Study on the Effect of Mobile Payment in the Internet Financial Era - Based on Structural Equation Modeling

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Abstract. For understanding the factors that use of mobile payments by older people, especially helping them overcome many problems they face in using digital products in their lives, and helping improve mobile payments to become 'age-appropriate', breaking the digital divide, the study used a stratified sample and three-stage unequal probability sample to collect 521 elderly people, and statistical analysis with the help of SPSS24.0. In addition, constructing a structural equation model and analysing the correlation between the perceived value and willingness to use mobile payment among elderly people in Wuhan. The analysis shows that four conclusions "in the process of using mobile payment, ease of operation and security are two important factors for seniors to consider whether to use mobile payment".

Keywords: Internet Finance · Mobile Payment · Aging · Digital Divide · SEM Model

1 Introduction

As a core city in the Yangtze River Economic Belt, Wuhan has a rising number of elderly people and an increasingly serious aging population, which can be drawn from the report on population aging released by the City's Civil Affairs Bureau as early as January 14, 2019. The report shows that the number of senior citizens over 60 years old in Wuhan has reached 1,879,400, and the number of people over 65 years old reached 1,242,500, accounting for 21.27% and 14.06% of the total population respectively, especially the population over 65 years old broke through 14% for the first time, making a "deeply ageing" society has become a reality in Wuhan.

With the country advocating the development of strategic emerging industries, seven major fields such as new generation information technology have opened the way to a new era of development. The rapid development and widespread use of mobile internet, artificial intelligence and other representatives of the information technology industry have most directly changed the way people produce and live, as well as leading the way in the advancement of people's thinking about the "Internet of Everything". In the era of Internet finance, mobile payment refers to payment operations initiated and

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confirmed by mobile devices, such as mobile computers, PDAs, smartphones and mobile payment terminals, which are used to pay bills and purchase goods or services. The new payment system, which integrates "cloud platform, mobile devices, home and financial institutions", enables people to make payments for life, business and other payments anytime and anywhere, while overcoming the inconvenience of cash payments. While young people are experiencing the rapid changes brought about by the information society and enjoying the speed and convenience it brings to their lives, a significant number of older people are suffering from the "digital divide" and find it difficult to share the convenience and dividends brought about by mobile payments. Research shows that only around 50% of people over 60 years old use mobile payments. Therefore, it is a realistic issue for urban governance to study the factors influencing the use of mobile payments by the elderly, to understand the willingness of the elderly to use mobile payments, and to provide decision support for the implementation of "age-appropriate" transformation of mobile payment products in the Internet financial era.

2 Literature Review

2.1 Research on 'Internet Finance'

Internet finance integrates Internet technology and financial functions, using the Internet platform data, cloud computing and other intelligent ways to dig and analyse data and business related to the financial industry in order to achieve and build a new type of financial service system.

Foreign scholars' studies on Internet finance mainly include the current development of Internet finance, risk regulation (Mohammed 2016; Lim 2019), and are more fruitful in terms of the impact of Internet finance on the financial industry and finance functions (Kim 2002, Reinhart 2007, Goodman 2000, Rock 2010, Rahman 2021).

In China, Internet finance has likewise received extensive attention from scholars. Research aspects mainly involve: research on the development and model of Internet finance (Lin 2015, Chen 2017, Zhang 2018, Wang 2019); research on the impact factors of Internet finance risks (Zhang 2015, Dong 2016); research on the regulation of Internet finance [6] (Li 2016, Wang 2019).

2.2 Research on 'Mobile Payments'

The concept of mobile payments has been defined differently by experts and industry associations at home and abroad, and as a result, there is no uniform definition yet. Mobile payments are defined in the Mobile Payments Forum as the use of mobile devices by consumers to complete transactions for goods or services, such as portable electronic terminals. By assessing past research on mobile payments, [3] points out the need for a multi-level and multi-perspective understanding of the mobile payment ecosystem, as well as micro-macro payment methods that could add mobile cloud services, etc. In addition, the investigation found that mobile payment overall research is relatively fragmented and lacks openness. While [5] argues that mobile payment is the act of transferring virtual electronic money to complete various transactions through mobile devices, wireless communication technologies, platform terminals, etc.

Regarding the research on the factors influencing the willingness to use mobile payment, in the process of the continuous development of mobile payment, scholars at home and abroad have applied different research theories to explore the users' willingness to use. Foreign scholar Davis proposed the Technology Acceptance Model (TAM) in 1989 and pointed out through his research that perceived usefulness and perceived ease of use affect users' attitudes towards the use of new technology systems, which in turn affects willingness to use and actual behaviour. However, with the rapid development of mobile internet technology, consumers no longer simply aim to improve efficiency as a goal of accepting new technological systems, so scholars have turned to perceived value theory research. Kim and Chan proposed the theory of perceived value model (VAM) for mobile internet from the user's perspective and based on mobile internet consumption platforms in 2007, clearly indicating that perceived value is an important factor influencing consumers' online behaviour. [4] argues that the Technology Acceptance Model can effectively explain users' adoption behaviour towards new technologies, so a TAM-based study was conducted in combination with NFC payments, and the results of the data analysis showed that the better the match between NFC payments and users' pre-existing values, the stronger the willingness to accept them. [1] selected a sample for the study in order to explore the reasons for the small proportion of mobile payment software use in Indonesia, and the results showed that trust was the most important reason affecting individual use.

Many studies have also been conducted by domestic scholars on the factors influencing the willingness to use mobile payments. Based on the technology acceptance model, the integrated technology acceptance and use model (UTAUT) is usually used. [2] used the UTAUT model to empirically analyse the factors influencing the willingness and behaviour of using the cloud flash payment platform to improve the applicability of the theoretical model of technology acceptance to the third-party mobile payment sector in China. (Chang 2018) brought in consumers and their innovation based on the use of UTAUT theory to jointly explore the factors influencing the willingness to use mobile payments. Apart from that, in recent years, domestic scholars prefer to adopt the perceived value theory model to study the factors influencing users' willingness to use. (Jiang 2019) studied the willingness to use mobile payment among middle-aged and elderly people based on perceived value theory and illustrated the correlation between perceived value and willingness to use. (Ren and Si 2018) studied the mechanism of the influence of mobile payment system construction characteristics on users' willingness to use based on the technology acceptance model and the perceived value model, and concluded that users' willingness to use mobile payment systems is influenced by the construction characteristics of mobile payment systems.

2.3 Review of Research Methods on Mobile Payment Issues

Structural equation modelling is a multivariate statistical model, defined by (Ullman 1996) as "an analytical equation that is validated using a covariance matrix. It is able to reflect relationships between multi-factor variables and can be applied to both continuous and discrete variables". Structural equation modelling has been used in several fields, for example, (Lee and Han 2017) used structural equation modelling to analyse medical

applications for customers who were unable to meet their healthcare needs and gave suggestions for improvement. (Li 2020) used SPSS and Amos software to analyse customer satisfaction with fresh supermarkets in a new retail model and made recommendations based on the analysis.

(Zhang 2018) proposed that principal component analysis is a multivariate statistical analysis, which transforms the originally correlated variables into mutually uncorrelated variables, and although the number of variables selected in this way is smaller, the representation is extremely strong, which is the principal component. According to (Yan 2021), principal component analysis is a statistical method in which multiple random variables must have some correlation in a particular practical problem, starting from the interrelationship of variables and transforms many correlated variables into mutually uncorrelated ones by dimensionality reduction.

2.4 Literature Summary

In the era of Internet finance, mobile payment has become the fastest growing payment method in the new economic conditions. By combing through the existing literature, it is found that most of the current studies in this field have adopted the technology acceptance model or the integrated information acceptance and use model, and in the perceived value model studies, many studies have confirmed that perceived value affects users' willingness to use, but there is a lack of studies exploring the willingness of middle-aged and elderly people to use. Therefore, by establishing a structural equation model based on perceived value theory, and taking the middle-aged and elderly population as the research object, we explore the factors that affect the use of mobile payment by the middle-aged and elderly population, which can help the elderly overcome the difficulties they face in using digital products in life such as medical care and online shopping, and is beneficial to government in implementing "age-appropriate" changes to mobile payment products and bridging the digital divide among the elderly in the Internet financial era. At the same time, it will help to expand the perspective and research area of empirical research on mobile payment in the Internet financial era.

3 Sample and Data Sources

Using elderly residents in Wuhan as the target population, the study sample was selected through stratified sampling and three-stage unequal probability sampling, and combined with a questionnaire to obtain the basic information of the respondents as well as their awareness, assessment and perception of mobile payment. Based on the completion of the pre-survey questionnaire, the minimum sample size required is determined for a given precision requirement. Taking the t-value at 95% confidence interval, $t = 1.96$, according to the calculation, P is the sample proportion and d is the absolute error, taking $d = 0.05$, according to the pre-survey result $P = 0.5$, to approximate the sample size.

$$n_0 = \frac{t^2 PQ/d^2}{1 + \frac{1}{N}\left[\frac{t^2 PQ}{d^2} - 1\right]} \tag{1}$$

Due to the complexity of the sampling scheme, we need to define the design effect (deff) as the ratio of the variance of the estimate of a particular sampling design to the variance of the estimate of a non-relaxed simple random sample with the same sample size and estimate the deff to be approximately 1.33, so that each sample size should be adjusted using deff to be the optimal sample size.

$$n = n_0 \times \text{deff} \tag{2}$$

The final calculated best sample size was 408. A total of 521 questionnaires were distributed, with a return rate of 88.3%, and a valid questionnaire of 460, which met the minimum sample size requirement.

3.1 Reliability Tests

As can be seen from the Table 1, the reliability of all variables is above 0.800, with good reliability. The CITC values of all question items are above 0.5, which proves that the sample data are reliable and can be analysed and studied in depth.

3.2 Validity Tests

Using a mature scale that has been previously studied by previous, the sample data was first tested for significance by KMO values and Bartlett sphere test for approximate

Table 1. Reliability tests for variables.

Variables	Item	CITC	Item deleted α value	Cronbach's α	Count
Network externality	Q1	0.697	0.95	0.868	3
	Q2	0.569	0.953		
	Q3	0.68	0.95		
Perceived ease of use	Q4	0.849	0.947	0.958	3
	Q5	0.802	0.948		
	Q6	0.84	0.947		
Perceived usefulness	Q7	0.775	0.948	0.948	2
	Q8	0.728	0.95		
Perceived riskiness	Q9	0.694	0.95	0.925	4
	Q10	0.707	0.95		
	Q11	0.793	0.948		
	Q12	0.601	0.952		
Usage Intention	Q13	0.593	0.952	0.925	4
	Q14	0.633	0.951		
	Q15	0.866	0.947		
	Q16	0.872	0.947		

Table 2. KMO and Bartlett test.

Kaiser-Meyer-Olkin metric for sampling adequacy		0.843
Bartlett sphere test	Approximate cardinality	1394.111
	df	120
	Sig	0.000

chi-squared values. The KMO value should be above 0.6 and the significance should be below 0.01 to meet the requirements, indicating that the dimensional correlation within the variable is strong. The results of the tests showed that the KMO value for all variables is 0.843 and the Sig value is below 0.001, therefore, the questionnaire is well designed and has structural validity (Table 2).

4 Analysis of Influencing Factors

4.1 Construction of Structural Equation Model

Using older people as the target, a value acceptance model is constructed based on perceived value theory between the factors that older people's use of mobile payments and their willingness to use them. This model is based on both perceived profits and perceived risks, with perceived value being the middle variable.

4.2 Hypothesis Formulation

We used structural equation modelling to explore the relationships between 10 variables: usage intention, perceived value, perceived profit, perceived risk, cognitive status, economic factors, network externalities, perceived ease of use, privacy risk and trust. The seven factors of intention to use, perceived value, perceived profit, perceived risk, cognitive status, network externalities and privacy risk are potential variables, while the remaining three variables are explicit variables. The equations were estimated using the great probability estimation method, and various methods were used to consider the goodness of fit of the model.

Therefore, this study has the following hypotheses:

H1: There is a significant positive correlation between cognitive status and perceived profit of mobile payments among the middle-aged and elderly people.

H2: There is a significant negative correlation between cognitive status and perceived risk of mobile payments among the middle-aged and elderly people.

H3: There is a significant positive correlation between economic factors and perceived profit of mobile payments among the middle-aged and elderly people.

H4: There is a significant negative correlation between economic factors and perceived risk of mobile payments among the middle-aged and elderly people.

H5: There is a significant positive correlation between network externalities and perceived profit of mobile payments among the middle-aged and elderly people.

H6: There is a significant negative correlation between network externalities and perceived risk of mobile payments among the middle-aged and elderly people.

H7: There is a significant positive correlation between perceived ease of use and perceived profit of mobile payments among the middle-aged and elderly people.

H8: There is a significant negative correlation between perceived ease of use and perceived risk of mobile payments among the middle-aged and elderly people.

H9: There is a significant positive correlation between trust and perceived profit of mobile payments among the middle-aged and elderly people.

H10: There is a significant negative correlation between trust and perceived risk of mobile payments among the middle-aged and elderly people.

H11: There is a significant positive correlation between privacy risk and perceived profit of mobile payments among the middle-aged and elderly people.

H12: There is a significant negative correlation between privacy risk and perceived risk of mobile payments among the middle-aged and elderly people.

Many research studies have confirmed that perceived value is positively related to usage intention, while perceived profit is positively related to perceived value and perceived risk is negatively related to perceived value. So this study uses perceived value as an intermediate variable with the following hypotheses:

H13: There is a significant positive correlation between perceived profit and perceived value of mobile payments among the middle-aged and elderly people.

H14: There is a significant negative correlation between perceived risk and perceived value of mobile payments among the middle-aged and elderly people.

H15: There is a significant positive correlation between perceived value and usage intention of mobile payments among the middle-aged and elderly people.

The conceptual framework of the model study is shown in Fig. 1.

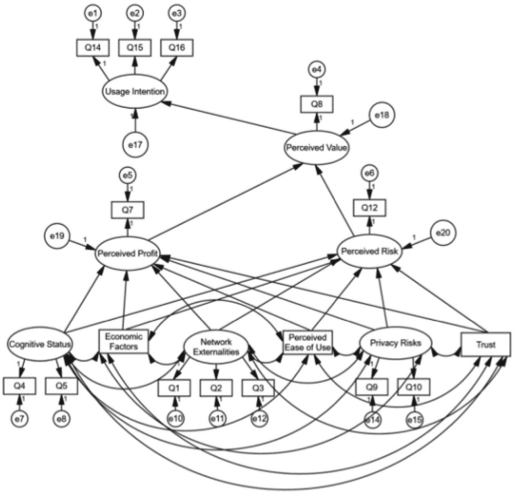

Fig. 1. Value acceptance model of the middle-aged and elderly population's usage intention for mobile payments.

Table 3. Table of variables

Variable name	The question of measurement
Usage Intention	Q14. People around me who use mobile payment and recommend it to me. Q15. I would recommend mobile payment to my friends and family. Q16. I would be more willing to learn to use mobile payment if someone taught me.
Perceived value	Q8. Using mobile payment meets my needs for payment activities.
Perceived profit	Q7. Save time by completing transactions quickly.
Perceived risk	Q12. I often wonder about mobile payment and its security.
Cognitive status	Q4. I think I still have a good memory and learning ability. Q5. I am still willing to learn new things and use new products.
Economic factors	Q13. Cancellation of certain free services will affect my continued use of mobile payments.
Network externalities	Q1. There is a good atmosphere for families to use mobile payment. Q2. Used by friends and relatives, I would consider using it too. Q3. The more friends use it, the easier it is for me to use.
Perceived ease of use	Q6. Mobile payment are easy to learn.
Privacy risk	Q9. Concerned about leaking personal information during use. Q10. Worried about login or password theft.
Trust	Q11. Trust in the internet technology used for mobile payments.

To ensure the scientific validity of the measurement, we chose a scale that has been used many times, and combined it with the characteristics of mobile payment for the elderly groups to make it more relevant to their actual needs. The question items and their sources are shown in Table 3.

4.3 Measurement of Influencing Factors

Based on the established structural equation model, the results are obtained by AMOS software as shown in Fig. 2.

From the Table 4, the chi-square statistic p-value is 0.000, which is not significant. The ratio of chi-square to freedom is below 3. In addition, the values of CFI, NFI and IFI are close to 1 and the RMSEA value is below 0.05. All of indicators meet the requirements of the mode, indicating that the model fits very well.

Table 5 shows that at a 5% confidence level, H3, H6, H13 and H14 do not accept the original hypothesis.

Cognitive status has the greatest effect for perceived profit, followed by trust, besides network externalities and perceived ease of use both have a significant positive impact on perceived profit.

Privacy risk is significantly and positively related to it with a factor of 0.939, which has the greatest impact. Trust is significantly negatively related to perceived risk.

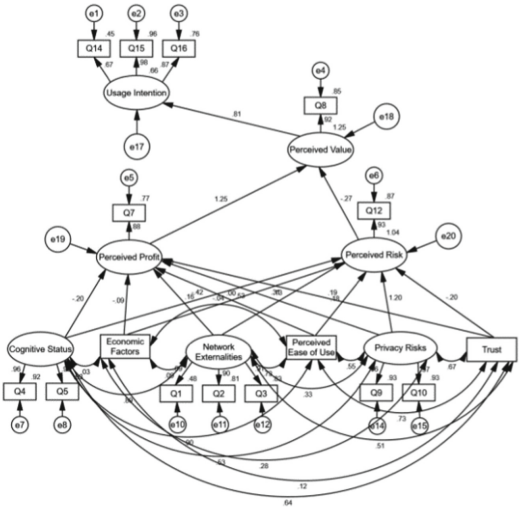

Fig. 2. SEM path analysis and validation results.

Table 4. Modified model test and goodness of fit results.

Model	CMIN	P	CMIN/DF	CFI	NFI	IFI	RMSEA
Default model	268.410	0.000	2.736	0.923	0.911	0.904	0.041

Table 5. SEM hypothesis testing results.

Research hypothesis	Standard factor	Conclusion
H1: Cognitive status is significantly and positively associated with perceived profit.	0.358	Acceptance
H2: Cognitive status is significantly and negatively associated with perceived risk.	−0.120	Acceptance
H3: Economic factors are significantly and positively associated with perceived profit.	−0.098	Non-acceptance
H4: Economic factors are significantly and negatively associated with perceived risk.	0.064	Acceptance
H5: Network externalities are significantly and positively associated with perceived profit.	0.139	Acceptance
H6: Network externalities are significantly and negatively associated with perceived risk.	0.040	Non-acceptance

(*continued*)

Table 5. (*continued*)

Research hypothesis	Standard factor	Conclusion
H7: Perceived ease of use is significantly and positively associated with perceived profit.	0.189	Acceptance
H8: Perceived ease of use is significantly and negatively associated with perceived risk.	0.028	Acceptance
H9: Trust is significantly and positively associated with perceived profit.	0.241	Acceptance
H10: Trust is significantly and negatively associated with perceived risk.	−0.730	Acceptance
H11: Privacy risk is significantly and negatively associated with perceived profit.	0.108	Acceptance
H12: Privacy risk is significantly and positively associated with perceived risk.	0.939	Acceptance
H13: Perceived profit is significantly and positively associated with perceived value.	0.917	Non-acceptance
H14: Perceived risk is significantly and negatively associated with perceived value.	−0.213	Non-acceptance
H15: Perceived value is significantly and positively associated with usage intention.	0.712	Acceptance

Perceived value has a significant positive effect on usage intention, while perceived risk is less negatively correlated with perceived value; perceived profit has a significant effect on perceived value, while perceived value significantly affects usage intention.

Network externalities and perceived risks are important factors affecting the use of mobile payments by older people. Therefore, developing and selecting appropriate marketing strategies, enabling positive network externalities and reducing the perceived risk will contribute to them to use mobile payments.

5 Conclusions

The key influencing factors for older people to use mobile payment were found to be: (1) Perceived value is significantly and positively correlated with usage intention. When older people think that mobile payments bring more value and benefits to their lives, they will be more willing to use. (2) Economic factors can affect the perceived risk. The worse the financial situation of older people, the more alert they will be of the risks of mobile payments, and the more cautious they will be in using them, or even not using them. (3) Awareness has the greatest impact on perceived profit, followed by perceived ease of use, while perceived profit have a significant impact on perceived value. In addition, both network externalities and trust have a significant positive effect on perceived profit. The influence of friends and family on older people's behaviour is also significant. The external image of mobile payment platforms and companies, and the safety and security

of payment platforms also have a significant impact on whether older people use mobile payment. (4) In the process of using mobile payment, the convenience of operation and security are two important factors for the elderly to consider whether to use mobile payment.

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