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Mobile commerce usage explained by intention to use, price motivation, and Covid-19

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Abstract

The objective of this research is to analyze the effects of price motivation, intention to use, and Covid-19 on the use of m-commerce by the Mexican population in the aftermath of the pandemic. A cross-sectional study was designed to explore the perception of performance expectancy, effort expectancy, social influence, hedonic motivation, facilitating conditions, perceived risk, and tradition in a sample of 864 people living in northern Mexico. Perceptions were collected through a 6-point Likert scale survey with a combination of items adapted and created from the literature whose version was validated by experts and a pilot study. The statistical technique used was structural equation modeling (PLS-SEM). The results obtained reflect that Covid-19 and intention to use directly influence the use of m-commerce; however, no evidence was found to prove the effect of price motivation on the use of m-commerce. The results may prove valuable to entrepreneurs by providing knowledge about customers that they can capitalize on through strategies to increase sales through m-commerce.

Keywords: M-commerce, Covid-19, Intention to use m-commerce, Price motivation, Mexican people, PLS-SEM.

Introduction

The m-commerce is a global phenomenon, it is a distribution channel because it is also a platform to reach the masses by having an online presence allowing a greater approach to customers; it has a great marketing potential due to the popularity of the use of mobile devices, mainly the smartphone, it is also a strategy that allows companies to survive in the competitive world of commerce (Bargavi et al., 2022; Moorthy et al., 2017).

M-commerce is an extension of e-commerce (Lissitsa and Kol, 2019; Sujatha and Sekkizhar, 2019) where the order for the good or service is placed via a computer network and a mobile device using wireless technology (Gao and Shao, 2019), whereas in e-commerce it does not matter whether the device used to place the order is mobile or not.

A feature that is not present in e-commerce is ubiquity or mobility, which refers to the ability of mobile devices to have their services available anytime and anywhere (Kalinic and Marinkovic, 2016), i.e., wireless technology

enables mobile devices to not rely on a fixed connection and allows providing localized services (Verkijika, 2018).

In addition to the advantages of ubiquity, m-commerce enables time savings, convenience, product variety, low prices, and transformation of the traditional way of consumer shopping in the physical store (Kim et al., 2015).

The National Survey on Availability and Use of Information and Communication Technologies in Households (ENDUTIH), indicates that, in Mexico, the number of internet users went from 71.3 million people in 2017 to 74.3 million in 2018. Of the 49 cities in the country considered in the survey, three cities in the state of Baja California ranked in the top nine places; Mexicali is the second city with the second highest proportion of internet users; Ensenada ranks fifth, and Tijuana is ninth (INEGI, 2019).

The survey shows that the most used device to connect to the internet is the smart cell phone, with 93.4 percent. Baja California after Sonora is the state that registered the highest proportion of cell phone users. Of the smart cell phone users, 69.4 percent installed applications; of which 89.5 percent installed applications for instant messaging and 81.2 percent to access social networks, while 29.8 percent installed applications to purchase goods or services (INEGI, 2019).

In this sense, it is important to study the use of m-commerce by users, as it represents a new way of shopping, to identify the strategies that companies should promote to boost the adoption of mobile commerce and counteract those that have a negative influence. It should be noted that Mexico is a region where the adoption of m-commerce has not been studied, in this sense, the results will be contrasted with the existing literature.

The general objective of the present research was to evaluate the factors that influence the intention to use and the use of m-commerce in consumers in the state of Baja California, analyzing the influence of the UTAUT2 variables (performance expectancy, effort expectancy, social influence, hedonic motivation and facilitating conditions); expanding the UTAUT2 model with the variables perceived risk, tradition, price motivation, and Covid-19.

LITERATURE REVIEW

M-commerce

Gao and Shao (2019, p. 840) define m-commerce as "an e-commerce system and model for combining a variety of information exchange and business activities through mobile devices and wireless network technology." For Moorthy et al. (2017), m-commerce is the conduct of transactions such as mobile shopping for events, mobile banking (m-banking), mobile marketing (m-marketing), mobile information services, shopping (m-shopping), mobile entertainment, among others, via mobile devices, some definitions of m-commerce are shown in Table 1.

Table 1. Definitions of m-commerce

Author (s)	Variable	Definition
Al-Adwan *et al*., (2019)	M-commerce	Actions involving a commercial transaction, through the use of wireless technology.
Lee and Wong (2016)	M-commerce	"Any transaction, involving the transfer of ownership or rights to use goods and services, that is initiated and/or completed using access to computer-mediated networks with the help of mobile devices" (p. 61).
Verkijika (2018)	M-commerce	"A business model that enables consumers to conduct commercial transactions on a mobile device" (p. 1).
Sujatha y Sekkizhar (2019)	M-commerce	Any type of commercial transaction or process conducted directly or indirectly with a monetary value is implemented over a wireless communication network.

Unified Theory of Acceptance and Use of Technology (UTAUT)

To explain the adoption of innovations, several theories have been used, such as the theory of reasoned action (TRA), the theory of planned behavior (TOPB), the theory of technological acceptance (TAM), the unified theory of acceptance and use of technology (UTAUT), the extended unified theory of acceptance and

use of technology (UTAUT2), the theory of diffusion of innovation (DOI), among others, using several variables, some of which are similar to each other.

Venkatesh et al. (2003), empirically compared eight important models and theories of technology acceptance in working users of four companies, from which they created and empirically validated UTAUT, achieving a higher percentage of explanation of the intentions and use of information technology by the working user with respect to other theories.

The theories and models analyzed to create UTAUT are TRA, TOPB, TAM, the motivational model (MM), DOI, social cognitive theory (SCT), the model of personal computer utilization (MPCU), and a model combining TAM and TOPB. UTAUT explains technology intention and uses with four variables (effort expectancy, performance expectancy, social influence, and facilitating conditions) and four moderating variables (gender, age, experience, and voluntariness). For each of the non-moderating variables, it accounts for the several similar variables found in the eight models (Venkatesh et al., 2003).

Venkatesh et al. (2012) propose an extension of the model and add the constructs of price value, hedonic motivation, and habit (Kalinić et al., 2019; El-Masri and Tarhini, 2017). With this, the model becomes identified as Venkatesh et al. (2012) UTAUT2, which fits the model to the context of an individual's voluntary adoption, since the UTAUT was designed to study individual adoption in the work context where there was not always a willingness to on the part of the worker.

The UTAUT2 is an effectively used model in recent studies, which has not been sufficiently tested in developing countries, as are most technology adoption models (El-Masri and Tarhini, 2017).

Previous studies

For the literature review, a search was conducted in the Ebscohost, Elsevier, and Emerald databases, using the expression (m-commerce OR m-shopping) AND (UTAUT OR UTAUT2) in the title or abstract of the article. Articles published in the period 2015 - 2021 were selected contemplating only those that refer to adoption, use, or intention to use in the consumer context, and that also used the UTAUT or UTAUT2 theories. Articles referring to m-commerce or e-commerce adoption by companies were not considered.

A total of 20 articles were found of which twelve used UTAUT and eight used UTAUT2. The results can be seen in Table 2. It is common to extend the UTAUT and UTAUT2 model with other variables; those most frequently found in the studies were trust, innovation, and perceived risk, and less frequently; perceived security, perceived satisfaction, self-efficacy, perceived compatibility, customer involvement, and tendency to negotiate. Regarding the moderating variables included in the models, variables such as age, gender, and personal innovativeness, among others, have been used.

Table 2. Study list.

Author(s)/Year	Title	Theory/ Location
(Yadav *et al*., 2015)	A multi-analytical approach to understand and predict the mobile commerce adoption	TAM UTAUT India
(Trojanowski Kułak, 2017)	The Impact of Moderators and Trust on Consumer's intention to Use a Mobile Phone for Purchases	UTAUT2 Poland
(Tarhini *et al*., 2019).	An analysis of the factors affecting mobile commerce adoption in developing countries Towards an integrated model.	UTAUT SERVQUAL Oman
(Sair and Danish, 2018)	Effect of Performance Expectancy and Effort Expectancy on the Mobile Commerce Adoption Intention through Personal Innovativeness among Pakistani Consumers	UTAUT Pakistan
(Pandey y Chawla, 2019)	Engaging mcommerce adopters in India. Exploring the two ends of the adoption continuum across four mcommerce categories	UTAUT India

(Blaise *et al*., 2018)	Mobile Commerce Competitive Advantage: A Quantitative Study of Variables that Predict Mcommerce Purchase Intentions	UTAUT the United States
(Shaw and Sergueeva, 2019)	The non-monetary benefits of mobile commerce: Extending UTAUT2 with perceived value	UTAUT2 Canada
(Verkijika, 2018)	Factors influencing the adoption of mobile commerce applications in Cameroon	UTAUT Cameroon.
(Chopdar *et al*., 2018)	Mobile shopping apps adoption and perceived risks: A cross-country perspective utilizing the Unified Theory of Acceptance and Use of Technology	UTAUT2 India and the United States
Soni *et al*. (2019)	Factors affecting the adoption of fashion mobile shopping applications	UTAUT2
Henrique De Borba and Tezza (2021).	Análise da percepçâo de usuarios sobre o comercio eletrônico móvel de artigos de moda.	UTAUT Brasil
Marinković *et al*. (2020).	The moderating effects of gender on customer satisfaction and continuance intention in mobile commerce: a UTAUT-based perspective.	UTAUT Serbia
Chimborazo *et al*. (2021)	Explaining mobile commerce usage intention based on technology acceptance models in a developing market context	UTAUT2 TAM Ecuador
Yu-Hung Dennis Chou *et al*. (2018)	Factors influencing the adoption of mobile commerce in Taiwan	UTAUT Taiwan
Sim *et al*. (2018)	Trust in vendor and perceived effectiveness of e-commerce institutional mechanisms in m-commerce adoption: A revised UTAUT model	UTAUT Malaysia
Asastani *et al*. (2018)	Factors Affecting the Usage of Mobile Commerce using Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT)	UTAUT Indonesia
Tak y Panwar, (2017)	Using UTAUT 2 model to predict mobile app-based shopping: evidences from India	UTAT2 India
(Njenga y Salih, 2019)	On Trust and Security Risk: Mobile Commerce Acceptance and Readiness in Sudan	UTAUT Sudan
(Khurana y Jain, Dipti, 2019)	Applying and Extending UTAUT2 Model of Adoption of New Technology in the Context of M-Shopping Fashion Apps	UTAUT2 India
(Dakduk *et al*., 2020)	Acceptance of mobile commerce in low-income consumers: evidence from an emerging economy	UTAUT2 Ecuador

Research model and hypotheses

Performance expectancy

The performance expectation variable is defined as "the degree to which using a technology will provide benefits to consumers in performing certain activities" (Venkatesh et al., 2012, p. 159). This variable is similar to other variables used in the eight models mentioned above, e.g., perceived usefulness, extrinsic motivation, relative advantage, outcome expectancy, and job suitability; these are variables that are strong predictors of adoption intention (Venkatesh et al., 2003).

In the context of m-commerce, it is defined as the extent to which an individual's expectation of using new technology will enhance their ability or help them achieve their shopping goals, improving their performance (Nikolopoulou et al., 2021; Singh et al., 2018). It is also the "extent to which the consumer believes that online shopping will provide access to information, facilitate price comparison, and enable faster shopping" (Kalinic and Marinkovic, 2016, p. 373). For this study, it is defined as the extent to which the consumer believes that using mobile commerce will provide benefits.

Several authors have found a relationship between performance expectations and m-commerce usage intention (Asastani et al., 2018; Blaise et al., 2018; Khurana and Jain, Dipti, 2019; Sair and Danish, 2018; Sim et al., 2018; Soni et al., 2019; Tarhini et al., 2019; Yu-Hung Dennis Chou et al., 2018), therefore, the following hypothesis is proposed: H1.

Expectations of m-commerce performance, positively influence m-commerce usage intention.

Effort expectancy

The effort expectancy variable is defined as "the degree of ease associated with consumers' use of technology;" (Venkatesh et al., 2012, p. 159). But the effort expectancy also reflects the degree of control that the person has over the tasks, and how much he/she must learn to interact with technology to overcome unforeseen problems or risks due to service failures, this scenario makes people perceive that they need to make a greater effort to obtain the maximum benefits in this case of m-commerce (Song et al., 2022). For this study, the degree of consumer perceived ease of use of m-commerce is defined by Turpo et al. (2022; Davis et al., 1989; Venkatesh et al., 2003, 2012).

Previous studies have found an influence of performance expectancy on m-commerce adoption intention (Asastani et al., 2018; Blaise et al., 2018; Sair and Danish, 2018; Sim et al., 2018; Soni et al., 2019, 2019; Yu-Hung Dennis Chou et al., 2018), therefore, the following hypothesis is proposed: H2. Expectations of effort in m-commerce usage, positively influence usage intention.

Social influence

UTAUT social influence is defined as "the extent to which consumers perceive that the important others (e.g., family and friends) believe they should use a particular technology" (Venkatesh et al., 2012, p. 159), for this study this definition is taken up.

The present research seeks to understand how social influence affects the intention to use m-commerce, i.e., how it influences the behavior of individuals.

Yang et al (2022) found that social influence significantly affects impulse buying behavior, other authors have found that social influence is a factor that has a significant relationship with the intention to use m-commerce (Asastani et al., 2018; Blaise et al., 2018; Chimborazo et al., 2021; Pandey and Chawla, 2018; Sim et al., 2018; Verkijika, 2018; Yu-Hung Dennis Chou et al., 2018), so the following hypothesis is proposed: H3. Social Influence positively influences m-commerce usage intention.

Hedonic motivation

Hedonic motivation is defined as "the fun or pleasure derived from using a technology, and it has been shown to play an important role in determining technology acceptance and use" (Venkatesh et al., 2012, p.161). This definition by Venkatesh has been used in several studies that investigated factors influencing the use of mobile commerce (Shaw and Sergueeva, 2019; Tarhini et al., 2019; Verkijika, 2018). For Soni et al. (2019) hedonic motivation is the reason for performing a behavior, due to the internal satisfaction experienced by the individual. For the present study, it is defined as the enjoyment or pleasure that a consumer can get from using mobile commerce (Soni et al., 2019; Venkatesh et al., 2012). Several studies have found that hedonic motivation is a factor that has a significant influence on the intention to use m-commerce (Chimborazo et al., 2021; Khurana and Jain, Dipti, 2019; Tak and Panwar, 2017; Tarhini et al., 2019; Verkijika, 2018), therefore the following hypothesis is proposed: H4. Hedonic motivation to use m-commerce positively influences the intention to use m-commerce.

Facilitating condition

UTAUT proposed the construct facilitating conditions, similar to TOPB's perceived behavioral control which is defined as "refer to consumers' perceptions of the resources and support available to perform a behavior" (Venkatesh et al., 2012, p. 159). For this study, it is defined as consumers' perception that the necessary infrastructure and technical resources exist to use mobile commerce (Pandey and Chawla, 2019; Venkatesh et al., 2012; Venkatesh and Davis, 2000; Verkijika, 2018).

Previous work has found a positive significant relationship between facilitating conditions and intention to use, and use m-commerce (Asastani et al., 2018; Chimborazo et al., 2021; Chopdar et al., 2018; Dakduk et al., 2020; Khurana and Jain, Dipti, 2019; Sim et al., 2018; Tarhini et al., 2019; Verkijika, 2018), thus the following hypotheses are established: H5a. Facilitating conditions for using m-commerce, positively influence the intention to use m-commerce. H5b. The facilitating conditions for

using m-commerce, positively influence the use of m-commerce.

Perceived risk

One of the variables with which UTAUT and UTAUT2 from innovation resistance theory (IRT) have been extended to study technology use is perceived risk; establishing that it negatively influences m-commerce adoption intention (Al-Adwan et al., 2019; Moorthy et al., 2017; Pandey and Chawla, 2019). Other studies look at the perceived trust variable in an opposite sense to perceived risk (Blaise et al., 2018; Tarhini et al., 2019; Yadav et al., 2015). Trust has to do with an individual's willingness to rely on a belief based on capability, benevolence, and integrity (Tarhini et al., 2019).

Perceived risk refers to the degree to which consumers believe that conducting transactions online, may result in harm or undesirable event (Al-Adwan et al., 2019). It also refers to perceptions of an individual regarding the possible risks occurring when using a given technology (Verkijika, 2018).

Moorthy et al., (2017, p.39), define it as the "uncertainty regarding possible negative effects or consequences of using a product or service". In this study perceived risk is defined as the extent to which consumers believe that using mobile commerce is unsafe or may have negative effects (Al-Adwan et al., 2019; Moorthy et al., 2017; Pandey and Chawla, 2019).

Recent research has found a significant and negative influence on perceived risk (Ashraf et al., 2017; Dakduk et al., 2020; Dwivedi et al., 2017; Khurana and Jain, Dipti, 2019; Verkijika, 2018), thus the following hypothesis is stated: H6. Perceived risk when using m-commerce, negatively influences the intention to use m-commerce.

Tradition

Tradition is one of the barriers that cause resistance to the adoption of innovations, including in IRT, along with other barriers such as use barrier, image, risk, value, and perceived cost (Kaur et al., 2020; Moorthy et al., 2017). Tradition as a barrier represents the obstacles that arise when the innovation produces a change in the established consumer tradition (Moorthy et al., 2017). For Kaur et al. (2020), this barrier refers to the obstacles to innovation being accepted since it implies changes in the routine, culture, and behavior of the adopter. For this paper, it is conceptualized as the resistance to using mobile commerce since it implies a change in the customer's habit of no longer making purchases physically but digitally.

Morthy et al. (2017), found that tradition is a factor that significantly and negatively influences the intention to use m-commerce, so the following hypothesis is established: H7. Tradition has a negative influence on the intention to use m-commerce.

Price motivation

UTAUT2 extends UTAUT with the variables habit, hedonic motivation, and price value. The price value is used to capture consumers' perception of the cost originated by using technology; if the cost involved is perceived as lower than the benefits obtained, then the price value is positive, therefore, it will influence the adoption intention (El-Masri and Tarhini, 2017; Kalinić et al., 2019; Venkatesh et al., 2012).

In m-commerce costs such as that originated from the purchase of the mobile device or that required for internet subscription is already implicit in the use of mobile internet, which the consumer uses for multiple purposes, so using m-commerce does not originate a substantial additional cost in terms of costs to use this technological innovation (Shaw and Sergueeva, 2019).

Several authors have found that the price value defined in UTAUT2 does not influence m-commerce adoption (Chopdar et al., 2018; Shaw and Sergueeva, 2019). Similarly, Moorthy et al. (2017) found that the cost barrier used in innovation diffusion theory which refers to the additional expenses incurred when using technology does not affect m-commerce adoption.

Instead, acquiring products at a good price when using m-commerce is a driver of online shopping (Faqih, 2016; Sarkar, 2019). Product price may be part of utilitarian value or performance expectancy; however, it was decided to treat it as a separate variable to investigate how price influences intention to use and usage of m-commerce (Sarkar, 2019).

Faqih (2016) considers price as a tendency of consumers to be motivated to make purchases when the price is low. That is, low price will be a determinant in deciding to make the purchase or a driver in the intention and use of m-commerce. Hence, for the present research, this construct has been named, price motivation, and is defined as consumers' perception that the use of m-commerce provides them with the ability to purchase products at a low price, considering value for money (Faqih, 2016; Sarkar et al., 2019). Due to the above, the following hypothesis is postulated: H8. Price motivation negatively influences the use of m-commerce.

Covid-19

The adoption of innovations not only occurs as part of a natural process involving innovation, time, a social system, and communication channels where individuals communicate the innovation to the members of their social system; where of course various factors influence the rate of adoption of the innovation and the time it takes to reach late adopters or laggards (Kim, 2020).

Not only innovation-related factors, personal traits, motivational factors, normative factors, etc., can influence the adoption of innovation but also situational factors caused by the environment; such as the case of the pandemic caused by COVID-19 (Verweijmeren, 2020).

Nguyen et al. (2020, p. 1), refer to the influence of COVID-19 on online bookstore purchases as "situational influences, involving the closure of physical bookstores, health risks associated with visiting such stores, the trend of online shopping and marketing the additional efforts of online bookstores during the pandemic."

The variable COVID-19 for this study is defined as the use of mobile commerce by consumers due to situations such as physical store closures, increased promotion for online shopping, and health risks (Nguyen et al., 2020), in such a sense the following hypothesis is established: H9. The COVID-19 phenomenon had a positive influence on the use of m-commerce.

Intention to use m-commerce

In the theory of reasoned action, behavioral intention refers to the degree of an individual's willingness to perform a behavior (Ajzen, 1989). For Kalinic and Marinkovic (2016), behavioral intention is the subjective likelihood that an individual will use mobile services. While Shaw and Sergueeva (2019) define usage intention as a "measure of the perceived likelihood that the respondent will use the innovation" (p. 48).

For Moorthy et al. (2017), adoption intention is "the consequence of the sum of variables culminating in an intention that demonstrates that the consumer is willing to take certain actions" (p. 39). Returning to the contributions of the aforementioned authors, starting from the theory of reasoned action defines the intention to use m-commerce as the measure of a consumer's willpower to use mobile devices to make purchases (Kalinic and Marinkovic, 2016; Shaw and Sergueeva, 2019). According to TRA the greatest predictor of behavior is the intention to execute that behavior (Ajzen, 1989). Chopdar et al. (2018) found a relationship between intention to use and the use of mobile commerce applications. Due to the above, the following hypothesis is established: H10. Usage intention positively influences m-commerce usage.

Use of M-commerce

According to Venkatesh (2012), the variable use in technology adoption studies has been defined and measured as the degree of use, variety of use, breadth of use, and cognitive absorption of the system used by users; thus, in his study on mobile internet use, he operationalizes use by measuring the frequency of use of the six most popular mobile applications, starting from never to several times a day.

In the same vein, Davis et al. (1989) measured the use of the WriteOne system with two questions that capture the frequency of use of the system. For this study, the operational definitions of Davis et al. (1989) and Venkatesh et al. (2012) are taken into account, adapting them to the context of mobile commerce and defined as: the extent and frequency of consumer use of mobile commerce.

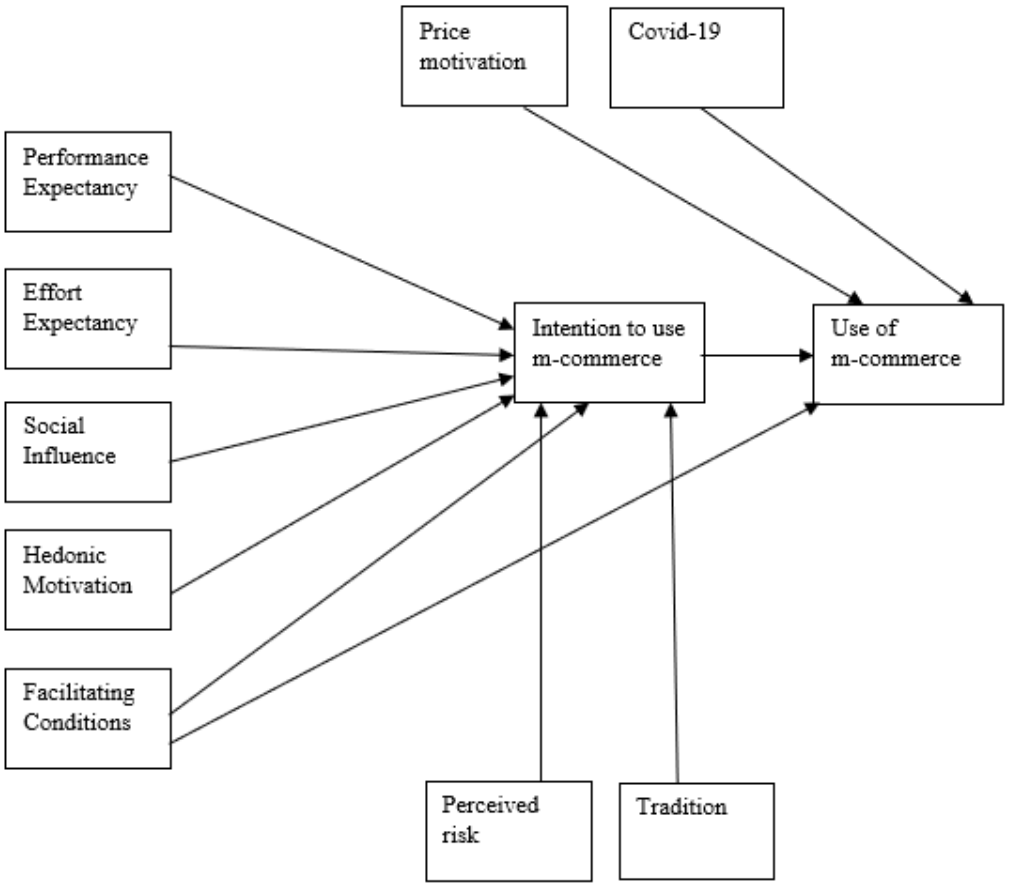

Figure 1: Research model

Method

The present research uses a quantitative approach with a correlational-causal scope, the design is non-experimental and cross-sectional. The questionnaire was sent and answered online, through Google forms, to 864 consumers of the seven municipalities of the state of Baja California, belonging to the Autonomous University of Baja California, who use mobile devices to connect to the Internet and therefore, are users or potential users of m-commerce.

Sample

From the municipality of Mexicali 346 consumers (40%), from Tijuana 265 consumers (30.7%), from Ensenada 176 (20.4%), from San Quintín 35 consumers (4.1%), from Tecate 21 consumers (2.4%), from Playas de Rosarito 18 consumers (2.1%), and from San Felipe 3 consumers (.3%). Of the sample, 81.1% lived in urban areas while 18.9% lived in rural areas. The sample consisted of 39.5% male and 60.5% female consumers. The percentage of the age of the consumers who responded was from 18 to 26 years old 86.9%; from 27 to 40 years old 7.4%; from 41 to 55 years old 4.7% from 56 to 75 years old 0.8% and more than 75 0.1%. Regarding the mobile device most frequently used by consumers, 91.1% of consumers (787) use smartphones, 8.2% (71) use laptops, and 0.7% (6) use tablets.

Instrument Development

For the development of the instrument, once the constructs were defined, based on an extensive literature review, the items were adapted and designed to be integrated into an instrument, after a validation process, a cross-sectional quantitative study was carried out with an empirical, analytical and non-experimental approach, through which consumer responses were evaluated. Based on the above, the technical quality of the items and their reliability and validity were established.

The measurement scale used in the instrument is a six-point Likert-type scale, with the options totally disagree, disagree, slightly disagree, slightly agree, agree, agree, and agree; in it, a value of one is assigned to the option disagree and a value of six to the alternative agree (DeVellis, 2016).

The variable Use of m-commerce included a list of six options to inquire about the frequency of use of m-commerce in the respondents; ranging from: Never; One or more times a year; One or more times every six months; One or more times every three months; One or more times a month; and One or more times a week.

Table 3. Items by variable

Variable	Item
Use of m-commerce	Use 1. Buy prepared food (ready to eat: hamburger, pizza, wings, etc.).
	Usage3. Buying products from department stores (Sears, Coppel, Liverpool, etc.).
	Usage4. Buy products in Marketplaces such as Amazon, AliExpress, MercadoLibre, or others.
	Usage6. Buy products directly from the brand's website or application (app) (Adidas, Nike, Pizza Hut, Guess, Gap, Caffenio, etc.).
Intention to use m-commerce	Int1. I will increase the frequency of mobile commerce purchases in the future.
	Int2. I intend to make purchases in mobile commerce.
	Int5. In the future, I plan to use mobile commerce.
Performance expectancy	Thanks to mobile commerce I have the following benefits:
	ER1. I can shop anywhere.
	ER2. I can shop at any time
	ER3. I save time
	ER6. I buy products that are not sold in my locality.
Effort expectancy	When I use mobile commerce it is easy for me:
	EE1. Shop
	EE2. Find the product I am looking for.
	EE5. Find deals
	EE6. Pay
Social influence	People important to me (friends, family, colleagues, acquaintances):
	IS1. They think I should buy in m-commerce.
	IS2. They recommend me to buy in m-commerce.
	IS3. They influence my decision to use m-commerce.
	IS4. They motivate me to use m-commerce to shop.
Hedonic motivation	Shopping in m-commerce works for me:
	MH1. Entertaining.
	MH3. Nice.
	MH5. Pleasant.
Facilitating conditions	CF1. I have access to devices (cell phone, tablet or laptop) to use mobile commerce.
	CF2. If I use my mobile device for mobile commerce, it will work properly.
	CF5. Thanks to high speed Internet it is possible for me to make online purchases.
	CF6. It is possible to use mobile commerce because there are different payment methods (credit/debit card, online banking, convenience store, Paypal, etc.).
Price motivation	When shopping in m-commerce:
	MP1. I look for the best value for money.
	MP2. I take into account the price
	MP3. I decide on the basis of the price

	MP5. I compare what I pay with what I will get.
	MP6. I keep an eye on sales campaigns (El Buen Fin, Black Friday, Cyber Monday, Prime Day, etc.).
Perceived risk	I am concerned that when I buy on mobile commerce:
	RP1. It may generate fraud or hacker intrusions.
	RP3. It may expose my private information.
	RP4. May have a billing error.
	RP6. Allow m-commerce vendors to provide my information to others without my consent.
Tradition	TRA1. I am desperate to shop in m-commerce.
	TRA2. I prefer to shop physically rather than in m-commerce.
	TRA3. I prefer to have contact with other people when I shop.
	TRA5. It is important for me to feel the product before buying it.
	TRA6. I am used to shopping in physical stores.
Covid-19	Covid1. The coronavirus has prompted me to use mobile commerce.
	Covid2. The coronavirus has strongly influenced me to make purchases on the Internet, using mobile commerce.
	Covid4. Because of the coronavirus I have increased my use of mobile commerce, to make purchases on the Internet.
	Covid5. As a result of the coronavirus, I initiated or increased the use of mobile commerce.
	Covid6. I adopted m-commerce because, as a result of the coronavirus, my favorite store closed physically and only sells online.

Results

The mobile commerce adoption model proposed in this research is shown in Figure 1. It was analyzed using SMARTPLS 3.3.7 software (Ringle et al., 2015). The measurement model, structural model, and global model were evaluated (Benitez et al., 2020).

Evaluation of the measurement model

To evaluate the measurement model, a distinction must be made between formative and reflective variables; the measurement model of the present study was made up of reflective variables. The reflective measurement model was analyzed by running the PLS algorithm to verify construct reliability, convergent validity, and discriminant validity (Sarstedt et al., 2014).

In the reflective measurement model, construct reliability was assessed with Cronbach's Alpha, Rho, and composite reliability (Hair et al., 2017). Values greater than 0.8 are adequate for strict reliability, however, values greater than 0.95 indicate redundancy in the items (Reidl, 2013; Cascaes da silva et al, 2015).

Because of the above, several items in the different variables were eliminated to reduce redundancy, and items with loadings lower than 0.7 or until having sufficient reliability were eliminated (Hair et al., 2017). From the facilitating conditions variable, items CF3 and CF4 were removed; from the COVID-19 variable, item COVID3 was removed; from the effort expectancy variable, items EE3 and EE4 were removed; from the performance expectancy variable, items ER4, ER5, and ER7 were removed.

From the variable intention to use m-commerce, items INT3 and INT4 were eliminated. From the hedonic motivation variable, items MH2 and MH4 were removed; from the price motivation variable, item MP4 was removed; from the perceived risk variable, RP2, RP5, and RP7 were removed. From the tradition variable, item TRA4 was eliminated. Finally, items USO2 and USO5 were eliminated from the m-commerce use variable.

Table 3 shows the items with which each variable was measured in the final version of the model, as well as their loadings, Cronbach's Alpha coefficient, Dijkstra-Henseler value (rho_A), and composite reliability; these last three indicated adequate reliability of the

construct since it had values of greater than 0.7 and less than 0.95 (Hair et al., 2017).

Table 4. Construct reliability and convergent validity

Latent variable	Item	Loads	Cronbach's alpha	rho_A	Composite reliability	AVE
Facilitating conditions	CF1	0.906	0.915	0.917	0.940	0.798
	CF2	0.903				
	CF5	0.856				
	CF6	0.907				
Covid-19	COVID1	0.872	0.925	0.938	0.944	0.773
	COVID2	0.912				
	COVID4	0.913				
	COVID5	0.923				
	COVID6	0.766				
Effort expectancy	EE1	0.907	0.920	0.922	0.943	0.806
	EE2	0902				
	EE5	0.890				
	EE6	0.892				
Performance expectancy	ER1	0.892	0.901	0.903	0.931	0.772
	ER2	0.917				
	ER3	0.883				
	ER6	0.820				
Social influence	IS1	0.875	0.874	0.889	0.913	0.725
	IS2	0.889				
	IS3	0.779				
	IS4	0.859				
Intention to use	INT1	0.899	0.900	0.902	0.938	0.833
	INT2	0.927				
	INT5	0.912				
Hedonic motivation	MH1	0.920	0.913	0.914	0.945	0.852
	MH3	0.939				
	MH5	0.909				
Price motivation	MP1	0.851	0.878	0.916	0.908	0.664
	MP2	0.872				
	MP3	0.781				
	MP5	0.829				
	MP6	0.733				
Perceived risk	RP1	0.878	0.926	0.926	0.947	0.818
	RP3	0.925				
	RP4	0.906				
	RP6	0.909				
Tradition	TRA1	0.807	0.865	0.922	0.895	0.631
	TRA2	0.864				
	TRA3	0.814				
	TRA5	0.752				
	TRA6	0.726				
Use of m-commerce	USO1	0.717	0.733	0.752	0.831	0.552
	USO3	0.688				
	ESO4	0.801				
	USO6	0.762				

AVE-average variance extracted, rho_A- Dijkstra-Henseler's value

Convergent validity refers to the degree to which an item correlates positively with the other items of the same variable, i.e., they converge (Hair et al., 2017). The external loadings of each item and the variance extracted from the mean (AVE) were analyzed. High external loadings indicate that the items have a lot in common; it is considered that they must have a value greater than or equal to 0.708 for the square of the loadings to explain at least 50% of the variance of the variable (Benitez et al., 2020), as confirmed in Table 3, except for USO3 which has a loading very close to 0.7.

The AVE indicates the average value of the squared loadings, i.e., the sum of the squared loadings of all the items of the variable between the number of items, must have a value equal to or greater than 0.5 to explain at least 50% of the variance of the items of the variable (Sarstedt et al., 2014). As can be seen in the AVE column of Table 3, all the values of the variance extracted from the mean were greater than 0.5.

Discriminant validity represents the extent to which an item is different from the others and measures a different aspect of the variable and is determined with cross-loading analysis, the Fornell-Larcker criterion, and HTMT (heterotrait-monotrait ratio) (Hair et al., 2017). According to the HTMT value, values of correlations lower than 0.85 suggest discriminant validity, with it the constructs are different (Hair et al., 2019), which was fulfilled as can be seen in Table 4.

Table 5. Discriminant validity criterion with HTMT

Latent variable	1	2	3	4	5	6	7	8	9	10
1. COVID-19										
2. Effort expectancy	0.472									
3. Facilitating conditions	0.471	0.751								
4. Hedonic motivation	0.494	0.774	0.691							
5. Intention to use	0.389	0.580	0.594	0.608						
6. Performance expectancy	0.389	0.775	0.685	0.635	0.590					
7. Price motivation	0.481	0.758	0.726	0.698	0.542	0.650				
8. Perceived risk	0.268	0.394	0.425	0.331	0.256	0.358	0.500			
9. Social influence	0.403	0.501	0.468	0.583	0.535	0.431	0.493	0.265		
10. Tradition	0.071	0.112	0.123	0.192	0.177	0.087	0.119	0.332	0.061	
11. Use of m-commerce	0.440	0.364	0.335	0.397	0.429	0.288	0.286	0.059	0.337	0.275

It is also possible to evaluate discriminant validity with the Fornell-Larcker Criterion, where the value corresponding to the square root of the AVE is compared with the correlations of the construct, hoping that the square root of the AVE is higher to confirm discriminant validity (Fornell and Larcker, 1981), as shown in Table 5.

Table 6. Fornell-Larcker Criterion

Latent variable	1	2	3	4	5	6	7	8	9	10	11
1. COVID-19	**0.879**										
2. Effort expectancy	0.437	**0.898**									
3. Facilitating conditions	0.436	0.691	**0.893**								
4. Hedonic motivation	0.456	0.71	0.633	**0.923**							
5. Intention to use	0.36	0.529	0.54	0.552	**0.913**						
6. Performance expectancy	0.357	0.707	0.623	0.577	0.531	**0.879**					
7. Price motivation	0.449	0.671	0.636	0.621	0.483	0.569	**0.815**				
8. Perceived risk	0.246	0.363	0.392	0.306	0.233	0.328	0.434	**0.905**			
9. Social influence	0.364	0.464	0.432	0.531	0.481	0.393	0.451	0.246	**0.851**		
10. Tradition	-0.025	-0.124	-0.003	-0.204	-0.186	-0.041	-0.01	0.26	-0.032	**0.794**	
11. Use of m-commerce	0.374	0.311	0.287	0.332	0.363	0.246	0.26	-0.048	0.274	-0.233	**0.743**

Note: The square root of the AVE value is in the bold diagonal.

Continuing with discriminant validity, cross-loadings are used to check that no item has a higher loading value on a variable other than the one it measures (Hair et al, 2017), this was met for each item of the different constructs, as can be seen in Table 6, the highest loadings have been highlighted.

Table 7. Cross Loads

	COVID-19	EE	FC	HM	IUM	PE	PM	PR	SI	TRA	UM
Covid1	**0.872**	0.430	0.402	0.435	0.331	0.358	0.435	0.276	0.326	0.011	0.278
Covid2	**0.912**	0.398	0.418	0.412	0.329	0.348	0.429	0.247	0.324	-0.003	0.325
Covid4	**0.913**	0.426	0.415	0.435	0.352	0.344	0.405	0.217	0.349	-0.065	0.352
Covid5	**0.923**	0.407	0.407	0.429	0.370	0.327	0.402	0.202	0.337	-0.069	0.384
Covid6	**0.766**	0.251	0.244	0.280	0.178	0.184	0.301	0.148	0.259	0.038	0.287
EE1	0.425	**0.907**	0.660	0.641	0.508	0.664	0.594	0.315	0.392	-0.120	0.312
EE2	0.373	**0.902**	0.626	0.637	0.478	0.641	0.600	0.349	0.428	-0.090	0.270
EE5	0.401	**0.890**	0.590	0.648	0.445	0.637	0.637	0.351	0.435	-0.094	0.248
EE6	0.370	**0.892**	0.601	0.626	0.464	0.594	0.584	0.291	0.413	-0.143	0.282
CF1	0.388	0.630	**0.906**	0.564	0.474	0.506	0.586	0.388	0.380	0.028	0.250
CF2	0.406	0.593	**0.903**	0.559	0.499	0.543	0.552	0.318	0.389	-0.023	0.277
CF5	0.368	0.562	**0.856**	0.515	0.448	0.519	0.495	0.300	0.378	0.002	0.248
CF6	0.393	0.681	**0.907**	0.619	0.506	0.600	0.634	0.394	0.397	-0.015	0.251
MH1	0.439	0.675	0.599	**0.920**	0.516	0.535	0.577	0.320	0.491	-0.165	0.304
MH3	0.414	0.701	0.605	**0.939**	0.522	0.575	0.606	0.294	0.496	-0.202	0.311
MH5	0.408	0.587	0.546	**0.909**	0.488	0.485	0.534	0.230	0.482	-0.197	0.306
Int1	0.315	0.487	0.478	0.477	**0.899**	0.487	0.419	0.211	0.446	-0.111	0.301
Int2	0.341	0.473	0.504	0.528	**0.927**	0.468	0.447	0.182	0.443	-0.217	0.374
Int5	0.329	0.489	0.496	0.505	**0.912**	0.501	0.456	0.246	0.429	-0.177	0.315
ER1	0.309	0.581	0.522	0.481	0.451	**0.892**	0.450	0.262	0.354	-0.017	0.223
ER2	0.316	0.607	0.546	0.500	0.473	**0.917**	0.472	0.267	0.355	-0.029	0.227
ER3	0.340	0.666	0.584	0.544	0.495	**0.883**	0.547	0.324	0.347	-0.062	0.217
ER6	0.287	0.628	0.533	0.499	0.445	**0.820**	0.530	0.298	0.324	-0.032	0.197
MP1	0.361	0.658	0.623	0.588	0.438	0.558	**0.851**	0.413	0.381	-0.022	0.172
MP2	0.343	0.643	0.633	0.563	0.440	0.563	**0.872**	0.447	0.390	0.028	0.186
MP3	0.320	0.531	0.518	0.502	0.358	0.432	**0.781**	0.388	0.339	0.042	0.146
MP5	0.357	0.552	0.556	0.512	0.406	0.487	**0.829**	0.398	0.343	0.010	0.172
MP6	0.395	0.404	0.342	0.400	0.332	0.330	**0.733**	0.205	0.360	-0.057	0.297
RP1	0.212	0.353	0.405	0.302	0.214	0.317	0.423	**0.878**	0.232	0.248	-0.045
RP3	0.205	0.318	0.321	0.268	0.207	0.280	0.374	**0.925**	0.210	0.220	-0.056
RP4	0.234	0.322	0.352	0.275	0.213	0.309	0.391	**0.906**	0.224	0.249	-0.034
RP6	0.239	0.320	0.340	0.261	0.208	0.279	0.382	**0.909**	0.225	0.223	-0.040
IS1	0.315	0.493	0.452	0.508	0.469	0.396	0.437	0.243	**0.875**	-0.059	0.253
IS2	0.338	0.487	0.454	0.523	0.443	0.411	0.457	0.284	**0.889**	-0.028	0.225
IS3	0.279	0.248	0.232	0.328	0.342	0.223	0.275	0.131	**0.779**	0.010	0.225
IS4	0.304	0.300	0.288	0.417	0.362	0.274	0.337	0.154	**0.859**	-0.020	0.229
TRA1	-0.049	-0.206	-0.126	-0.220	-0.207	-0.112	-0.084	0.113	-0.043	**0.807**	-0.181
TRA2	-0.059	-0.091	0.042	-0.183	-0.151	-0.033	-0.011	0.260	-0.071	**0.864**	-0.245
TRA3	0.011	-0.065	0.003	-0.161	-0.141	-0.014	0.002	0.204	0.025	**0.814**	-0.156
TRA5	0.046	0.000	0.121	-0.075	-0.088	0.045	0.097	0.291	0.001	**0.752**	-0.153
TRA6	0.008	0.025	0.138	-0.047	-0.051	0.103	0.106	0.331	-0.007	**0.726**	-0.200
Uso1	0.267	0.263	0.264	0.270	0.276	0.220	0.188	-0.049	0.199	-0.140	**0.717**
Uso3	0.225	0.152	0.144	0.198	0.181	0.102	0.147	-0.016	0.191	-0.117	**0.688**
Uso4	0.333	0.284	0.279	0.294	0.347	0.237	0.243	-0.028	0.235	-0.273	**0.801**
Uso6	0.267	0.194	0.131	0.205	0.237	0.139	0.172	-0.049	0.182	-0.125	**0.762**

Note: The highest loadings of each item are in bold type.

Assessment of the structural model

The evaluation of the structural model comprises the evaluation of the predictive relevance with the values of the coefficient of determination (R2), and the Stone-Geisser value (Q2), the evaluation of the effect size (f2), the evaluation of the collinearity and the determination of the path coefficients (Benitez et al., 2020; Ringle et al., 2020). As part of the assessment of the structural model, the path coefficients, and the relationships between the variables representing the hypotheses established in this research study, were evaluated. Figure 2 and Table 8 present the results obtained from the evaluation of the structural model. Those hypotheses whose p-value was significant, the p-value was less than 0.05, were accepted. Therefore, all hypotheses are accepted, except for H2, H5b, H6, and H8.

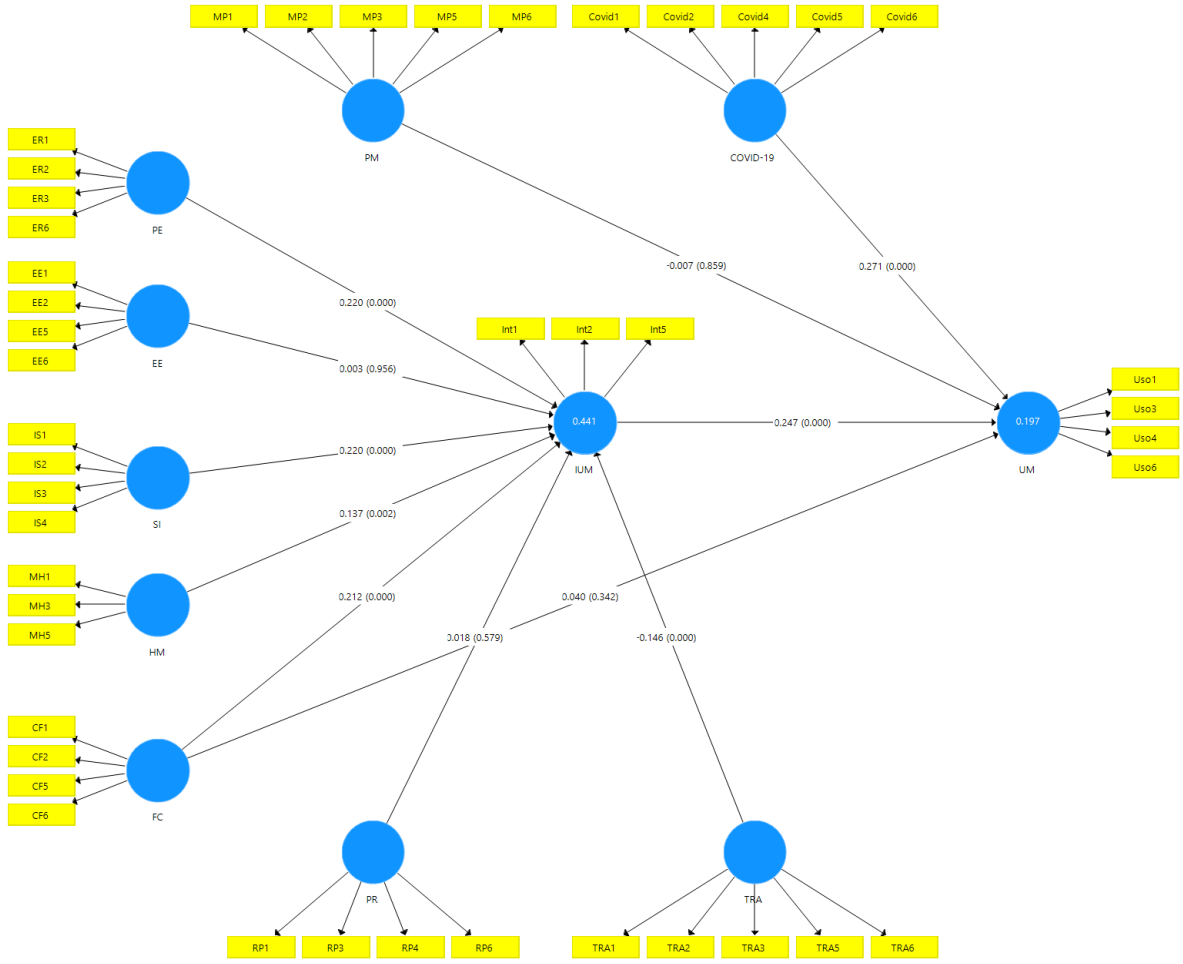

Figure 2. Structural model results

EE-effort expectancy, FC- facilitating condition, HM-hedonic motivation, IUM-intention to use m-commerce, PE-performance expectancy, PM-price motivation, PR-perceived risk, SI-social influence, TRA-tradition, UM-use of m-commerce. R2 values are in the endogenous constructs, path coefficients are in the arrows and p-values are in parentheses.

Table 8. Hypothesis testing

Relation	Coefficient path	Statistics t	P-Values	f^2	VIF	Hypotheses supported
H1. Performance expectancy -> Intention to use	**0.220**	**5.140**	**0.000**	0.040	2.174	**YES**
H2. Effort expectancy -> Intention to use	0.003	0.056	0.956	0.000	3.085	No
H3. Social influence -> Intention of use	**0.220**	**6.047**	**0.000**	0.060	1.446	**YES**

Relation	Coefficient path	Statistics t	P-Values	f^2	VIF	Hypotheses supported
H4. Hedonic Motivation -> Intention to use	**0.137**	**3.130**	**0.002**	0.013	2.539	**YES**
H5a. Facilitating conditions -> Intention of use	**0.212**	**5.375**	**0.000**	0.035	2.300	**YES**
H5b. Facilitating conditions -> Use of m-commerce	0.040	0.951	0.342	0.001	1.960	No
H6. Perceived risk -> Intention of use	0.018	0.555	0.579	0.000	1.351	No
H7. Tradition -> Intention of use	**-0.146**	**4.646**	**0.000**	0.032	1.209	**YES**
H8. Price motivation -> Use of m-commerce	-0.007	0.177	0.859	0.000	1.849	No
H9. Covid-19-> Use of m-commerce	**0.271**	**7.883**	**0.000**	0.069	1.333	**YES**
H10. Intention of use -> Use of m-commerce	**0.247**	**6.831**	**0.000**	0.051	1.501	**YES**

f2- effect size, VIF- variance inflation factor

The coefficient of determination R2 indicates the degree of the explanatory power of the independent variables on the dependent variables, which will be greater as it is closer to 1; an R2 value greater than 0.75 indicates that it is substantial, R2 greater than 0.5 moderate, and R2 greater than 0.25 weak (Hair et al, 2011). Only the intention to use m-commerce had a weak R2 as shown in Figure 2. With the Q2 value, the degree of prediction of the endogenous variables is evaluated, values less than 0.25 indicate a small predictive accuracy found (Ali et al., 2018, Hair et al., 2017). The Q2 value was 0.242 for the intention to use m-commerce, and for the use of m-commerce, the Q2 value was 0.103, which points to a small predictive accuracy.

The effect size f2 indicates the degree to which an independent variable explains the dependent variable in terms of R2, from 0.02 to 0.15 indicates a small effect, from 0.15 to 0.35 a moderate effect, and greater than 0.35 a large effect (Hair et al., 2011; Cohen, 1992). The largest value of f2 was for the relationship between COVID-19 and the use of m-commerce. Variance inflation values (VIF) less than 5 in the structural model indicate that there is no multicollinearity between the constructs (Hair et al., 2017), which is corroborated in Table 8.

Assessment of the overall model

A good model fit must have a standardized root mean square residual (SRMR) less than 0.08, the approximate model fit was found to be 0.055 (Henseler et al., 2016), so this condition is met. While, by exact fit tests, the values of SRMR, unweighted least squares discrepancy (dULS), and geodesic discrepancy (dG) of the estimated model should be less than the 95th and 99th quantile (Benitez et al., 2020, Henseler et al., 2016), which is confirmed since, the value obtained by the SRMR was 0.024, which is below the 95th percentile (0.027) and the 99th percentile (0.029). Likewise, the value obtained for dULS was 0.616, lower than the 95th (0.764) and 99th (0.842) percentile value. Finally, the dG value was 0.252, lower than the 95th percentile value (0.290) and 99th percentile value (0.310).

Conclusions

The results obtained reflect that Covid-19 and intention of use directly influence the use of m-commerce; however, no evidence was found to prove the effect of price motivation on the use of m-commerce. One of the strengths of this study is that it is one of the first to analyze the use of m-commerce in the Mexican population in times of epidemic. The results allow inferring that the pandemic is an event that affects the way of shopping, and represents an opportunity to open new sales channels, given the probability of contagion by exposure to having to go out to buy in a traditional way the population opted to use m-commerce, this situation was enhanced by the intention of use.

As evidenced, the use of m-commerce is being affected by the pandemic, a fact that makes it necessary to establish programs and measures aimed at strengthening this sales channel, for example, emphasizing minimizing the

perceived risk by incorporating security in the computing processes, to provide confidence and certainty to minimize negative impacts and promote the e-shopping culture of the population. As the pandemic is not over yet, m-commerce becomes a persistent strategy, which can maintain and increase sales volume.

Considering that the data collection was conducted through an online survey, there is a possible selection bias due to non-probability sampling; therefore, the findings are not generalizable to the general population. However, given the consequence of the results, the reported data should be considered as part of the rapid evidence generated in the evolving context of the Covid-19 pandemic. Furthermore, the instrument used presents adequate psychometric properties of reliability and validity.

It is recommended that this work be replicated in other contexts and sectors. It is believed that it is possible to advance knowledge by studying other territories; it is likely that, in that environment, the effects of Covid-19 on m-commerce will be greater.

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