Factors Determining the Use and Acceptance of Mobile Banking in Colombia

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Abstract: The purpose of this paper is to identify the factors that influence the acceptance and use of mobile banking among users in Medellín (Colombia). The factors we propose are built upon on seven constructs (customer service and support, perceived attitude, perceived usefulness, ease of use, perceived trust, intention to use, and perceived security), which were developed based on the Technology Acceptance Model (TAM) and the literature. We collected the data from 220 questionnaires self-administered by mobile banking users in Medellín. Subsequently, we conducted a confirmatory factor analysis to determine the correlation between the set of observed variables and the constructs defined in the proposed acceptance model. We empirically conclude that the use of mobile banking among the population under study is mainly influenced by users' perceived usefulness, perceived trust, and ease of use. The results show a strong correlation between perceived trust and perceived security and between perceived usefulness and intention to use.

Keywords: Adoption model, Colombia, mobile banking, perceived ease of use, technology acceptance

Introduction

Companies strive to innovate their products and processes to organize themselves and interact with customers in new ways (Herman, Sulhaini & Farida, 2020). For instance, technological changes and the use of smartphones have transformed the way the banking sector delivers

financial products to users, moving from traditional to self-service channels that save time and trips to the branch (Nichkasova & Shmarlouskaya, 2020).

Despite the growing use of mobile devices, there is still a gap between mobile banking users in different countries (Ortiz & Núñez, 2017). In particular, Latin American users still have a hard time to access financial and banking services in spite of the considerable potential demand for such services (Roa, 2013). The use of mobile technologies becomes, thus, an opportunity to bring financial services closer to vulnerable population groups. In Colombia, according to the Private Council of Competitiveness (2017), online access to banking services (especially new e-payment schemes) should be promoted across the country as a relevant and necessary strategy to increase the use of Information and Communication Technologies (ICTs), favour financial inclusion in e-commerce and productive sector practices, and create access channels to reduce transaction costs for agents.

Online banking has emerged as an effective channel to enhance financial inclusion (Avendaño, 2018). In addition, mobile banking (m-banking) offers multiple services and creates new technology-based banking products (Singh & Srivastava, 2020). In the latter, customers interact with the bank via smartphones to transfer funds, check their balance or detailed account information, issue cheques, and pay bills, among other options (Joy & James, 2018). Therefore, this transactional channel makes it possible to overcome the space and time constraints of traditional banking activities conducted at bank branches and offices.

A vast number of studies have investigated the use and acceptance of mobile banking in countries such as Turkey, Iran, South Korea, Pakistan, India, Jordan, and China (Glavee-Geo, Shaikh & Karjaluoto, 2017; Lee & Son, 2017; Altin, Kaya & Ozlu, 2018; Hamidi & Safareyeh, 2018; Singh & Srivastava, 2018; Siadat, Najjar & Nezafati, 2019; Choi *et al.*, 2020; Ibrahim, Khalil & Ahmed, 2020; Kumar *et al.*, 2020; Al-Dmour *et al.*, 2020; Zhu *et al.*, 2021). However, there is no empirical model to understand the factors that influence such acceptance and use in Colombia (Mejía & Quintero, 2017) despite the great importance mobile technology has gained in this country. According to the Colombian Ministry of Information and Communication Technologies (2020), only 43.09% of the country's current demand for mobile Internet services has been met.

In Colombia, electronic transactions have become popular in recent years due to their low costs and multiple access possibilities. Transactions over different channels reflect the development of the national financial system. For instance, by the end of the first half of 2020, there had been 3,517 million electronic transactions for COP 2,351 billion (Superintendencia Financiera de Colombia, 2020). Furthermore, the total amount of transactions over the Internet reached COP 1,646 million, which represented the largest share (45.3%) over the total

number of electronic transactions; at ATMs, it was 637 million (17.5%); at branches, 82 million (27.6%); and via mobile phones, 2,469 million (9.6%) (Superintendencia Financiera de Colombia, 2020). These figures, however, reveal the low acceptance and use of mobile banking compared to other channels regardless of the high demand for mobile devices in the country.

According to previous studies, the success of new channels for delivering financial services and products (e.g., mobile banking) is due to their acceptance among customers (Tan & Lau, 2016), which depends on their different levels of understanding and skills to use them (Alkhaldi, 2017). Keisidou, Sarigiannidis & Maditinos (2011) claim that multiple factors influence users' acceptance and use of these channels, such as the type of product or service and its characteristics and individuals' perceptions of security, trust, ease of use, and usefulness.

The mandatory preventive social distancing measures imposed by the Colombian government due to the COVID-19 pandemic revealed shortcomings in the country's financial system, especially in terms of financial inclusion. These shortcomings have prompted the country to adopt digital channels as low-cost and simple tools to carry out transactions (Formento, 2020), making this topic increasingly interesting to scholars. Therefore, motivated by the fact that mobile banking and its low acceptance are difficult to understand, this study poses the following research question: What are the main factors that drive users in Medellín (Colombia) to accept and use mobile banking?

In view of the above, this research aims to identify the main factors that drive users in Medellín (Colombia) to accept and use mobile banking. For this purpose, we adapted the Technology Acceptance Model (TAM) and applied it to a questionnaire self-administered by 220 mobile banking users to determine the way specific factors (perceived attitude, customer service and support, perceived trust, ease of use, intention to use, perceived security, and perceived usefulness) influence the acceptance and use of said service.

Theoretical Background

Overview of Mobile Banking

The banking sector is one of the leading industries in the adoption of Internet and mobile technologies for consumer markets, and, nowadays, its actions must consider additional aspects, such as advanced technology, competitiveness, market uncertainty, and technological progress (Souiden, Ladhari & Chaouali, 2020). According to Hoehle, Scornavacca & Huff (2012), the banking industry has changed the way it provides services to its customers; even before the emergence of Internet banking, banks had invested heavily in information technologies and, as a result, their operations became electronic, using systems such as ATMs and online banking. The Internet has, thus, significantly influenced the expansion of electronic

banking, which is regarded as one of the most successful applications of business-to-consumer (B2C) relationships in e-commerce (Joshi, 2013).

However, despite the rapid increase in many commercial wireless services, the level of use of online banking is far lower than expected, which is why it is considered to be underutilized (Muhammad, Chin-Hong & Arif, 2015). The reason for this, according to Premalatha & Sundaram (2014), is that banking consumers are still reluctant to use the online services provided by banks, maybe, as mentioned by Mohammadi (2015), due to a lack of effective communication strategies to promote their use, rather than because these products or services should be changed.

Online banking and m-banking are considered part of electronic banking and represent competitive areas for banks to generate resources (Kashmari, Nejad & Nayebyazdi, 2016). Nonetheless, they are, in turn, two alternative channels for banks to provide their services and for customers to access them (Kapinus & Skrygun, 2014).

According to Han & Baek (2004), Security First Network Bank (SFNB) was a pioneer in Internet banking through its website. Thereafter, thousands of banks have adopted this delivery channel. As a result of globalization, the operating environment of the banking industry tends to be more dynamic. In this regard, Cheng, Gaur & Rahim (2020) point out that banks are increasingly focused on providing differentiated products by improving service quality through security, customer service, and trust, which becomes a competitive strategy that translates into higher revenues, percentage of sales, customer retention, and brand expansion.

Technological developments applied to mobile banking have also led to organizational changes: that is, creating products and services (in the financial sphere, in this case) has become a social innovation that also adopts inclusive business approaches (Lashitew, Bals & van Tulder, 2018). M-banking is characterized by providing banking services via applications designed for smartphones, regardless of users' location or bank opening hours (Changchit, Lonkani & Sampet, 2017). Using electronic banking services through effective applications and means of communication, such as mobile banking, can fundamentally change the way bank–customer relationships are built and maintained (Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas, 2017).

Mobile banking in Colombia

The wide variety of studies into mobile banking acceptance reflects the significant interest of many researchers in understanding the way users decide, adopt, and form their perceptions,

attitudes, intentions, and behaviour towards the use of mobile banking (Mehrad & Mohammadi, 2017; Baabdullah *et al.*, 2019; Singh & Srivastava, 2020).

Colombia has made efforts to increase the number of channels and encourage the development of products in the national banking system as part of an overall government policy on financial inclusion. In terms of creation of new channels, the geographical coverage of banking and mobile banking agents has been expanded. On the other hand, in terms of product development, the use of electronic deposits and savings accounts has been promoted (Fernández de Lis *et al.*, 2014).

Thus, the country has made significant progress in financial inclusion in recent years. According to the latest report on financial inclusion published by the Banca de las Oportunidades (2019), "as of December 2019, 82.5% of the adult population had access to at least one financial product; that is, of the 35.6 million adults in Colombia, 29.4 million had a deposit or credit product" (p. 58). In addition, in the first nine months of 2020, 2.2 million adults were included in the financial system, doubling the number of people who were banked in the previous year.

Additionally, the COVID-19 pandemic has caused fear of contagion in physical branches, as well as the need to distribute government aid. These events have, in turn, accelerated the country's transition to mobile banking, a process that had been underway for ten years and whose goals were met more than two years ahead of schedule (Portafolio, 2021). According to Forbes Advertorial (2021), banking digitalization in the countryside of Colombia has become an ally for micro and small businesses seeking financial inclusion precisely using digital solutions.

In Colombia, many people believe that mobile banking is only related to electronic transactions, which has generated resistance to innovation, mainly in rural communities (van Klyton, Tavera-Mesías & Castaño-Muñoz, 2021). Therefore, mobile money should be distinguished from mobile banking. Gichuki & Mulu-Mutuku (2018) classify mobile money technologies into four categories: (i) mobile money transfer; (ii) mobile banking services; (iii) mobile payments; and (iv) group transaction services.

Mobile money transfer refers to services that allow users to send or receive money via mobile phones. Mobile banking enables users to access banking services, such as payments, account balance inquiry, transfers, bill payments, and financial management (Malaquias & Hwang, 2019), via online banking channels and mobile phones. This has important implications for financial transactions. In turn, mobile payments are services that allow users to pay for goods and services without using cash (de Luna *et al.*, 2019). Finally, group transaction services

enable members of banking groups to send savings and loan repayments to virtual group accounts (Gichuki & Mulu-Mutuku, 2018).

Proposed model and hypotheses

The original TAM — designed and published by Davis in 1989 — defines the factors that influence individuals' intention to use new technologies. According to Al-Gahtani & King (1999), the main purpose of this model is to provide a basis for measuring the impact of external factors on beliefs, attitudes, and intentions. Among multiple theoretical models, the TAM is one of the most widely employed to understand technology adoption and usage, particularly in the field of information systems (Gangwar, Date & Ramaswamy, 2015). Davis' model is considered one of the most reliable, cited (Tamilmani, Rana & Dwivedi, 2020), and widely used (Loiacono, Watson & Goodhue, 2007) native technology adoption theories, making it the ideal choice to predict the usage of information technologies such as mobile banking.

Recently, the adoption of mobile banking has attracted increasing interest because it provides significant information on consumer behaviour and marketing communication for bank marketing (Glavee-Geo, Shaikh & Karjaluoto, 2017). Since the TAM has been one of the most widely accepted and used models in information technology (IT), it is no surprise that it has been implemented in recent studies into the adoption of mobile banking services in several contexts (Chawla & Joshi, 2019; Siyal, Ding & Siyal, 2019). Likewise, this study (on the key factors that affect the adoption of mobile banking by customers of financial institutions) employs the TAM because it is in line with its approach.

Since its inception, the TAM has been tested in multiple contexts. In particular, Malaquias & Hwang (2019) recently implemented it to compare the factors that determine the use of mobile banking in Brazil and the United States, thus contributing to the field of technology acceptance in developed and developing countries. This model has served to study the adoption and acceptance of m-banking by different types of users (Alalwan, Dwivedi & Rana, 2017; Lee & Son, 2017; Altin, Kaya & Ozlu, 2018; Hamidi & Safareyeh, 2018; Singh & Srivastava, 2020; Azhari & Usman, 2021). Additionally, it is considered one of the most popular and recognized models in the literature, as evidenced by the fact that, by 2021, the international Google Scholar search engine had reported 56,925 citations of the original article by Davis.

Davis took into account fundamental, determining, and significant factors in the field of computers and their use. He drew upon previous studies and applied a psychological hypothesis; hence, the TAM is used to model hypotheses that correlate factors that are thought to be determining (Davis, 1989). Importantly, using mobile banking technologies does not necessarily imply that they have been accepted. Guner & Acarturk (2020) explain that, if

individuals consider that a technology or information system is useful and easy to use, they will be more likely to adopt it. Davis (1989) identified two constructs: (a) *perceived usefulness*, defined as the degree to which individuals believe that using a specific technology would improve their job performance; and (b) *perceived ease of use*, defined as the degree to which individuals consider that using a specific technology would be easy. The next subsections present the hypotheses proposed in this paper.

Users' perceived usefulness

Stewart & Jürjens (2018) summarize this main premise of the TAM as follows: the use of a specific technology is influenced by users' intention to use it, which, in turn, is determined by its perceived usefulness and ease of use. As reported by Baki, Birgoren & Aktepe (2018), perceived usefulness and perceived ease of use (and the relationship between them) are the most frequently accepted variables in the literature. According to this premise, we formulate the first hypothesis in this study:

H1. *Users' perceived usefulness of mobile banking significantly influences ease of use.*

Customers are more likely to use mobile banking when they perceive it is useful and improves their work efficiency; on the contrary, they are less likely to use it when they feel it is difficult to interact with it, even if it may turn out to be useful for their work (Davis, 1989). The more useful and simple mobile banking tools are, the more likely they will be employed (Yamakawa, Guerrero & Rees, 2013). Previous research has proven that user acceptance based on trust is the most significant factor for online transactions (Kim, Jin & Swinney, 2009). For this reason, within perceived usefulness, trust is influenced by the usability of mobile applications, as well as by users' beliefs and expectations regarding websites (Boon-Itt, 2019). Therefore, in order to build a relationship based on trust, banks must strive to foster a customer-focused culture that revolves around privacy, security, and ethics by instilling shared values and the concept of commitment in the two parties (Mukherjee & Nath, 2003; Wichittakul & Prasongsukarn, 2018). In light of the above, we develop the following hypothesis:

H2. *Users' perceived usefulness of mobile banking influences their perceived level of trust.*

Several studies have demonstrated the direct relationship between perceived usefulness and attitude towards adoption (Azad, 2016; Changchit, Lonkani & Sampet, 2017; Mehrad & Mohammadi, 2017; Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas, 2017). According to Mehrad & Mohammadi (2017), users tend to have a more positive attitude towards the adoption and use of new technologies when they understand their many benefits. The literature on the adoption of online banking has shown that perceived usefulness has the closest relationship with attitude towards its adoption (Lévy Mangin *et al.*, 2011). In other

words, perceived usefulness is a factor that determines mobile banking adoption. Considering this, we propose our third hypothesis:

H3. *Users' perceived usefulness of mobile banking directly influences their attitude towards its adoption.*

Users' intention to employ a technology has been reported to be affected by its perceived usefulness (Amoako-Gyampah, 2007). For instance, Glavee-Geo, Shaikh & Karjaluoto (2017) found a relationship between perceived usefulness and intention to use mobile banking, where the former influences the latter. This is supported by the findings of Oliveira *et al.* (2014), who argue that the behavioural intention to adopt and accept a new technology is determined by its usefulness. Some authors have even claimed that users' perceptions of the usefulness and relevance of a technology can contribute to its successful implementation, i.e., its effective usage (Amoako-Gyampah, 2007). In view of the above, we propose the following hypothesis:

H4. *Users' perceived usefulness of mobile banking influences their intention to use it.*

Customer service and support

Other studies have shown that customer service and technical support encourage users to adopt Internet banking (Abd Ghani *et al.*, 2017). As stated by Alawan, Dwivedi & Rana (2017), mobile banking users feel more motivated to use this service when they receive customer service and support. Therefore, if a bank has a customer service team that provides quick and effective responses to user inquiries, users tend to trust that financial service provider (Das & Ravi, 2021). Thus, according to Chung & Kwon (2009), the mobile experience and technical support strengthen the relationship between technology features and users, which, in turn, enhances trust. According to this, we present the following hypothesis:

H5. *Customer service and support provided by bank staff to consumers influence their perception of trust in mobile banking.*

Users' perceived trust

The importance of trust has been investigated in order to better understand the determinants and key factors that influence the acceptance of mobile banking (Ramos *et al.*, 2018; Shareef *et al.*, 2018). Regarding the latter, Tham *et al.* (2017) also consider trust to be the ideal situation, in which an individual voluntarily becomes susceptible and vulnerable to the actions of a bank, a mobile device, and a telecommunications service provider, considering, though, that this is a gradual process, similar to that of interpersonal relationships.

Furthermore, Oliveira *et al.* (2014) found that providing the necessary organizational and technical infrastructure to support the use of m-banking may decisively influence its adoption and acceptance. Countries like Japan have made efforts to improve security in mobile banking

because this has increased trust between banks and users of the service. In line with this approach, Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas (2017) point out that trust effortlessly reduces users' need to understand, control, and monitor the situation, thus facilitating the use of this mobile banking tool. Based on the above, we establish the following hypothesis:

H6. *Users' perceived trust in mobile banking management influences its ease of use.*

Mobile devices increasingly expose individuals to mobile threats, such as identity theft and viruses that come from web browsers and spread via Bluetooth, Wi-Fi, SMS, and other methods (Cano & Domenech-Asensi, 2011). For this reason, financial institutions must protect customers against these threats by incorporating effective technological tools and send them messages that build trust and reflect their commitment to personal information security. In this regard, Changchit, Lonkani & Sampet (2017) state that security is influenced by how secure banks can make users feel about their financial data and risk avoidance. In turn, Vejačka & Štofa (2017) suggest that trust is associated with perceived security and grows stronger as the latter increases. In addition, Mohammed *et al.* (2016) indicate that perceived security and privacy have a significant relationship with perceived trust in Internet banking services. Thus, we hypothesize that:

H7. *Users' perceived trust when they interact with mobile banking significantly influences their perceived security.*

Stewart & Jürjens (2018) stress that m-banking's susceptibility to hacking, in addition to not having antivirus software installed on mobile phones, may lead to security breach problems; as a result, m-banking cannot be a completely reliable tool. Moreover, banks find it difficult to communicate risks to their customers, because this may affect their reputation. However, if they focused on finding ways to increase trust in their mobile banking service, the number of frauds, uncertainties, and potential risks would be minimized, thus facilitating mobile banking transactions (Hamidi & Safareyeh, 2018). For instance, according to Stewart & Jürjens (2018), banks should be transparent and inform users about how their data are safely used and stored. In this regard, Luo, Zhang & Shim (2010) consider initial trust to be the main factor influencing the acceptance of mobile banking, because incorporating this construct into the services provided via banking channels encourages individuals to trust not only in new technologies but also in new business partners and in the structural assurance offered by mobile banking companies. In other words, the more consumers trust a bank's services, the more likely they are to use them. Then, we put forward the following hypothesis:

H8. *Users' perceived trust in mobile banking influences their attitude towards its use.*

Users' perceived security

Security is paramount when doing business online because fear and anguish among consumers are highly likely, which might potentially prevent them from using mobile banking, as they may be required to provide personal information that they consider sensitive (Haque et al., 2009). Likewise, Haque et al. (2009) argue that most transactions (not all) are made through web browsers connected to commercial websites that carry out data encryption, protection, verification, and authentication processes, which build trust between users and m-banking.

In the context of banking services, mobile technologies offer alternative channels to deliver financial products, such as social media (Kemal, 2018). According to Molony (2006), mobile phones are perceived as a technology that facilitates the provision of services and can be used to build trust and security in business relationships. As a result, economic activities rely on social media to transform their processes and engagement with users. Furthermore, according to Wichittakul & Prasongsukarn (2018), security is the most critical factor influencing the use of mobile banking. In view of the above, we present the following hypothesis:

H9. *Users' perceived security in social media significantly influences the ease of using mobile banking.*

Privacy and security have been considered the main sources of dissatisfaction in the use of web services and systems, which has affected user experience with banking transactions (Mohammed *et al.*, 2016). However, new applications, such as mobile banking, have turned their attention to aspects such as accessibility, comfort, design, and content to improve customer satisfaction. Additionally, speed, product characteristics, availability, and reasonable rates and charges have become fundamental factors for banks' success (Moraga, Campos & Villalón, 2008). Based on this, we propose the following hypothesis:

H10. *Users' perceived security in web tools influences their attitude towards the use of mobile banking.*

Ease of use

According to Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas (2017), the TAM considers attitude towards the use of new technologies to be a factor that determines ease of use. Additionally, it has been demonstrated (Lévy Mangin *et al.*, 2011) that ease of use positively influences customers' attitude towards the use of new banking technologies. Likewise, Changchit, Lonkani & Sampet (2017) suggest that users' perceived ease of use plays an important role (as a factor) in their attitude towards the use of mobile banking. As a result of this close relationship between these two constructs described in the literature (Azad, 2016), we posit that:

H11. *The ease of use of and access to a bank's websites influences users' attitude towards their use.*

According to Davis' premise (Davis, 1989), the less effort users expect to put into using mobile banking technologies, the greater their intention to use them. Thus, this effort expectation, defined as the degree of ease of use of this delivery channel, has a positive impact on the intention to accept said channel (Azad, 2016). This premise is supported by previous studies that demonstrate that ease of use significantly influences the intention to use mobile banking (Luarn & Lin, 2005). In light of the above, we establish the following hypothesis:

H12. *The ease of use of digital tools provided by banks significantly influences users' intention to use them.*

Users' attitude

Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas (2017) demonstrated that attitude towards mobile banking is the main factor that determines the use of mobile applications, followed by other factors like usefulness and risk. In this study, users' intention to use m-banking services is considered a factor that depends on other constructs, such as attitude. The growing use of the Internet in the future is expected to enhance customers' expectations and perceptions of mobile banking and, thus, their intention to use it not only once but constantly (Lee & Son, 2017), which makes this an increasingly important topic to analyze. Considering the studies mentioned above, this paper presents the following hypothesis:

H13. *Users' attitude towards mobile banking significantly influences their intention to use it.*

Based on the classical TAM structure and the theoretical evidence we collected from the field of banking digitalization, we proposed the research hypotheses mentioned above. As a result, we obtained a behavioural model (Figure 1) that serves to identify the variables involved in the acceptance and use of mobile banking in Medellín.

Research Methodology

This study adopted a quantitative, nonexperimental, causal-correlational approach. The primary source of information to test the hypotheses was a set of 220 questionnaires answered, during 2020, by mobile banking users in Medellín (Colombia), selected by convenience sampling (Otzen & Manterola, 2017).

Considering the context of the study population, this instrument administered here was written in Spanish. It was validated by an expert in the field to ensure that the items were sufficiently clear and in line with the dimensions previously outlined. Given the COVID-19

situation, the questionnaire was distributed online to mobile banking users in Medellín during the second half of 2020. First, the instrument was applied as a pilot test with 10 students to make sure that the information it presented was clear and understandable.
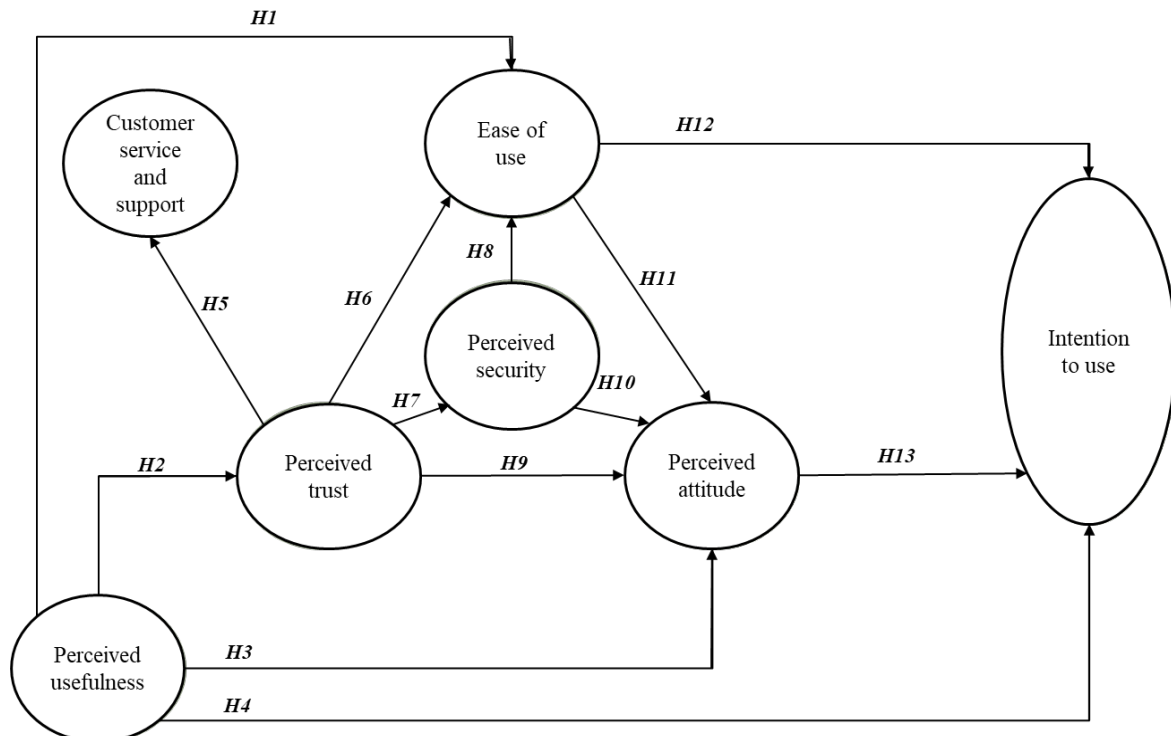

Figure 1. Adoption model proposed to analyse individuals' behaviour towards mobile banking

The questionnaire addressed seven constructs (customer service and support, perceived attitude, perceived usefulness, ease of use, perceived trust, intention to use, and perceived security), which were developed based on the TAM and the literature (Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas, 2017). This instrument included 16 Likert scale questions and 5 closed-ended and multiple-choice questions with multiple answers. We collected the data using anonymous forms.

The results revealed that 61.63% of the respondents were female, with the majority of them (40.45%) being between the ages of 25 and 34. It should be noted that our findings (in terms of acceptance of mobile banking) cannot be generalized to all types of banking users in Medellín.

After data collection, we conducted a confirmatory factor analysis and processed and examined the data to ensure that the items in the questionnaire generated the expected number of factors and that each factor had an appropriate loading. In other words, we performed reliability and validity tests to verify the suitability of the constructs and the instrument. Furthermore, the Cronbach's alpha coefficients of the individual variables allowed us to assess the reliability of the instrument, as explained below.

Confirmatory factor analysis

Using factor reduction analysis, we empirically evaluated the model's suitability to measure the use of mobile banking *versus* face-to-face banking services. With this analysis, we can test the validity and reliability of each variable based on the understanding that an instrument can be reliable but not valid, but must necessarily be reliable if it is valid.

We may say that there are three types of validity. First, validity can be expressed in terms of content. *Content validity* provides evidence of the degree to which the items in an instrument are relevant to and represent the target construct for assessment purposes. For said assessment, a panel of experts evaluates the items in the instrument and classifies them according to their relevance and representativeness within the scope of the content (Almanasreh, Moles & Chen, 2019). Second, *criterion validity* is also used to examine the validity of an instrument. Its purpose is to measure the degree of correlation between an instrument and the external variables (criteria) to which it is hypothetically and somehow expected to be related. Finally, *construct validity* complements the assessment of an instrument by determining whether the relationships between the variables define a dimensional structure in the questionnaire that remains unchanged and could serve as the basis to interpret the results in different populations (Lacave *et al.*, 2016).

Data processing and analysis

Although several statistical software packages can be used for data processing and analysis (e.g., Minitab, SAS, R-programming, STATA, SEM-AMOS, SEM-SmartPLS, and WarpPLS), we employed the Statistical Package for Social Sciences (SPSS) because it is one of the most widely implemented in social sciences, and it is easy to use for correlational comparison and correlation statistical tests in the context of univariate, bivariate, and multivariate analysis for parametric and nonparametric statistical techniques (Ong & Puteh, 2017). Thus, the data were processed and analyzed using SPSS software (version 22.0) for Windows.

All the variables were adjusted in terms of typology, nature of the data, dimensionality reduction, and categorical transformation. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, which tests whether the partial correlations between the variables are sufficiently low, was used to evaluate the validity of the convergent construct. The KMO statistic takes values between 0 and 1. A value below 0.5 indicates that the correlation is not significant enough, and, hence, analyzing the relationships between the variables with the data sample being used would be pointless.

The previous result was then verified using Bartlett's test of sphericity, which tests the null hypothesis that the correlation matrix of the variables is an identity matrix, in which case said

variables would not be related. Therefore, if the significance level of the Bartlett's test is above 0.05, the null hypothesis cannot be rejected, and thus performing a dimensional structure analysis or factor analysis of the questionnaire would be meaningless (Bartlett, 1950).

Finally, we measured the internal consistency of the questionnaire using Cronbach's alpha and analyzed the items' discriminant power with Spearman's rank correlation coefficient. To assess the correlation strength between the variables, we employed Somers' D, interpreting values close to 0.30 as satisfactory; between 0.30 to 0.50 as of moderate magnitude; above 0.50 as of strong magnitude; and below 0.30 as of little value in practice even if statistically significant.

Interpretation and Analysis of Results

Construct validity

The proposed model demonstrated convergence between its variables (as shown in Table 1) because most of the standardized factor loadings were above 0.7, as recommended by Bagozzi & Yi (1988). In addition, the indicators' average factor loading was above 0.7 for each construct (Hair *et al.*, 1999).

Table 1. Standardized factor loadings of the indicators

Construct	Item	Standardized factor loading	Average standardized factor loading
Perceived attitude	ATT1	0.757	0.703
	ATT2	0.552	
	ATT3	0.800	
Customer service and support	CS1	0.740	0.740
	CS2	0.740	
Perceived trust	TRU1	0.797	0.792
	TRU2	0.806	
	TRU3	0.772	
Ease of use	EU1	0.870	0.870
	EU2	0.870	
Intention to use	INT1	0.900	0.900
	INT2	0.900	
Perceived security	PS1	0.926	0.926
	PS2	0.926	
Perceived usefulness	PU1	0.886	0.886
	PU2	0.886	

After that first test, we conducted Bartlett's test of sphericity. Table 2 reveals that the coefficients calculated by the SPSS software for each construct meet the minimum criteria to perform a data reduction analysis.

Table 2. KMO measure and Bartlett's test of sphericity

Construct	KMO value	Bartlett's test value	Meets criteria
Perceived attitude (ATT)	0.561	0.000	Yes
Customer service and support (CS)	0.500	0.000	Yes
Perceived trust (TRU)	0.672	0.000	Yes
Ease of use (EU)	0.500	0.000	Yes
Intention to use (INT)	0.500	0.000	Yes
Perceived security (PS)	0.500	0.000	Yes
Perceived usefulness (PU)	0.500	0.000	Yes

Moreover, we tested the presence of common method bias using Harman's single factor test in SPSS. Since the total percentage of variance extracted by a single factor (extraction method: maximum likelihood) was below the generally established cut-off point (50%), we concluded that common method bias was not present in this study (as shown in Table 3).

Table 3. Harman's single factor test using SPSS

Item	Total variance explained					
	Initial eigenvalues			Sum of the squared saturations of the extraction		
	Total	% of variance	Accumulated %	Total	% of variance	Accumulated %
1	8.142	50.890	50.890	7.704	*48.151*	48.151
2	1.540	9.626	60.516			
3	1.032	6.448	66.964			
4	.889	5.559	72.523			
5	.654	4.089	76.612			
6	.542	3.387	79.999			
7	.498	3.116	83.114			
8	.477	2.979	86.093			
9	.431	2.694	88.787			
10	.354	2.214	91.002			
11	.325	2.033	93.035			
12	.274	1.714	94.748			
13	.250	1.566	96.314			
14	.225	1.409	97.723			
15	.190	1.186	98.909			
16	.174	1.091	100.000			

Also, we calculated and compared (Table 4) the standardized regression weights of the model with a Common Latent Factor (CLF) and without it in a confirmatory factor analysis conducted in AMOS. Since no difference (i.e., the difference between the standardized regression weights with and without CLF) was above 0.2, we concluded that none of the paths was affected by common method bias.

Table 4. Standardized regression weights and confirmatory factor analysis

Item	Standardized regression weights		
	With Common Latent Factor	**Without Common Latent Factor**	**Difference**
ACT1 <--- ATT	0.737	0.683	-0.054
ACT2 <--- ATT	0.029	0.036	0.007
ACT3 <--- ATT	0.558	0.578	0.02
CON1 <--- TRU	0.713	0.679	-0.034
CON2 <--- TRU	0.746	0.671	-0.075
CON3 <--- TRU	0.808	0.824	0.016
SP1 <--- PS	0.838	0.834	-0.004
SP2 <--- PS	0.888	0.896	0.008
UP1 <--- PU	0.788	0.783	-0.005
UP2 <--- PU	0.811	0.843	0.032
FU2 <--- EU	0.734	0.745	0.011
FU1 <--- EU	0.791	0.765	-0.026
INT2 <--- INT	0.77	0.809	0.039
INT1 <--- INT	0.749	0.786	0.037

Instrument reliability

We evaluated the reliability of the proposed measurement scales by calculating their Cronbach's alpha coefficients. As observed in Table 5, this coefficient takes values higher or close to the recommended minimum values (0.7 and 0.5, respectively) in all cases (Hair *et al.*, 1999), which confirms the internal reliability of the proposed constructs.

Table 5. Reliability index

Factor	Cronbach's α coefficient
Perceived attitude (ATT)	0.730
Customer service and support (CS)	0.715
Perceived trust (TRU)	0.842
Ease of use (EU)	0.878
Intention to use (INT)	0.911
Perceived security (PS)	0.939
Perceived usefulness (PU)	0.895

Moreover, we measured the discriminant validity of such scales following the procedure described by Anderson, Gerbing & Hunter (1987), which calculates the confidence intervals of the correlation between the constructs and compares them with the unit. Table 6 shows that, in none of the cases, the proposed estimates of intervals presented as a cross-correlation matrix contain a value of 1, which demonstrates the discriminant validity of the proposed model.

Table 6. The discriminant validity of the proposed model

	Perceived attitude (ATT)	Customer service and support (CS)	Perceived trust (TRU)	Ease of use (EU)	Intention to use (INT)	Perceived security (PS)	Perceived usefulness (PU)
Perceived attitude (ATT)	1.000						
Customer service and support (CS)	0.043	1.000					
Perceived trust (TRU)	0.413	0.334	1.000				
Ease of use (EU)	0.408	0.188	0.608	1.000			
Intention to use (INT)	0.475	0.162	0.601	0.664	1.000		
Perceived security (PS)	0.459	0.267	0.737	0.593	0.607	1.000	
Perceived usefulness (PU)	0.442	0.149	0.554	0.699	0.688	0.540	1.000

Hypothesis testing

To continue the statistical analysis, we next evaluated the adapted structural model's suitability to measure the use and acceptance of mobile banking in Medellín. For this purpose, we listed the hypotheses proposed above and estimated the level of association between pairs of variables using Somers' D. According to Schreiber *et al.* (2006), this correlation coefficient takes values between -1 and 1; those close to 1, in absolute value, indicate a strong correlation between the variables; and those close to 0, a low or null correlation between them.

Table 7 presents the values obtained from the SPSS software, which reveal a significantly high level of association (all p-values < 0.001). One of the most significant and revealing correlations was found between perceived usefulness and intention to use (0.688), which means that users decide whether or not to use a service based on their expectations of what they will experience. Moreover, perceived trust is a fundamental aspect in users' perceived security (0.737) in mobile banking because it is key to explaining their behaviour towards banking access (Ramos *et al.*, 2018). Similarly, the positive effect of perceived trust on ease of use (0.608) and perceived attitude (0.413) proves that it is a multidimensional construct. Finally, the weakest correlation in this study was established between perceived trust and customer service and support (0.334).

Table 7. Hypothesis testing between pairs of variables

Hypothesis	Correlation between variables		Somers' D
H1	Perceived usefulness	Ease of use	0.699 ***
H2	Perceived usefulness	Perceived trust	0.554 ***
H3	Perceived usefulness	Perceived attitude	0.442 ***
H4	Perceived usefulness	Intention to use	0.688 ***
H5	Perceived trust	Customer service and support	0.334 ***
H6	Perceived trust	Ease of use	0.608 ***
H7	Perceived trust	Perceived security	0.737 ***
H8	Perceived trust	Perceived attitude	0.593 ***
H9	Perceived security	Ease of use	0.413 ***
H10	Perceived security	Perceived attitude	0.459 ***
H11	Ease of use	Perceived attitude	0.408 ***
H12	Ease of use	Intention to use	0.664 ***
H13	Perceived attitude	Intention to use	0.475 ***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Furthermore, we extracted the Somers' D coefficients and listed them in a table of crossed factors to show the level of association between the variables that were part of the hypotheses and those that were not. The purpose of this procedure was to corroborate that some constructs in the model had no established correlation. As observed in Table 8, none of the levels of association is high.

Table 8. Somers' D correlation statistic

	(ATT)	(CS)	(TRU)	(EU)	(INT)	(PS)	(PU)
(ATT)	1.000						
(CS)	0.043	1.000					
(TRU)	0.413 ***	0.334 ***	1.000				
(EU)	0.408 ***	0.188	0.608 ***	1.000			
(INT)	0.475 ***	0.162	0.601	0.664 ***	1.000		
(PS)	0.459 ***	0.267	0.737 ***	0.593 ***	0.607	1.000	
(PU)	0.442 ***	0.149	0.554 ***	0.699 ***	0.688 ***	0.540	1.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

The results summarized in Figure 2 support the causal relationships proposed in the hypotheses for the sample of mobile banking users who participated in this study. Therefore, we can confirm the positive influence of users' perceived usefulness of mobile banking on their intention to use it and perceived ease of use. These results also reveal that perceived trust has a significant influence on the perceived usefulness and ease of use of mobile banking.
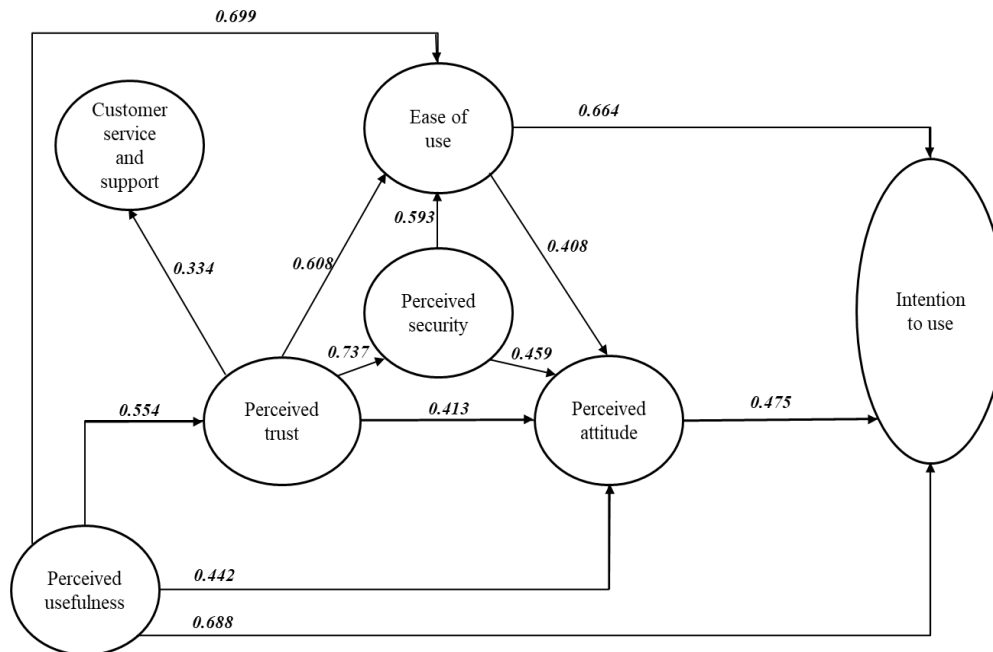
Figure 2. Variables in the proposed model and their correlations (Somers' D)

Discussion

Mobile banking services are well rated because they allow users to make transactions at any time and place, and their general characteristics reduce the effort necessary to use them (ease of use). According to Mallat, Rossi & Tuunainen (2004), security and comfort (perceived ease of use) are key to increasing mobile banking usage. In line with this, Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas (2017) propose attitude, intention to use, perceived usefulness, perceived ease of use, and social image as constructs that determine the acceptance of mobile devices to access banking services. Additionally, trust, which has generally been most peoples' concern about adopting new technologies (Hanafizadeh *et al*., 2014) can also provide several benefits to financial institutions and increase consumer satisfaction (Glavee-Geo, Shaikh & Karjaluoto, 2017).

In the Latin American context, a study conducted by the Deloitte Center for Financial Services (2012), which evaluated the potential of mobile banking in countries such as Argentina, Brazil, and Mexico, revealed that this type of banking will eventually be a need rather than a choice and may become an integral component of banks' commercial strategy. This will occur because users may be increasingly satisfied with the ease of access to financial services, low-cost investment, and inclusiveness that this delivery channel provides. For this reason and in accordance with the study by Hanafizadeh *et al*. (2014), in this paper, the factors that have the greatest influence on the adoption of mobile banking are mostly related to the infrastructure of banks. Hence, their research departments should pay more attention to said infrastructure.

When we compared our findings to those reported in other Latin American studies, we found that, in Peru, for instance, the factors that influence the intention to use this new technology are perceived ease of use and usefulness, according to Yamakawa, Guerrero & Rees (2013). These authors also propose lifestyle compatibility and personal innovativeness toward information technologies as additional factors that increase the intention to use these channels.

In the case of Colombia, Giraldo (2013) presents a theoretical model that studies the intention, adoption, and continuance scenarios of the use of mobile banking in this country. In each scenario, he highlights the factors that might be determining: attitude of use, perceived ease of use, perceived credibility, and perceived service quality (intention scenario); transaction costs, lack of information, perceived usefulness, and perceived effectiveness (adoption scenario); and intention of continued use (continuance scenario). In addition, this author proposes six risks: performance risk, security risk, privacy risk, convenience risk, financial risk, and social risk. Among the studies into the digital commercial channel of banks, we highlight the paper by Sánchez-Torres, Rojas Berrío & Ortiz Rendón (2021), where the most important adoption factors in Colombia were precisely those related to the technological infrastructure and those factors were found to assume a fundamental role.

In the business field, the rapid growth of smartphones and wireless and mobile service channels in the market is seen as a promising opportunity for companies to provide easy access and inclusion (Lashitew, Bals & van Tulder, 2018). Such growth has been driven by globalization and technological development, which have, in turn, reduced access barriers not only for competitors but especially for today's users, who wish to perform banking transactions while on the move, regardless of bank opening hours (Sepashvili, 2020).

Theoretical implications

This study built upon the two behavioural premises of the TAM (perceived usefulness and perceived ease of use) (Davis, 1989) and five other constructs commonly used in the literature on mobile banking acceptance (security; attitude; trust; customer service and support; and intention to use) (Chung & Kwon, 2009; Tan & Lau, 2016; Vejačka & Štofa, 2017).

Our findings reveal that perceived usefulness, trust, and ease of use are the most important factors to understand the use and acceptance of mobile banking, which is corroborated by Sampat (2016) and Tham *et al.* (2017). They, however, contradict the results reported by Joy & James (2018), who claim that trust in m-banking is the least significant variable when deciding whether or not to use it. Nevertheless, our findings do support the results obtained by Hanafizadeh *et al.* (2014), who explain that banks themselves should be more reliable than cell phone manufacturers and telecommunications operators for customers to trust them.

Figure 2 shows five strong associations between the variables analyzed in this study: (1) a significant correlation between perceived usefulness and ease of use, which confirms the results of the original study by Davis ([1989](#)); (2) an association between perceived usefulness and intention to use, which is in agreement with the findings of Teo *et al.* ([2012](#)) and refutes those of Muñoz-Leiva, Climent-Climent & Liébana-Cabanillas ([2017](#)), who did not find this factor to be significant; (3) a relationship between perceived trust and ease of use, which is consistent with the results of the study by Ifeonu & Ward ([2015](#)) and suggests the need to provide users with a user-friendly interface that enhances trust and makes it easier for them to use mobile banking services; (4) a relevant correlation between perceived trust and security, which corroborates the results obtained by Vejačka & Štofa ([2017](#)) because m-banking users consider that improving security and banking standards increases their trust in it; and (5) a correlation between ease of use and intention to use, which is in line with the findings by Singh & Srivastava ([2020](#)), who state that the perceived ease of use of mobile banking helps to significantly increase the intention to use this channel.

Practical implications and contributions

In practice, the results of this study have four implications. First, they contribute to the established theory in order to understand the financial practices of mobile banking users. Second, they shed some light on the factors or determinants that influence the acceptance of mobile banking and encourage the use of these tools in some developing countries, such as in the case examined here. Third, this study provides readers with an overview of the current mobile banking environment in Colombia. Fourth, these results may draw the attention of Colombian financial regulators to detect factors that could pose a threat to transactions, the stability of the financial system, and the country's financial inclusion efforts.

More studies are needed to analyze financial inclusion and the new normal because the current pandemic and crisis due to COVID-19 have forced a reduction in human interaction and an increase in the use of mobile technologies [(Agarwal, Poddar & Karnavat, 2020)](#). Some people even had to open a bank account for the first time on their mobile devices. Therefore, this study can help identify challenges in the use and acceptance of financial services and mobile devices. It can also prepare the financial industry for the post-COVID-19 period in order to accelerate the banking of several segments of the population, especially people who consider themselves digital natives.

Another significant contribution of this study is that it presents the characteristics of the expectations of mobile banking users and their knowledge about finance. Thus, financial service providers can learn more about the behaviour of their consumers from this paper and improve the services they offer: i.e., if banks and banking institutions want to establish strong

relationships with their users, they should provide services that minimize risks and improve the quality of mobile banking.

Conclusions and Future Research

Investigating the main factors that influence the acceptance and use of mobile banking is clearly important, as evidenced by the numerous studies on this subject. Few studies, however, have examined the acceptance and use of this service in Medellín (Colombia). This paper provides insights on people's intention to use mobile banking in said city, which will be useful for banks to promote their products and better understand people's behaviour towards new technologies and their characteristics, especially in a developing country. In addition, this study presents an overview of the current mobile banking environment in Colombia and shows that, since the COVID-19 crisis, financial inclusion has changed from being a future goal of the national government to a reality that has brought Colombians closer to mobile banking.

Thus, our findings contribute to a better understanding of the factors that influence the use and acceptance of mobile banking technologies in Medellín and provide local banks with a basis to implement strategies for bridging the financial inclusion gap that has been identified. Understanding these factors would represent an opportunity for the country's financial institutions to design and develop novel banking applications.

In this study, we stressed that perceived usefulness and trust and ease of use are the key factors that influence users' acceptance and use of mobile banking in Medellín. We developed 13 hypotheses to assess the relationships between the proposed constructs and empirically found strong correlations in 12 of them. According to our findings, ease of use, perceived trust and attitude, and intention to use are all directly influenced by perceived usefulness (H1, H2, H3, and H4, respectively), while ease of use, perceived security, and attitude towards the use of mobile banking are highly influenced by users' perceived trust towards such services (H6, H8, and H9).

Regarding perceived security, we may conclude that it has a medium level of association with ease of use and perceived attitude towards the use of mobile banking (H7 and H10). This is because, if users assume that mobile banking is risky, they will not choose mobile devices to access banking services, which may change their attitude towards its use. Moreover, ease of use also exhibited a medium to high level of correlation with perceived attitude and intention to use (H11 and H12). In this case, when users realize that learning how to use mobile banking is simple, their perceptions of and attitude towards its use improve. Finally, perceived attitude showed a medium level of association with intention to use, which suggests that a significantly positive attitude towards the acceptance of mobile banking influences users' intention to use this service.

This model designed to evaluate users' acceptance of mobile banking in Medellín also allowed us to identify relationships with a low level of correlation between the constructs. For instance, perceived trust presented a low level of association with customer service and support (H5), which indicates that this model empirically examined the influence of external variables on users' decisions to use mobile devices to access banking services. We can thus conclude that the delivery of financial products via information technologies and mobile devices is necessary not only because it is in line with banking modernization but also because the users of mobile banking and its related services perceive desirable characteristics in them, such as immediacy, ease of access, and virtuality.

In accordance with the main purpose of this study, we were able to identify the variables that influence the use and acceptance of mobile banking and presented, beyond the descriptive scope, an empirical analysis of the theoretical model we proposed. Our results show that the proposed model has a considerable explanatory power because it applies the theoretical constructs introduced in previous studies, which have already been empirically tested in other contexts and countries. Therefore, our model is empirically significant, since it explains the variation in users' intention to accept and use mobile banking in Medellín.

Future studies should collect data from a longitudinal perspective, that is, from various periods in order to understand how the influence of the factors under analysis evolves over time in the same population and compare their findings. It may also be relevant to conduct qualitative research to analyze the acceptance and use of mobile banking considering two dimensions: service effectiveness and user experience with this technology.

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