them. Third, it is necessary to establish effective measures such as privacy and security protocols beyond what is determined by the regulatory framework itself, the development of periodic audits and the incorporation of basic measures such as encryption and two-factor authentication. Finally, mobile payment service providers must establish ongoing communication with users, with actions such as, for example, security and privacy protocols that are understandable and transparent, the establishment of guidelines for improving security and privacy practices for their clients, or reliable customer service that provides quick and satisfactory responses in this area. In general terms, it is essential that e-wallet providers have elements for proactive risk management to avoid security and privacy failures, as well as establish transparent communication with users to inform, prevent and solve them.

5.3 Limitations and future research agenda

This research had some limitations that must be recognized so that they can be the basis for future research. First of all, it must be acknowledged that the moderating effect of gender was not studied. This effect has been widely studied in the academic literature on mobile payments and has shown differential effects between men and women, so future studies could study the moderating effect of gender on building trust based on the perception of security and privacy. Another limitation is the lack of consideration of the cultural effect in our sample, i.e., that perhaps not all young people behave in the same way, so we recommend that future research evaluate the possible effect that geographical, economic and social conditions in generation Z may have on the generation of trust toward the use of e-wallets. We also recognize as a limitation the scope of the trust analyzed, which is fundamentally an initial trust. This implies that the effect of perceived security and privacy is likely to only be important in building trust toward e-wallets before using them or in the initial stages, so we consider it relevant to study these relationships in consumers with more experience in the use of e-wallets.

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