



Mobile payment adoption in the time of the COVID-19 pandemic

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Abstract

Current situation in COVID-19 pandemic as well as the significant digital transformation, where the whole world is being forced to participate, are lead for a wide acceptance to use the mobile payments. The main objective for the current study is to focus on analysing the primary variable “intention to use” through the Apple Wallet mobile payment system “apple wallet app” in United Arab Emirates (UAE), in addition to defining a context and evaluating the various antecedents of its use. The main variables that addressed by the current study are ability to use (skilfulness), perceived usefulness, convenience of the system, perceived risk and the primary variable that mentioned before was intention to use. To conduct the study, we invited 422 respondents to an online survey, and we have used a structural equation modelling analysis. The results indicate that mobile user skilfulness is the variable that most influences the intention to use the proposed payment system, followed by perceived usefulness and convenience of the system, while the perceived risk has a weak negative relationship with intention to use mobile payment via apple wallet app in the light of high Cybersecurity Index in the UAE.

Keywords Mobile payment · Apple wallet app · Information society · International Telecommunication Union · Digital transformation · COVID-19 pandemic

Mathematical Subject Classification E42 · J33 · L86

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Abbreviations

| | |
|----------|---|
| ITU | International Telecommunication Union |
| LDCs | Least developed countries |
| LLDCs | Land-locked developed countries |
| SIDS | Small island developing states |
| USSD | Unstructured supplementary service data |
| DCX | Digital client experience |
| COVID-19 | Corona virus disease 2019 |
| GCC | Gulf Cooperation Council |
| CFA | Confirmatory factor analysis |
| KMO | Kaiser–Meyer–Olkin coefficient |
| UAE | United Arab Emirates |
| VSN | Virtual social networks |

1 Introduction

Since the inception of the Information Society in Geneva in 2003, access to and use of information and communication technologies has increased enormously, especially since the Internet services became available on mobile telephones. International Telecommunication Union (ITU), in their new edition of *Measuring Digital Development: Challenging time for the international community*, discussed the effects of the COVID-19 pandemic on economies and societies in the whole world, especially the shifting of many activities to the online mode, which has brought global connectivity in the spotlight [32]. “Facts and Figs. 2020” reveals that people in urban areas are face lower challenges than people in rural areas in staying connected during the lockdown, in particularly in developing economies. Large tracts of the rural areas still with no mobile broadband networks, and all of households in such areas have no access to the Internet [14].

The profound changes that the COVID-19 pandemic brought about to the use of digital devices and services have rendered the past trends less useful for predicting present or future phenomena. Anyway, progress made before the COVID-19 will have influenced how well-prepared people in different parts of the world have been to face the challenges posed by COVID-19 and the consequent disruptions in normal life, including the challenge of switching between “physical” or “digital,” this introduces a modern perspective on the effect and significant of connectivity for all nation’s economy [39].

A growing number of studies has been published in recent years on digital payments because of the rapid expansion of e-banking and payment systems, as well as the complexities of the factors that influence their use and adoption. Previous studies demonstrate that a significant number of these publications have looked at factors that influence the outcome, customer acceptance and adoption of digital payment, such as stakeholders’ expectations, cultural orientation differences, customer satisfaction, security and privacy risk, design attributes, and innovation [34, 43]. Despite the growing number of publications on digital payments, there is little peer-reviewed literature about their adoption and determinants, due to this gap, some suggestions

are raised that there is still a need to conduct an extensive literature review and provide suggestions for future research on developed nations regarding to the adoption of mobile and digital payments [18].

“Appendix 2” shows the types of mobile networks and the population coverage, and the extent of geographical areas covered by each network in 2020. Despite virtually 99% of “urban areas” in the world are covered by a mobile and Internet network, still a lot of gaps exist in the other areas “rural areas”. As shown below, in LDCs “the least developed countries” a 17% of the population of rural areas has no mobile coverage at all, and 19% of the rural population is covered only by a 2G network, while 100% of urban areas in LDCs are coverage in 67% by 4G network.

In an informed opinion, in urban areas about 72% around world of households had access to the mobile Internet network at home in 2019, almost the double of the ratio in rural areas (nearly 38%). At the starting of the last year (2020), only about 50% of the people in the world was using Internet, but this ratio inflated to be about 69% between age bracket 15–24 years. In other words, this means that a 369 million of the young people and a 3.7 billion people in total have no Internet connectivity. In developed countries, practically all young people were using the Internet network. In LDCs, the aggregate share of people using the Internet is half of the other share for young people, which is the same as only 38%. The Asia–Pacific region has the highest youth/overall ratio, which indicates that there is a potential for older age groups to catch up with younger users of the Internet [59].

Technological developments that we have seen in recent years are closely related to the use of mobile payment systems. Currently, we can use five main technologies implemented for mobile payments systems: voice services, short message service that known by SMS, wireless application protocol that formally known WAP, near field communication NFC, and the last technology is the unstructured supplementary service data (USSD; [5]. The global mobile payment market is anticipated to witness a Compound Annual Growth Rate (CAGR) of over 25% from 2020 to 2028 [47].

More than a thousand models of mobile phones are contained in each geographic market. The launch of mobile commerce applications in developed markets for iPhone, BlackBerry and Android may cover a large percentage of the target audience. Directly, when launching a mobile service for payment systems, a lot of customers want a gradual approach to the devices that will support these services [1]. The features of mobile applications are complex and continuously changing. The mobile firms that planning to introduce such applications or technologies should research the alternatives and work with a clever partner who can make credible recommendations as per the services offered and target market [50]. The holistic digital transformation approach that consolidates the changes needs to take into account four main aspects: transforming core operations from physical to digital, experience, digital infrastructure, and finally information management and analytics [3]. In the context of the current digital transformation of business it can be argued that mobile payment systems and wallet apps such as Apple Wallet, are eligible of generating significant impacts during situations such as the COVID-19 pandemic. In digital transformation concepts, Rogers [56] argues that upgrading your strategic thinking it should be the main target instead of updating your technology. For about 10 years

Rogers gains long experience in providing consultations and research to companies around the world, from his informed opinion he presented some ideas about how pre-digital-era firms can activate their plans and take the new opportunities of the digital transformation world and why traditional businesses need to rethink their core assumptions in five aspects of strategy: data, competition, customers, value, and innovation. Based on the above, it can be said that, in the context of the current digital transformation of business, mobile payment and wallet apps like Apple Pay are capable of generating positive impacts in all of the five main business strategy domains that were proposed by Rogers: customers, competition, data, innovation and value. This study aims to understand the factors that affect the adoption of these tools by users, and how mobile payments can be key tools for helping companies on their journey to digital transformation.

The rest of the paper is organized as follows: Sect. 2 presented literature review and hypothesis development; Sect. 3 described research design that included sample selection, methodology, and then empirical models; Sect. 4 presented empirical results; Sect. 5 included discussion and conclusions; and finally, Sect. 6 contained the limitations of this research and suggestions.

2 Literature review

The number of payments made through a mobile device in the United Arab Emirates (UAE) has been increasing significantly in the past 2 years. It is also set to accelerate further in the coming years, which presents opportunities for local businesses. The COVID-19 pandemic affected every area of life for many people across the globe over the past two years. One of the perhaps most enduring effects of it is the decline in the use of cash to make payments and increase in digital transactions, including those on mobile devices. Notably, digital payments had been growing quickly in the UAE for some years pre-pandemic. In the years 2014–2019, digital payments grew by 9% per year on average—whereas in Europe, growth was only about half of that [68]. Now, more than half of consumers in the UAE want to move to purely digital transactions in the next 2 years, according to a recent survey by payments company Visa.

The mobile payments market is growing quickly in the UAE and around the world, which means there is plenty of scope for new players to enter the market as it is still developing and numbers that use it are still relatively small. This means that those businesses that can provide innovative solutions that disrupt the market can make big inroads quickly and healthy profits [11].

Digital transformation is the mechanism of using digital technologies instruments to produce new or modifying the current business processes, culture, and clients' experiences to meet the market needs. This reforming of business and companies in the digital era is known “digital transformation”. Talking about digital transformation, even a small pilot project can be intimidating, as it calls for deep changes in how stakeholders think about customer data and the changes in the modes of communication, and the fact that those changes will not happen overnight [2]. The good news is that the new technology has made the first steps toward transformation much

easier than they were just a few years ago. From gathering the data to orchestrating and optimizing campaigns, every step on the banks' path to digital transformation has been further simplified by modern AI-driven tools [6, 8].

Solis [65] argues that six main stages must be included in each digital transformation, namely: business as usual, present and active; formalized; strategic; converged; innovative and adaptive. All together, these stages serve as a digital maturity project to lead helpful and meaningful digital transformation. Most of Solis' research were mainly based on the digital client experience (DCX) in the regard of digital transformation and thus reflects one of many tracks toward to change. He concluded that the DCX was a significant catalyst in driving the business developments, beside to the market factors and other technological aspects.

After the introduction of the Apple wallet app in the UAE in October 2017, alongside with Denmark, Finland, and Sweden, the accumulated number of countries that using the Apple wallet reached up to twenty. Apple wallet will remain compete with Samsung Pay that launched in April 2017 [4]. Apple has designed this app to offer freely use anywhere that uses a contactless payment terminal. Euromonitor has estimated that 50% of the POS Terminals in the UAE are NFC enabled and expected growth of nearly 52% during the year. Also, they had estimated the number of transactions through digital wallets would reach nearly 1.7 million during 2017. Nearly 2% of the retail sales come from online retail in the Gulf Cooperation Council (GCC), according to Euromonitor. The region's Internet retail sales are estimated to be \$4.5 billion in 2017 of which nearly 73% accounted for by Saudi Arabia and the UAE [62].

As per the latest survey that conducted by MasterCard, the result indicates that mobile payments in the Middle East increasing quickly, and more than 70% of respondents in this survey mentioned that they were willing to use mobile payment systems to achieve their tasks. The moving to mobile phones could also have a massive economic effect as studies have shown that the Middle East may add USD 95 billion to the Gross Domestic Product (GDP) by 2020 [21].

In the digital transformation era, the technology has an important role, accordingly, that role is to reform the company to increase the competitive advantage in an increasingly digital economy. It is significant to focus on the role of the client's experience lifecycle and the companies' requirements to ensure that companies used technology to enter the digital transformation process in order to reforming business strategies. To this, the mobile payment systems are highly effective communication tracks between business and customers [44]. By using a combination of experiences, the ability to use a given technology can be defined, also, the knowledge and background training for the individual about this technology, the ability to use a particular technology needs a greater confidence in order to result a greater intrinsic motivation to be used [36].

Skillfulness, or the ability to use a given technology, is defined as a combination of the experience, training, and knowledge the individual has regarding that technology. Greater confidence in the ability to use a technology will lead to a greater intrinsic motivation to use it [17]. For its part, perceived usefulness shows how people believe that a given technology can improve their productivity or performance in any work task [19]. In addition, positive evaluation of the user's mobile expertise

will reduce anxiety regarding the adoption of mobile services, and it will increase their enjoyment of mobile purchases/payments and their perception of the usefulness of mobile information, thereby increasing their intention to use it [63]. Based on these arguments, the following research hypothesis is proposed:

Hypothesis 1 Mobile users' skillfulness positively influences the perceived usefulness of the Apple wallet app during the COVID-19 pandemic.

Perceived usefulness is one of the most important original constructions of the technology acceptance model and has been widely studied as a central variable in the adoption of new technology. In the context of our research, we understand that the usefulness of the payment system will influence intention to use. A body of research, which includes studies focused on mobile banking [15, 25] and mobile payments [64, 54], supports this approach. Davis [19] argued that the "perceived usefulness" can tell how clients believe that a particular technology can promote their performance in any task. On the other side, a good evaluation of the user's mobile expertise will decrease their concern about the adoption of mobile services [63]. Vice versa, a positive evaluation will give them a maximum enjoyment and conception of the usefulness of mobile services, and then it will lead to increase their intention to use such services (Hsin [16]. Accordingly, in the marketing field, customers will value companies that produce value by combining amenities by access, purchase and use their services [57], and, at the same time, the maximum appreciation for the technology will be achieved when this technology makes the lives of users easier [35]. For all these reasons, the following hypothesis is proposed:

Hypothesis 2 The perceived usefulness of the Apple wallet app positively influences the intention to use it during the COVID-19 pandemic.

In today's marketing landscape, consumers value companies that offer value by incorporating amenities during the search for, access to, and purchase and use of services [57], and users value technology best when it makes their lives easier [29]. NFC mobile payment has a variety of features and user benefits that reinforce this approach. Convenience is a combination of time and place utility, which can impact a user's decision to use a particular system [49] and consequently the perceived value of the system. Convenience of use will thus have a positive effect on the intention to use [51], giving rise to the following hypothesis:

Hypothesis 3 The convenience of the Apple wallet app's system for the user has a positive influence on the intention to use it during the COVID-19 pandemic.

The influence of perceived risk on consumer behavior has attracted the attention of researchers since Bauer's seminal work [12]. In it, two main components are distinguished by Bauer, (1) lack of knowledge related to what will happen when use the mobile payment systems, it also can be called: client's uncertainty and (2) the possibility of negative or unexpected results of this payment. Bauer also affirms that

any client's behavior with uncertainty involves risk, due to the unexpected consequences by the users [12], but Gerrard and Barton Cunningham [24] defined perceived risk as that which arises from the possibility that use of the innovation is not safe. Perceived risk has also been given great importance in different modeling of the adoption of information systems, reflecting users' perceptions of uncertainty and the adverse consequences of participation in the activity, which thereby reduce their intention to use and continue to use [71]. The following hypothesis is proposed:

Hypothesis 4 The perceived risk for the user of the Apple wallet app negatively influences the intention to use it during the COVID-19 pandemic.

3 Research design

3.1 Sample selection and data

Snowball sampling (chain-referral sampling) [46] was used to achieve the study objectives that are reflected in the above hypotheses. This online survey was carried out in some similar previous studies such as that by Rozalia [58] who the types of non-probabilistic sampling used in marketing research, Otamendi and Sutil Martín [48] in the study of the emotional effectiveness of advertisement, Sebastian et al. [61] when they explored the opinions of the YouTube visitors towards advertisements and their influence on the purchase intention among viewers, and Pötzschke and Migrant [53] in the migrant sampling using Facebook advertisements.

This sampling method involves a primary data source that names other data sources that will potentially be useful in the research. The snowball sampling method is purely based on referrals and that is how a researchers generate a sample. Therefore, this method is also called the chain-referral sampling method [13]. To use the snowball sampling procedure a message was designed sent to individuals in the UAE (the target population in this study) via social networks on platforms such as LinkedIn, WhatsApp, and Facebook messenger.

In the content of our questionnaire the structure includes a video to be viewed by the respondents, this video was important to make sure that the respondents understand the tools that will be analyzed after we will receive their responses. In according to Westland [69], all questions in the questionnaire didn't include open-ended, this will not lead to more coding using more qualitative methods. In addition to the video, a short letter was sent in advance to inform the sampled respondents about the questionnaire combined with short introduction. All questionnaire's questions were clear, non-offensive and easy to respond to for the objective under study.

The response rate was increased using the advanced letter, short introduction, and brevity [42]. In general, this questionnaire was not from the long surveys type, all these procedures that were taken in account helped us to avoided approximately, less than 5% of the total respondents' number that were collected, were chosen mainly because of the lack of answers for the main variables [66].

The questionnaire was split into five main sections (as shown in "Appendix 1" Scales Used/Questionnaire). The targeted respondents read the first one that was a

short paragraph about the adoption of mobile payment using Apple wallet in the UAE and the necessity of changing to the use of digital transactions during the COVID-19 pandemic. The second section included several evaluative paragraphs designed to assure the subjects that their privacy and interests were protected when they responded to the questions in the survey. The third includes several evaluation questions designed to confirm the coherence and interest the study objective. The fourth step included the items to seek responses to lead to the attainment of the proposed study objectives. And finally, items that sought the subjects' socio-demographic data and the classification aspects.

According to Rodríguez-Ardura and Meseguer-Artola [55], some measures were taken to prevent the methodological bias that enters such studies. Also, all questions that introduced in the questionnaire were reviewed by experts in this field to ensure that the questions were understandable, accurate and well-formulated. The questionnaire included items framed both positively and negatively to avoid extremes and biased responses. Before they responded to the survey, the participants were assured through a message that their identity would not be revealed and their anonymity would be preserved.

3.2 Study variables

The measuring instruments were adapted from previous studies conducted in the same field. Table 1 shows the definition of variables and the previous study from which each one of them was adapted.

Figure 1 shows the estimated model for our study, it can be seen the theoretical model proposed for the present study, which includes the previously hypothesized relationships. The variables that shown above in the estimation model have used previously in some studies, but they didn't combine all of them together, the most close model that used before was the model of Francisco et al. (2020), when they analyzed the electronic payment adoption in the age of digital transformation in China [41, 40, 49, 67].

The data collection took approximately 2 months, during which 422 relevant and valid questionnaires were collected. The avoided questionnaires (approximately, less than 5% of the total respondents' number that were collected) were chosen mainly because of the lack of answers for the main variables. The sample details are shown in Table 2.

3.3 Evaluation of the variables used

Emulating Hidayat et al. [30], in the present study the sample was checked for validity and reliability at two levels—quantitative data were analyzed using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) using SPSS 23.0 and AMOS 18.0 software. Also, the validity, reliability and suitability of the used variables were confirmed with a series of confirmatory and exploratory analysis using AMOS 18.0 and SPSS 23.0.

Table 1 Definition of variables

| Variable | Symbol | Adapted from previous study |
|------------------------------|--------|--|
| Ability to use (skilfulness) | SF | Lu and Su [41]: the purpose of this paper is to explore a conceptual model for analysing customers' perceptions of using mobile commerce services for online shopping (369 participants) |
| Perceived usefulness | PU | Davis et al. (1989): the purpose of this paper was to develop and validates new scales for perceived usefulness which is hypothesized to be fundamental determinant of user acceptance (152 users) |
| Convenience of the system | CS | Pal et al. [49]: the purpose of this paper was to introduce new technologies like the Near Field Communication (NFC), payment today can be done very easily and conveniently using any NFC enabled mobile phone (270 participants) |
| Perceived risk | PR | Liébana-Cabanillas et al. [40]: as per the methodology of this study they analysed in this paper users' acceptance of mobile payment in VSN, due to their assumption that the mobile payment in Virtual Social Networks (VSN) is not among the most commonly used mobile services. External influences, attitude, usefulness, and risk are determinants of intention |
| Intention to use | INT | Venkatesh et al. [67]: the purpose of this paper was to study the acceptance and use of technology in a consumer context. They proposed UTAUT2 incorporates three constructs into UTAUT: hedonic motivation, price value, and habit (1512 mobile Internet consumers) |

Source made by the authors

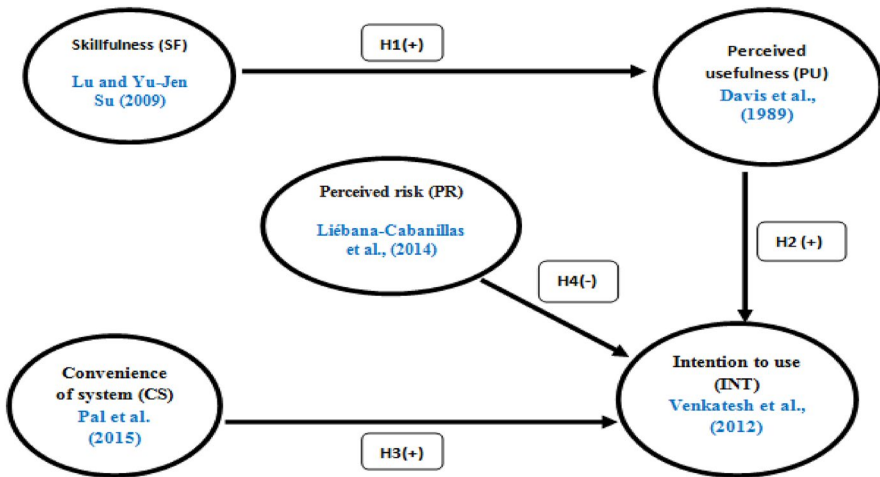


Fig. 1 Estimated model

Table 2 Sample details

| Item | Details | Number | Percentage |
|---------------------------|--------------------|--------|------------|
| Gender | Male | 201 | 47.6 |
| | Female | 221 | 52.4 |
| Age | 20–25 | 129 | 30.56 |
| | 26–35 | 116 | 27.49 |
| | 36–45 | 99 | 23.46 |
| | 46–55 | 69 | 16.35 |
| | 56–65 | 9 | 2.13 |
| Level of education | Not educated | 5 | 1.18 |
| | Primary educated | 49 | 11.61 |
| | Secondary educated | 112 | 26.54 |
| | Higher education | 241 | 57.11 |
| | Other | 15 | 3.55 |
| Income level ^a | < USD 1500 | 87 | 20.61 |
| | USD 1501–4000 | 111 | 26.31 |
| | USD 4001–6000 | 107 | 25.35 |
| | > USD 6000 | 117 | 27.72 |

Source made by authors

^aUSD = AED3.67 (constant)

Cronbach's α indicator was used to measure the reliability of the variables [20]. Cronbach's α is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. Technically speaking, Cronbach's α is not a statistical test—it is a coefficient of reliability (or consistency). Cronbach's α indicates the internal coherence of the indicators. If the coefficient exceeds 0.7, it is considered as indicating the existence of internal

coherence [26]. All the variables yielded good results ($\alpha > 0.75$). Also, to test the degree of unidimensionality of the variables, an EFA was conducted using the principal component extraction model.

To verify that the ratio of the variance for the variables have in common and more than the value of 0.5, Kaiser–Meyer–Olkin coefficient (KMO) was used, which indicates that the sample adaptation was acceptable. The result of Bartlett’s sphericity test also was acceptable with ($p\text{-value} \leq 0.001$). Also, we verified the communalities (> 0.5) between the main variables in this analysis, which indicates that most of the main variables in this study are well represented in the common factor space, and the factor loads in these variables are higher than the recommended minimum ($R^2 > 0.5$). Thus, the analysis was well verified to be adequate for the main variables in this study.

To test the convergent and divergent validity of the scales a CFA was conducted and through the factor loads of the variables convergent validity was evaluated. Based on Hair et al. [27], the coefficients that do not differ significantly from (0) were verified, also in all cases the loads between the latent and variables are high (> 0.7), once 1 was eliminated from the ease-of-use construct. After that we have verified the loads between the latent variables and main (observed) variables, then it can we can say that the latent variables explain the observed variables.

Regarding the validity of discriminant, the variances were found to significantly differ from (0), and the relationships between the constructs were weak, in addition to the correlation between each pair of scales was not higher than (0.8). Indicators of variance and extracted composite reliability for all the dimensions of the model were found to be above the recommended limits (> 0.7 and > 0.5 , respectively [27] as shown in Table 3.

4 Results

Once the reliability and validity of the measurement scales had been analyzed, the research hypotheses supported by the literature review were assessed. To this end, a model of structural equations was developed, using the maximum plausibility method with the resampling or bootstrapping technique, since the assumption of multivariate normality was not met.

The absolute, incremental and parsimony fit measures indicated that the model was a reasonably good fit. To evaluate the structural model, the statistical significance of the structural loads was analyzed, as well as the R^2 coefficients.

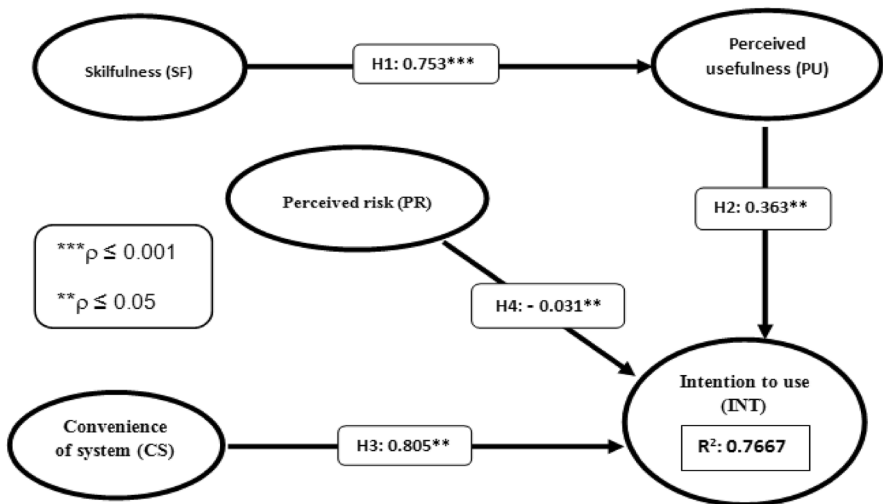
In Fig. 2, it can be seen the results of the behavioral model as designed by the authors, that mainly measured “intention to use” the new mobile payment system, combined with the standardized coefficient for each relationship that introduced in the study hypotheses.

The results of the analysis confirmed the four proposed hypotheses through the verification of their meaning and significance. For the first hypothesis—the perceived usefulness is positively affected by the mobile user skillfulness of the Apple wallet app during the COVID-19 pandemic—the estimated model shows a strong

Table 3 Composite reliability and variance extracted

| Construct | Items | Standard coefficient | Composite reliability | Variance extracted |
|------------------------------|-------|----------------------|-----------------------|--------------------|
| Ability to use (skilfulness) | SF1 | SF1 | 0.86 | 0.76 |
| | SF2 | SF2 | | |
| | SF3 | SF3 | | |
| Perceived usefulness | PU1 | 0.809 | 0.84 | 0.71 |
| | PU2 | 0.825 | | |
| | PU3 | 0.813 | | |
| | PU4 | 0.867 | | |
| Convenience of the system | CS1 | 0.845 | 0.91 | 0.69 |
| | CS2 | 0.801 | | |
| | CS3 | 0.817 | | |
| | CS4 | 0.902 | | |
| | CS5 | 0.867 | | |
| Perceived risk | PR1 | 0.833 | 0.87 | 0.73 |
| | PR2 | 0.881 | | |
| | PR3 | 0.823 | | |
| | PR4 | 0.821 | | |
| Intention to use | INT1 | 0.889 | 0.89 | 0.81 |
| | INT2 | 0.861 | | |
| | INT3 | 0.877 | | |

Source made by authors, SPSS 23.0 and AMOS 18.0 results

**Fig. 2** Estimated model results

positive relationship between the mobile users' skillfulness and the perceived usefulness with estimated values, $\beta=0.753$, $p\text{-value}<0.001$.

Furthermore, the estimated model showed a positive relationship between the perceived usefulness and intention to use with an estimated value of $\beta=0.363$, $p\text{-value}<0.05$ for the second hypothesis—the perceived usefulness of the Apple wallet app positively influences the intention to use it during the COVID-19 pandemic. For the third hypothesis—the convenience of the system for the user of Apple wallet app has a positive influence on the intention to use during the COVID-19 pandemic, the model, with a value of $\beta=0.805$ and $p\text{-value}<0.05$, estimated the strongest positive relationship between the convenience of the system and the intention to use it.

An amazing result emerged for the last hypothesis. The relationship between intention to use and perceived risk was weaker than the other results. The estimated model found a negative relationship between perceived risk and the intention to use with a value of $\beta=-0.031$ and $p\text{-value}<0.05$. These values, however, did not exceed the reasonable results found in the literature review. This result will be discussed further in the last section of this study. The predictive power of the model regarding the intention to use the mobile payment system studied is 76.67%, which represents a reasonably significant value, considering other models used to study the adoption of mobile payments [41, 40, 49, 67].

At the conclusion of this section, Table 4 summarizes the most important results:

5 Discussion and conclusions drawn from the study

Due to the money, the world goes around. Economies turnover is relying on the money exchange for services and products. Economists define money, from where it came and its worth. Before the development of a medium of exchange, that is, money, people used barter to obtain the goods and services they needed. Two individuals, each possessing some goods the other wanted, would agree to a trade. Early forms of bartering, however, did not provide the transferability, divisibility, and efficiency that the use of commodity money brought these advantages to trade. Commodity money is a type of good that has been functioning as currency since the seventeenth and early eighteenth centuries.

Table 4 Hypotheses results*

| H | Variable 1 | Variable 2 | β | p-value | Result |
|----|---------------------------|----------------------|---------|---------|---------------------------------|
| H1 | Mobile user skilfulness | Perceived usefulness | 0.753 | <0.001 | Strong positive relationship |
| H2 | Perceived usefulness | Intention to use | 0.363 | <0.05 | Positive relationship |
| H3 | Convenience of the system | Intention to use | 0.805 | <0.05 | Strongest positive relationship |
| H4 | Perceived risk | Intention to use | -0.031 | <0.05 | Weak negative relationship |

Source made by authors

The next generation of money is the fiat money, which does not require the backing of a physical commodity [6]. Instead, the value of fiat currencies is set by supply and demand and people's faith in its worth. Fiat money evolved to replace gold and silver coinage because these commodities were a scarce resource and not enough of these metals could be mined in necessary quantities to meet the demand for currency created by rapidly growing economies. For a booming economy, the need for gold to give money its value makes providing the money extremely inefficient, especially when the value of money is created by people's perceptions [22].

The value of money today, (not only the dollar value, but most of other currencies) is completely determined using the purchasing power parity PPPs, as forced by the inflation rate. Due to the inflation rate forces, the process of printing new money cannot generate new wealth for any country. The creation of money will be generated due to the perpetual interactions among tangible assets, real assets, our desire for these assets and our abstract faith in what has value. The money will gain the value because we want it, to be used to buy the desired product or services.

About three decades ago (1997), the first using for the mobile payment system, for services or goods was introduced by Coca-Cola in Helsinki, with a beverage vending machine that accepted just an SMS message from a buyer in payment for the commodity. After that (2007), Vodafone company took the competition advantage by launching one of the biggest systems that rely on the mobile payment, the systems that time were produced using USSD/SMS technologies, and they have offered various types of systems depend on the micro and macro payment. These services were launched in cooperation with local telecom operators in Kenya and Tanzania. Recently in 2011, some primary players such Google and Apple have entered the area of mobile payment systems. Nowadays, Google can be considered in the front of companies that dealt with the digital mobile wallet. For sure, in coming years the field of mobile payment systems will be replete with drastic changes and might be seen the mobile payments systems in an entirely new form.

In addition to this general trend, the coronavirus crisis has meant that mobile payments, by keeping economies functioning and helping people reduce contact with the virus, have received a little more attention [70]. Contactless mobile payments at the point of sale, using facial recognition, QR codes or NFC codes, also help to prevent the spread of the virus through cash exchanges and physical contact, making this a safe payment method from this point of view for consumers and businesses alike, and indicating its great potential as a means of payment in the near future [7].

The current study aimed to investigate the adoption of mobile payment in the era COVID-19 pandemic using the case of Apple wallet, UAE. The researchers considered some variables related to this subject as mentioned in the literature review. These variables were, the ability to use (skillfulness), perceived usefulness, the convenience of the system, perceived risk, and the intention to use. From the results of the estimated model (Fig. 2) that was developed to achieve the aim of this study, the researchers found some interesting results.

The estimated model shows a strong positive relationship between the mobile user's skillfulness and the perceived usefulness with estimated values of $\beta=0.753$, $p\text{-value}<0.001$. This result agrees with the results obtained by Saprikis et al. [60] that aimed to find out users' reaction towards different parameters that would

influence their intention to use their mobile devices to purchase products and services online in the context of the current Greek reality. The proposed model in the study of Saprikis et al. [60] included behavioral intention, mobile skillfulness, enjoyment, anxiety, perceived usefulness, perceived ease of use, trust, relationship drivers, and innovativeness.

The second interesting result in this study regarding the perceived usefulness and intention to use found that the estimated values were, $\beta=0.363$, $p\text{-value}<0.05$. This result matches with the findings of Jahangir and Begum [33]. Their study focused on the Perak State academics' intention and behavior to adopt an e-filing tax system. The target population for this study was the academic staff in Perak State in Malaysia. The findings showed that the perceived usefulness, perceived security, and perceived credibility influenced the Perak State academic's e-filing adoption intention.

Also, the result from the current study regarding the perceived usefulness and intention to use matched with the findings of Hamida et al. [28]. That study analyzed the relationships between perceived usefulness and perceived ease of use (predictors variables) and continuance of intention to use e-government via mobile phones (criterion variable). The results of multiple regression analysis showed that perceived ease of use ($\beta=0.14$, $p<0.05$) and perceived usefulness ($\beta=0.65$, $p<0.01$) and both were positively related to the continuance of intention to use e-government, and 56% of variance can be explained by the model.

For the third result in the current study, regarding the convenience of the system and intention to use, the estimation values were $\beta=0.805$, $p\text{-value}<0.05$. This result regarding convenience is consistent with the previous findings by Prayoonphan and Xu [52]. That study had revealed a comparable connection between the influences of perceived convenience on perceived value. The results had proved that transport users would be more willing to use the Spider Card if they believed it was more convenient than other means of payment in terms of monetary benefits and timesaving.

The last result in this study was weaker than the other results. The estimated model showed that a negative relationship between intention to use and perceived risk existed (with values: $\beta=-0.031$, $p\text{-value}<0.05$) but not exceed the reasonable results that were found in the literature review. For example, the study by Liu, et al. [38] showed that perceived convenience, perceived enjoyment, and perceived money-savings positively influenced the perceived value, whereas perceived fees and perceived privacy risk negatively influenced the perceived value. Also, the results of a study by Lin et al. [37] that analyzed the factors influencing the intention of adopting Internet banking showed differences in the factors that companies and consumers adopted. The estimated values in Lin's (2020) study regarding perceived risk and trust were $\beta=0.51$ and $p\text{-value}<0.001$. For perceived risk and trust in Internet banking, the estimated values were $\beta=0.40$ and $p\text{-value}<0.001$.

The study of Feathermana and Pavloub [23] also conducted an amazing study by including some variables such as the potential losses (negative utility) caused by e-service adoption drawing from the theory of perceived risk (RRT). The results showed that the performance-based risk perceptions negatively affected on e-services adoption. However, the concerned of e-service risk were reduced due to the perceived ease of use. And the application of merging the perceived risk into the proposed e-services adoption model were discussed.

When the researchers compared the result of the last hypothesis regarding perceived risk and intention to use with the findings of the previous studies, it was observed that the result of most of those studies invariably showed a strong negative relationship between perceived risk and intention to use in e-commerce, Internet banking, mobile payment, digital transformation, purchase intention on mobile shopping, and the M-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). The researchers attribute the weak relationship in this study to several factors, which may later comprise an important research topic for future researchers in this field in the UAE. The most important of factors is self-confidence. According to the 2019 report, the UAE is considered to rank first among the countries in the Arab Region and 9th globally in the “digital competitiveness” factor. The UAE has advanced five positions from the previous year’s ranking to the 12th rank globally and the first rank in the Arab Region. In the 2020 report, the UAE progressed to the first rank in the Arab Region in all three main factors considered in the report, namely, the “technology” factor, in which the country achieved the second rank globally, advancing by five ranks since last year, and the 9th globally in “Future Readiness” factor, progressing from the 12th rank last year. The UAE advanced one rank in the “knowledge” factor to be at the top in the Arab Region and 35th globally [31]. As per IMF 2020, most of the UAE residents have enough self-confidence to use e-banking and mobile payment without feeling at any risk by its use [7]. That’s why the results of the questionnaire showed a weak relationship between the perceived risk and intention to use in a country that has ranked second in the world in the cybersecurity index [59].

The second point of view was the result of the study by Marafon et al. [45]. They found in their study that the risk acceptance and self-confidence are main drivers to moderate the relationship between intention to use Internet banking and the risk perception. For the customers that have less confidence, the effect of perceived risk on intention to use Internet banking is higher than it is for customers with high confidence. Vice versa, for the customers that have less risk-acceptance the effect of perceived risk on intention to use Internet banking is higher than it is for individuals with high risk-acceptance. Also, the results of a study by Alghamdi et al. [9], in addition to the cognitive perceptions, the psychological characteristics of customers are main keys elements to determine the continuing use of Internet banking services. The merging of psychological characteristics into technology acceptance systems can provide more strengthens explanatory power and support the understanding of Internet banking services behavior. Users’ uncertainty elimination, technology readiness, and their satisfaction are main keys elements to keep going in using Internet banking services. Based on the findings in IMD’s [31] report, the study of Marafon et al. [45] and Alghamdi et al. [9], they found that the weak negative relationship between intention to use and perceived risk can be explained by the high cybersecurity index of the UAE.

In conclusion, the Apple wallet is one of the most important banking financial services that has been developed by Apple and banking operators a few years ago. Consumers are already accustomed to using Internet banking, and it works with major credit and debit cards issued by many UAE banks. With the rise of digital transformation in financial technology, however, consumers have access to financial

services from more diversified channels other than traditional institutions. The COVID-19 pandemic sparked a boom in the Middle East digital payments sector. As per the report of Alicia Buller [10] that conducted based on a regional questionnaire that included more than 5000 customers in Kuwait, Jordan, UAE, Pakistan, Egypt, Saudi Arabia, Qatar, and Bahrain, more than 47% of customers mentioned that they expect to use online payment systems more frequently in the upcoming year. While about a 15% expect their shopping via online payment frequency to be declined, but the remaining of customers, about a 38%, they expect to remain the same. In this sense, a stubborn level of cash-use in the Middle East could decline after an acceleration in the adoption of digital payments due to the coronavirus pandemic.

The e-commerce and digital payment industries in the Middle East region are set for major growth in 2021. Therefore, the mobile payment mode is set to see increasingly fierce competition. Most prior studies discussed mobile payment using Internet banking in GCC countries (of which the UAE is one) relying on expert reports and data collected from banks. This study, however, tried to add new literature in this field by designing a questionnaire that covers five main variables—mobile users' skillfulness, perceived usefulness, the convenience of the system, perceived risk, and the intention to use—to discover the mobile payment adoption during the COVID-19 pandemic in the UAE. All used variables were adopted from previous studies in this field. The findings of this study were strongly and positively related to the mobile user skillfulness and perceived usefulness. There was a positive relationship between perceived usefulness and the intention to use and the strongest positive relationship between the convenience of the system and the intention to use. The last of the results was a weak negative relationship between intention to use and perceived risk, which was justified by the high cybersecurity index in the UAE.

According to the results found at the paratactical level—economic and commercial—we especially recommend that companies and public sectors interested in promoting the use of mobile payment concentrate their efforts on, and allocate resources to, adding value to the payment tool and reducing the perceived risk of using it, encouraging the customer to see the advantages of using this payment method. At the same time, we recommend that companies direct their marketing actions towards users who already have mobile user skills, as this user group is more likely to appreciate the utility and benefits of mobile payments.

6 Research limitations and suggestions

The limitation of this study mainly lies in the method of data collection. The data was collected through a questionnaire that was designed by the researchers based on the previous studies. Although the measures produced reasonable results (Table 5), the biases might still have entered the results due to the subjective consciousness of the respondents. As shown in Table 3, 18.48% of the respondents were aged 46–65 years, and the level of education of the respondents was 12.79% with primary education or less. Also, due to the scope of our study, our sample is limited in size and not representation a population sample. In our questionnaire, we explicitly stated that one should only participate if one either lives in UAE or

Table 5 Main adjustment indicators of the proposed model

| Coefficient | RMSEA | GFI | AGFI | CFI | NFI | IFI |
|--------------------------------|-------|-------|-------|-------|-------|-------|
| Model value | 0.05 | 0.84 | 0.86 | 0.91 | 0.92 | 0.94 |
| Recommended value ^a | <0.08 | >0.90 | >0.90 | >0.90 | >0.90 | >0.90 |

RMSEA root-mean-square error of approximation, *GFI* goodness-of-fit index, *CFI* comparative goodness-of-fit, *NFI* normed fit index, *IFI* incremental fit index

^aHair et al. [27]

has his or her habitual residence there, however, we cannot ensure that this is true for every response. Also, though a good size, was obtained under a non-probabilistic sampling design (snowball), and this may have biased the results. In this regard, it is suggested that the number of respondents may be increased in future studies so that the sample and the judgment based on it are closer to the actual situations and render the age and level of education insignificant.

Also, the fourth hypothesis in the study was established based on the previous studies in this field, but the result regarding this hypothesis was completely different from the findings of the other studies. In this regard, it is suggested that the cybersecurity index and self-confidence in the UAE might be considered in future studies.

Appendix 1: Scales Used/Questionnaire

Mobile User Skilfulness (Lu et al. 2009)

- I feel confident using the payment system displayed to complete an online transaction efficiently (SF1)
- I would be able to use the payment system displayed to complete an online transaction in a short period of time (SF2)
- I would be able to use the payment system displayed to complete an online transaction in a short period of time if I had used a similar system before (SF3)

Perceived Usefulness (Davis et al. 1989)

- Using the payment system displayed can help me make the purchases I normally make over the Internet (PU1)
- Using the payment system displayed can increase my efficiency when making purchases (PU2)
- Using the payment system displayed for my purchases can increase my productivity (PU3)
- In general, the payment system displayed can be useful to me when making purchases (PU4)

Convenience [49]

- The payment system displayed is convenient because I usually carry the mobile phone with me (CS1)
- The payment system displayed is convenient because I can use it at any time (CS2)
- The payment system displayed is convenient because I can use it in any situation (CS3)
- The payment system displayed is convenient because it is not complex (CS4)
- The payment system displayed is convenient because it can be used regardless of location (CS5)

Perceived Risk [40]

- Other people may access information about my online transactions if I use this mobile payment system (PR1)
- There is a high potential for monetary loss if I make purchases with this mobile payment system (PR2)
- There is a significant risk when making purchases using this mobile payment system (PR3)
- I consider making purchases with this mobile payment tool a risk (PR4)

Intention to Use (Venkatesh and Bala 2008)

- Assuming I have access to the payment system displayed, I intend to use it to make purchases (INT1)
- If I have access to the payment system displayed during the next few months, I believe I will use this system rather than another, alternative system (INT2)
- Assuming I had access to the payment system displayed, I would use it in the near future (INT3)

Appendix 2

See Table 6.

Table 6 Population coverage by type of mobile network and area 2020*

| | 4G (%) | 3G (%) | 2G (%) |
|------------------|--------|--------|--------|
| World | | | |
| Rural | 71 | 13 | 8 |
| Urban | 95 | 4 | 1 |
| Africa | | | |
| Rural | 22 | 40 | 18 |
| Urban | 77 | 22 | – |
| Arab states | | | |
| Rural | 44 | 34 | 10 |
| Urban | 78 | 24 | – |
| Asia and Pacific | | | |
| Rural | 89 | 4 | 5 |
| Urban | 100 | – | – |
| CIS | | | |
| Rural | 44 | 22 | 29 |
| Urban | 100 | – | – |
| Europe | | | |
| Rural | 89 | 4 | 4 |
| Urban | 100 | – | – |
| The Americas | | | |
| Rural | 54 | 24 | – |
| Urban | 98 | 1 | – |
| Developed | | | |
| Rural | 88 | 3 | 9 |
| Urban | 100 | – | – |
| Developing | | | |
| Rural | 70 | 14 | 7 |
| Urban | 94 | 4 | 1 |
| LDCs | | | |
| Rural | 27 | 37 | 19 |
| Urban | 67 | 32 | 1 |
| LLDCs | | | |
| Rural | 25 | 39 | 27 |
| Urban | 84 | 15 | – |
| SIDS | | | |
| Rural | 35 | 31 | 4 |
| Urban | 77 | 21 | 2 |

LDCs least developed countries, *LLDCs* land-locked developed countries, *SIDS* small island developing states

*Concluded by the authors, ITU [32]

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Data availability Authors confirm that all relevant data are included in this manuscript, and all sources are well cited.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval We confirm that the manuscript follows compliance with ethical standards; authors confirm that the study does not need any approval from any Ethics Committee.

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